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Origin of Neanderthals. Neanderthals of the Altai: Myth or Reality?*

Some 3 mln years ago, the genus Homo originated from australopithecines in Africa. In the Pleistocene, in the course of subsequent evolutionary processes such as natural selection, hybridization, and adaptation to changing environments, in the 200–100 ka BP interval, anatomically modern humans emerged in Africa, H. sapiens neanderthalensis in Europe, and H. sapiens denisovan in Central and Northern Asia. The origin of these taxa has been discussed in various publications and at many symposia. In the course of debates, several hypotheses were advanced—African Eve, multiregional evolution, evolution with hybridization, etc. All of them proceed from the assumption that the earliest anatomically modern humans originated in Africa. The main disagreement between the experts concerns the role of native Eurasians in the origin of H. sapiens sapiens following the migration of anatomically modern humans from Africa to Eurasia. In several publications of mine, a scenario of the phylogenetic history of the genus Homo, somewhat different from the currently discussed hypotheses, was proposed. The analysis of the genetic legacy of anatomically modern humans, H. sapiens neanderthalensis, and H. sapiens denisovan has shown that those hominins were able to hybridize and that the hybrids were fertile. This means that hybridization and assimilation proceeded not between separate species but within a single species, whose populations were open genetic systems. Consequently, if, at the final stage of the phylogenetic history of Homo, 200–100 ka BP, three taxa capable of hybridization emerged on various continents in the process of a long evolution, then all previous Early and Middle Pleistocene taxa in Africa, Europe, and Asia, established by the analysis of fossils, had likewise open genetic systems. This means that over a nearly 3 mln year long evolution of the genus Homo, resulting in progressive sapienization, three key factors—natural selection, hybridization, and adaptation to changing environments of the Pleistocene—have shaped both morphology and genetics of that genus. The article addresses the origin of a single basal species in Africa, ancestral to all anatomically modern humans, their spread to Eurasia, and role in the origin of H. sapiens neanderthalensis in Europe.

Keywords: *H. erectus, H. rhodesiensis (heidelbergensis), H. antecessor, H. sapiens sapiens, H. sapiens neanderthalensis, H. sapiens denisovan, Acheulean, Mousterian, Denisovan Middle Paleolithic industry.*

Introduction

More than 150 years have passed since the discovery of human fossils in the Neanderthal Valley in Germany; on the basis of the derived data, the Neanderthal taxon was identified, and studies of *Homo sapiens neanderthalensis* have been carried out since that time. The origin and the material and spiritual culture of representatives of this species have been discussed in dozens of books and hundreds of papers.

*The article was written at the request of the Editorial Board.

I became interested in Neanderthals back in my student years. For me, they were real explorers who, owing to their small numbers, could settle in comfortable environmental conditions; there were enough such zones in the Pleistocene. Neanderthals occupied not only the most favorable areas between the 40th parallel north and 40th parallel south, but also far to the north. In the process of adaptation to more severe climatic conditions and thanks to hunting large animals, including predators, using spears mainly in close combat, Neanderthals developed a special morphology: short stature, wide chest, special facial structure, robust bones, and others.

In 2005, in one of my papers, I wrote about my special attitude toward Neanderthals, who bravely explored northern latitudes (Derevianko, 2005: 107). I think that if a European Neanderthal had visited a fashionable barber and put on a business suit, he probably wouldn't have managed to direct an orchestra, but would have enjoyed Vivaldi's music for sure. Dear colleagues, please do not offend Neanderthals. They are among our ancestors! After many years, I have only become more convinced in this opinion.

In the Altai, researchers from the Institute of Archaeology and Ethnography of the SB RAS have been conducting studies for more than 40 years. In total, ten caves and eleven open-air sites have been and are still studied there. The established Paleolithic sites are multilayered, with long stratigraphic sequences. Archaeologists, physical anthropologists, geneticists, geochronologists, geologists, biologists, paleogeographers, paleontologists and other experts, not only from Russia, but also from other countries, take part in field and laboratory works. Extensive archaeological and paleontological collections have been recovered, while anthropological remains are unfortunately rare. Particularly important results were achieved in the studies of Denisova Cave; the archaeological works in the cave are still going on.

The abundant archaeological material is quite clearly subdivided into the Middle and Upper Paleolithic collections. Previously, researchers involved in the study of the Altai Paleolithic attributed the entire Middle Paleolithic industry to Mousterian and correlated it with Neanderthals; the Upper Paleolithic industry was associated with *H. sapiens*. And this subdivision was reasonable; in the last century, scholars knew only two taxa existing in the terminal Middle and Upper Pleistocene: *H. sapiens neanderthalensis* and *H. sapiens sapiens*. In 1984, a cave was discovered, named in honor of the outstanding researcher of the Paleolithic of Asia, Academician A.P. Okladnikov. It revealed a Mousterian industry, which differed significantly from the Middle Paleolithic industry at other sites, including Denisova Cave (Derevianko, Markin, 1992). Chronologically, this lithic industry is close to the terminal stage of the Middle Paleolithic of the Altai, but in all technical and typological characteristics these industries differed from one another. The question arose: what two populations with the different industries could have inhabited the Altai?

The collaboration with the outstanding geneticist and a Nobel Prize winner Svante Pääbo and his team from the Max Planck Institute for Evolutionary Anthropology in Leipzig has provided the answer. In 2007, in the course of joint research, it was established that Okladnikov Cave was inhabited by Neanderthals with the Mousterian industry (Krause et al., 2007), and Denisova Cave, by representatives of a new taxon—*H.s. denisovan*, which was revealed by the data of DNA sequencing from small bone (Denisova 3), rather than through the analysis of anthropological fossils (Krause et al., 2010; Reich et al., 2010).

In 2007, anthropological remains of Neanderthals and Mousterian industry were discovered in Chagyrskaya Cave, same as in Okladnikov Cave (Derevianko, Markin, Kolobova et al., 2018). The studies have shown that this group of Neanderthals, called Chagyrskaya, migrated to Altai ca 60 ka BP and lived next to the Denisovans for more than 20 thousand years. The Neanderthals and the Denisovans used the same areas for foraging, but at the same time retained their mentality. The Chagyrskaya Neanderthals produced the almost unchanged Mousterian-like Micoquian industry. Their archaeological materials do not contain tools made of bone or non-utilitarian ornaments. At the same time, Denisovan industries of the period of 60–55 ka BP evidence the transition from the Middle to Upper Paleolithic, and those of 55 (50)–45 ka BP reveal the initial Upper Paleolithic, one of the earliest and brightest in Eurasia (Derevianko, Shunkov, Agadjanian et al., 2003; Derevianko, 2019, 2022; Derevianko, Shunkov, Kozlikin, 2020; and others). The Denisovans and the Chagyrskaya Neanderthals could meet and interbreed with each other: in Denisova Cave, fossils of a hybrid (Denisova 11) were discovered, whose father was a Denisovan and mother was a Neanderthal.

Identification of the Altai Neanderthals in Denisova Cave on the basis of genetic studies (Prüfer et al., 2014) is highly questionable, unlike the Chagyrskaya Neanderthals, whose dispersal in the

Altai ca 60 ka BP is well confirmed by anthropological finds from the Okladnikov and Chagyrskaya caves, the data of DNA sequencing, and the recovered Mousterian industry. The sequencing of soil samples from the cultural layers of Denisova Cave suggests the possible dispersal of Neanderthals in the Altai earlier than 175 ka BP and the alternate habitation of the Altai Neanderthals and Denisovans in the cave (Douka et al., 2019; Jacobs et al., 2019; Zavala et al., 2021). However, this assumption is not confirmed by the archaeological evidence. The entire cultural-stratigraphic sequence in Denisova Cave, from the lowest layer 22 to layer 11 inclusive, contains a homogeneous Denisovan industry, showing a clear continuity in the industry development from the early Middle to the initial Upper Paleolithic. The appearance and long-term habitation of Neanderthals in Denisova Cave would certainly have been confirmed in the cultural layers—the Mousterian industry would have been uncovered; however, it has not been found in the stratigraphic sequence. Any possibility of migration of Neanderthals from Europe to the Altai earlier than 175 ka BP is excluded, since Neanderthals morphologically and genetically developed into a separate taxon in the chronological interval of 200–150 ka BP, i.e. the possibility of their appearance in the Altai earlier than 175 ka BP is very doubtful. Moreover, no sites with Mousterian industry or remains of Neanderthals older than 100 thousand years have been found in the transit territory from Europe to the Altai.

Neanderthals populated a vast territory—from Spain to Eastern Siberia; they often lived in small groups in various climatic and environmental conditions, with various types of vegetation, fauna, availability of water resources, and stone raw materials for the manufacture of tools, which factors determined the variability of their morphology and social relations. Many researchers have repeatedly discussed this in various publications (McCown, Keith, 1939; Endo, Kimura, 1970; Vandermeersch, 1981, 1989; Trinkaus, 1983, 1987, 1989, 1991; Churchill, 1998; Voisin, 2007). The original explanation for the morphologic variability of Neanderthals was proposed by J.-L. Voisin (2006): as Neanderthals moved from west to east, the range of changes in their morphological features expanded, and their morphology became more and more blurred in the context of this taxon. But where and when did its morphological and genetic development take place?

Evolution of the ancestral taxon of anatomically modern humans, Neanderthals, and Denisovans

The genus *Homo* evolved in Africa ca 3.0–2.8 Ma BP on the ancestral basis of Australopithecines. At the earliest stage of anthropogenesis, three species are identified: *H. rudolfensis, H. habilis, H. ergaster/erectus*, which had open genetic systems; they could interbreed and produce fertile offspring (Derevianko, 2020, 2022; etc.). About 1.75 Ma BP, *H. ergaster/erectus* began to settle in Eurasia. In Africa, early *Homo* continued to evolve along the sapient line and to develop the pebble-flake industry. In Africa, about 1.75 Ma BP, hominins developed bifacially worked stone tools (axes), which formed the basis for the new industry—Acheulean (Beyene et al., 2013, 2015). It is very likely that in the time range of 1.75–1.4 Ma BP Africa was inhabited by two taxa: *H. habilis* with the Oldowan industry and *H. erectus* with the Acheulean industry, and a genetic drift may have occurred between them.

The smallest number of anthropological fossils found in Africa falls within the time range of 1.5–0.6 Ma BP. At the site of Nariokotome III, located on the western shore of Lake Turkana, cranial and postcranial remains of a juvenile aged ca 12 years were found (Brown et al., 1985). The age of the fossils is 1.6 million years. After the discovery of this uniquely informative fossil, a small amount of anthropological evidence was discovered on the continent.

A series of anthropological remains from the Olduvai Gorge indicates the further evolutionary development of *H. erectus* to sapient features: OH 9 (Rightmire, 1990); OH 12 (Leakey, Clarke, Leakey, 1971; Holloway, 1973; Antón, 2004); OH 22 (Rightmire, 1980), and others. The oldest fossil, OH 9, includes fragments of supraorbital structures and cranial vault. Analysis of the fossil, 1.25 million years old, discovered in the upper part of Bed II (Leakey, Clarke, Leakey, 1971) has shown the cranial capacity of the individual to be approx. 1076 cm^3 (Holloway, 1973). Fossil OH 12—the posterior part of a small skull (700–800 cm^3) (Holloway, 1973) and several fragments of facial bones (Antón, 2004)—were found on the surface of Bed IV (Leakey, Clarke, Leakey, 1971).

Some of the most informative materials—a well-preserved skull with the vault (BOU-VP-2166), three separate femurs and a proximal part of the tibia—were discovered during excavations in the middle reaches of the Awash River (Ethiopia) in the Bouri Formation, in the Dakanihylo, or Daka, member, aged 1042 ± ± 0.009 million years (Asfaw et al., 2002). The cranium capacity was 995 cm^3. The vault and supraorbital parts showed traces of peri-mortem injury in the form of scraping. The skull discovered at Bouri is of great importance for the phylogeny understanding. B. Asfaw and his co-authors made an important conclusion: in terms of metric indicators, the Daka skull is close to both African and Asian specimens of *H. erectus*; this implies the lack of any reasons to subdivide Asian and African *H. erectus* into different species (Ibid.). The metric and morphological features of the Daka skull indicate that Asian and African *H. erectus* belonged to a single biological species.

Chronologically close to the hominin fossils from Dakanihylo are the early human bones discovered in the Danakil Formation in the Afar Valley, near the village of Buya (Eritrea). These are a cranium with preserved facial parts, roots of molars and premolars, two incisors, and a fragment of the pelvic bone (Abbate et al., 1998). Based on the age estimations derived from paleontological findings, paleomagnetic dating, and measurements of the tephra layer decay, the finds are close to the upper part of the Jaramillo Subchron (~1 million years) (Bigazzi et al., 2004). The cranium capacity is in the range of 750–800 cm^3. According to S. Anton, in some morphological features, this skull differs from the Daka fossils. As E. Abbate and co-authors note, Buya skull shows a number of transitional features to modern humans. Other researchers have classified these fossils as late *H. erectus* (Macchiarelli et al., 2004).

In tropical Africa, several other human fossils dating to the range of 0.9–0.6 Ma BP were found. The Olorgesailie site (Kenya) revealed the frontal and left temporal bones and nine fragments of a hominin cranial vault (KNM-OL 45500) (Potts et al., 2004). The age of these finds is 0.97–0.90 million years. According to the researchers, the hominin was short in stature and had a small skull; the frontal bone is not wide. The thickness of the supraorbital torus and the overall size of the temporal bone are close to the corresponding parameters of the skull of an adult hominin of the Lower and Middle Pleistocene. R. Potts and his co-authors compared the Olorgesailie finds with other fossils representing the *H. erectus* lineage (KNM-ER 3733, KNM-ER 3883, and KNM-WT 15000 from Turkana in Kenya; OH 9 and OH 12 from Olduvai in Tanzania; Daka and Bodo from Ethiopia; Buya from Eritrea; Ndutu from Tanzania; D 2280 and D 2282 from Dmanisi in Georgia; Ceprano from Italy; Atapuerca from Spain; Zhoukoudian from China; Sangiran and Ngandung from Java; Kabwe from Zambia, and Saldanha from South Africa), and came to the conclusion that all of them, despite the large differences in chronological affiliation and significant distance from one another, can be combined into one polytypic species *H. erectus*. Several other anthropological fossils have been discovered in southern and eastern Africa.

In 1996–1998, P.G. Rightmire put forward a hypothesis that a speciation event occurred in Africa or Europe during the Middle Pleistocene or slightly earlier. The hypothesis was based on the discovery of a 640 thousand years old skull in the Bodo area, on the middle Awash, Ethiopia, in 1976. "The Bodo cranium", wrote P.G. Rightmire, "cannot be excluded from a population that is advanced anatomically in comparison to *H. erectus*" (1996: 32). This observation seems to be correct given the brain size of this individual, as well as the presence of many facial features in common with Kabwe (Broken Hill), typical of more modern hominins. The researcher also noted the similarity of this skull to those of *H. erectus/ergaster*, which was expressed in the excessively wide and robust base of the facial part, thickened bones of the cranial vault, the low, archaic skull, a flat face, and a prominent torus. The Bodo skull is 1300 cm^3. Rightmire defined this fossil as *H. heidelbergensis*, together with other anthropological finds made in Africa—Elandsfontein, Kabwe, Ndutu, in Europe—Mauer, Arago, Petralona, and in China—possibly Dali and Jinniushan (1988).

In his later works, Rightmire examined the further evolutionary development of the species *H. heidelbergensis* along the Neanderthaloid and sapient lines. In the terminal Middle Pleistocene, *H. neanderthalensis* and *H. sapiens* developed from Heidelberg man. The researcher regarded the finds from Florisbad, Laetoli, and Jebel Irhoud as a confirmation of the hypothesis on emergence of the first anatomically modern humans in Africa. Apparently, modern humans evolved in the process of anagenetic speciation (finds from the Klasies River in South Africa; Skhul, Kafzeh in Israel) during the terminal Middle Pleistocene (Rightmire, 2001a, b; 2009a, b; and etc.).

Many anthropologists support the hypothesis as to a speciation event that occurred in the terminal Early to early Middle Pleistocene: *H. erectus* sensu lato gave rise to a new species, designated differently: *H. heidelbergensis*, *H. rhodesiensis*, *H. sapiens*

(Rightmire, 1996; 1998a, b; 2004, 2008, 2009a, b; 2013, 2015; Tattersall, Schwartz, 2000; Bräuer, 2001a, b; 2007; Hublin, 2001; Stringer, 2002; Foley, Lahr, 2003; and others).

This species is a matter of debate between physical anthropologists. Initially, C. Stringer attributed early archaic hominins, European pre-Neanderthals, and, possibly, some archaic East Africans to this species (2002). Later, he came to the conclusion that *H. heidelbergensis* was the ancestral form of *H. sapiens*, Neanderthals, and Denisovans (Stringer, 2012). R. Foley classifies the available Middle Pleistocene anthropological remains into three species: *H. heidelbergensis, H. halmei*, and *H. sapiens* (2001). S. McBrearty and A. Brooks reject the species name *H. heidelbergensis* and propose *H. rhodesiensis* instead, considering the taxon *H. heidelbergensis* as specifically European (2000). Some anthropologists admit the possibility of evolution of *H. heidelbergensis* in the territory of China (Elter, 2010). J.-J. Hublin also believes that in relation to materials from Africa it is preferable to use the species name *H. rhodesiensis* (2001). In his opinion, the name *H. heidelbergensis* should be used only to designate populations that evolutionarily preceded the first pre-Neanderthal and Neanderthal hominins as two separate species: *H. heidelbergensis* and *H. neanderthalensis* (Hublin, 1998).

An original approach to the phylogeny of Middle Pleistocene hominins was proposed by G. Manzi (2011). In accordance with the trinomial nomenclature and the International Code of Zoological Classification, he classified all the available Middle Pleistocene hominins from Africa and Eurasia into four subspecies: 1) *Homo heidelbergensis heidelbergensis*—jaw from Mauer, Arago, Bodo, Ceprano and, possibly, Petralona; 2) *Homo heidelbergensis steinheimensis*—fossils from Atapuerca (SH). This subspecies was ancestral to *H. neanderthalensis*; 3) *Homo heidelbergensis/rhodesiensis*—Kabwe and possibly all African anthropological finds dating back to the late Middle Pleistocene, including the group of "archaic" *H. sapiens*; 4) *Homo heidelbergensis daliensis*—a selection of "non-erectus" specimens in which the Dali fossil was the typical model. To this subspecies Manzi attributed fossils from Denisova Cave as well.

The discussion about the taxonomic affinity of *H. rhodesiensis / heidelbergensis* has continued since the moment when the existence of this taxon was established. Moreover, researchers are most interested in *H. heidelbergensis*, while *H. rhodesiensis* remains "in the shadows". Interesting data have been provided by M. Roksandic et al. (2022). Their search in the Web of Science citation database yielded 274 direct citations to *H. heidelbergensis* and only 17 to *H. rhodesiensis*.

Roksandic and her colleagues propose to abandon the identification of the taxon *H. heidelbergensis* sensu stricto, since "supporting this argument is the recent consensus that the Sima de los Huesos hominins should be considered as early members of the Neanderthal lineage… As such, there is no need to introduce another species with the same morphology" (Ibid.: 22). No less radical is the proposal of these researchers to abandon the taxon *H. rhodesiensis*. In their opinion, "there are two primary reasons for this: (1) the taxon is poorly defined and variably understood and used; and (2) the taxon name is associated with sociopolitical baggage that our scientific community is trying to dissociate itself from" (Ibid.). Instead of *H. heidelbergensis* and *H. rhodesiensis*, the researchers introduce a new taxonomic unit—the Middle Pleistocene hominin species *H. bodoensis*, which is the direct ancestor of *H. sapiens*, from their point of view. The name *bodoensis* is associated with the fossil Bodo 1 (Ethiopia).

S. Athreya and A. Hopkins, when considering the problem of hominin taxonomy, pay great attention to the systematics and designation of *H. heidelbergensis*. They consider the discussion about the names of the identified members of the group and the definition of the term *H. heidelbergensis* itself to be premature, until sufficient information is gained to give a name to the new species, and propose to direct efforts on discussions of the issues of human evolution (Athreya, Hopkins, 2021: 18).

There are also other viewpoints on classification of these taxa. Some researchers changed their minds with the emergence of new data. This diversity of judgments can be explained by the fact that Middle Pleistocene fossils show both common and distinctive morphological features; in addition, scholars often differ in their assessment of the marker significance of individual morphological traits, when comparing anthropological materials. From my point of view, regardless of the differences in environmental and climatic conditions during early human dispersal, and certain morphological differences between hominins, their anatomical and genetic evolution continued toward sapienization. Hominins developed similar derived features, and most importantly, they maintained open genetic systems, which enabled interbreeding and producing fertile offspring.

H. rhodesiensis and H. heidelbergensis belonged to a single biological species that evolved in Africa 900–800 ka BP. This taxon split into two parts 800 ka BP, and each played its role in human phylogeny. 800 ka BP, there was a major event in the evolution of the genus *Homo*. One part of this taxon (*H. rhodesiensis*) stayed in Africa; it formed the ancestral basis for early modern humans, which evolved in the course of further evolutionary development, natural selection, genetic drift, and adaptation to changing climatic conditions 200–150 ka BP. The other part (*H. heidelbergensis*) with the Acheulean industry migrated to the Near East 800 ka BP. The site of Gesher Benot Ya'aqov (Goren-Inbar et al., 2018) provides the evidence of this migration. Subsequently, Neanderthals evolved in Europe 200–150 ka BP on the ancestral basis of *H. heidelbergensis* during assimilation with *H. antecessor*. The assimilation of *H. heidelbergensis* with the late *H. erectus* in Central Asia led to the formation of the Denisovans. This scenario for human evolution in the Middle Pleistocene is confirmed by genetic studies. According to some data, the divergence of DNA sequence between modern Africans, on the one hand, and Denisovans and Neanderthals, on the other, took place 804 ka BP (Reich et al., 2010). According to other data, the divergence of DNA sequence between modern humans from Denisovans with Neanderthals occurred in the chronological range of 812–793 ka BP (Meyer et al., 2012).

Homo heidelbergensis in the Near East and the origin of anatomically modern humans and Palestinian Neanderthals

The earliest site providing evidence for the migration of *H. heidelbergensis* to the Near East is Gesher Benot Ya'aqov in Israel. This is a unique site that reveals a stratigraphic sequence accumulated during ca 50 (100) thousand years. Studies undertaken at this site have been discussed in many publications, and the summarizing monograph appeared in 2018 (see (Goren-Inbar et al., 2018)). The early stage of deposition of its cultural horizons dates back to ca 0.78 Ma BP; in general, the site belongs to the period corresponding to MIS 20–18 (Feibel, 2004). This locality has yielded numerous artifacts related to the Acheulean industry.

Populations of *H. heidelbergensis*, which species had evolved in Africa, migrated to the Levant where they probably met the autochthonous population—late *H. erectus*. Since both the newcomers and the indigenous population had open genetic systems, their interbreeding resulted in producing fertile offspring. This determined the differences in the processes of further evolution of *H. rhodesiensis* in Africa and *H. heidelbergensis* in Eurasia. The former gradually evolved into *H. sapiens*, without mixing with other taxa (owing to their absence). The dispersal of *H. rhodesiensis* over the African continent with various ecology created the conditions for variability in both human morphology and lithic industry. This appears to have been the key reason for some differences in the morphology of early modern humans and their industry in the northeastern, southern, eastern, and western parts of the continent (Ragsdale et al., 2023). But most importantly, the evolution into *H. sapiens* occurred only in one species, *H. rhodesiensis*, without mixing with other taxa.

In the Levant, the further evolution of *H. heidelbergensis* occurred with their assimilation with the indigenous population, the late *H. erectus*. As a result of such hybridization, in the Near East, unlike in Africa, the evolution into *H. sapiens* followed a different path. The diffusion of the techno-typological complex of newcomers and the indigenous population can also be recognized in the development of lithic industry. As a result, the Gesher-Benot Ya'aqov industry acquired many features that distinguished it from the African Acheulean industry.

Excavations undertaken in the Levant produced sparse anthropological finds, and my hypothesis about the further evolution of *H. heidelbergensis* in the Near East certainly needs to be confirmed by new archaeological, anthropological, and genetic evidence. The key anthropological remains of the Middle Paleolithic were discovered in Israel, but unfortunately these are few in number, and not all of them have reliable dates. As early as 1925, in Mugharet el-Zuttiyeh Cave, a frontal, a right zygomatic, and a partially preserved sphenoid bones were found. These paleoanthropological fossils are referred to in the literature as the remains of the Zuttiyeh hominin. Sadly, the absolute age of these remains, recovered from the Acheulo-Yabrudian cultural horizon, has not yet been established. Some researchers dated them to early period (500–200 ka BP). However, recently, their age has been estimated as 150–110 thousand years (Bar-Yosef, 1988) or >122 thousand years (Millard, 2008).

Early in the study of the Zuttiyeh man, anthropologists noted its morphological proximity to Neanderthals. A. Hrdlicka found that these remains revealed common features with the Asian Early

Pleistocene skull EI from Zhoukoudian, which he identified as a Neanderthal (1929). T. McCown and A. Keith recognized the remarkable similarity of the Zuttiyeh fossil with Tabun C1, as well as with Skhul 5 cranium (1939). F. Weidenreich also pointed to the closeness of the Zuttyieh to Skhul 5, which he considered a "progressive Neanderthal", an intermediate link between more primitive forms and modern humans (1943). Fossils from Mugharet el-Zuttiyeh Cave were attributed to a common ancestor of Western Asian Late Pleistocene hominins such as Amud, Tabun, Shanidar, Skhul, and Qafzeh (Smith, Falsetti, Donnelly, 1989; Trinkaus, 1989; Simmons, Falsetti, Smith, 1991). Researchers noted that these fossils showed the mixture of features from various groups, and represented a prototype of a single species (Frayer et al., 1993; Sohn, Wolpoff, 1993; Arensburg, Belfer-Cohen, 1998). S. Sohn and M. Wolpoff, using a metric analysis, showed that Zuttiyeh morphology is closest to that of the Near Eastern Neanderthals, and reveals certain similarities to the Zhoukoudian hominins (1993). G. Rightmire believed that the Zuttiyeh frontal bone links this specimen with both early Neanderthals and the direct ancestors of humans from Skhul and Qafzeh (2001a). The occurrence of Acheulo-Yabrudian artifacts (350–300 ka BP) in Mugharet el-Zuttiyeh Cave makes it possible to associate the Zuttiyeh hominin with an archaic population that used to inhabit Africa, i.e. with the taxon that includes individuals from Bodo, Elandsfontein, Broken Hill, Eyasi, Ndutu (Rightmire, 2009a). G. Bräuer associated the Zuttiyeh man with early archaic *H. sapiens* (2008).

There are different hypotheses concerning the taxonomic affinity of the above fossils; however, the experts always point to the mosaic combination of morphological features typical of Neanderthals and anatomically modern humans. This argues in favor of my hypothesis that in the Middle Pleistocene, the single biological taxon, *H. heidelbergensis*, split into two related subspecies: anatomically modern humans and Palestinian Neanderthals (Derevianko, 2020). The finds from Mugharet el-Zuttiyeh Cave illustrate one of these transitional stages.

In one of the latest papers addressing this issue, S.E. Freidline and her colleagues presented the results of their study, carried out using three-dimensional geometric morphometry and multivariate statistical analysis, to determine the morphological correspondence of Zuttiyeh remains to a specific Pleistocene group: *H. erectus* sensu lato, *H. heidelbergensis* sensu lato, *H. neanderthalensis*, transitional *H. sapiens*, early *H. sapiens*, and Upper Paleolithic *H. sapiens*. The use of new methods provided data about the traits that are difficult to measure using traditional anthropometry. Ultimately, the researchers proposed four hypotheses on the evolution of the Zuttiyeh hominins, based on the results of morphology analysis of the Zuttiyeh and other fossils and taking into account the opinions of other experts (Freidline et al., 2012: 237–238). In terms of time, Zuttiyeh fossils coincide with the Amudian industry.

The researchers conclude that the Zuttiyeh hominin is morphologically similar to Near Eastern Neanderthals (Shanidar V), Middle Pleistocene hominins (Arago XXI), and Near Eastern early modern humans (Skhul V). As noted by Freidline and co-authors, the results of the study do not provide an unambiguous taxonomic attribution of the Zuttiyeh remains, but their morphology is suggestive of a population ancestral to both Neanderthals and modern humans, or a population that existed immediately after the split of these two species (Ibid.).

In my opinion, the Zuttiyeh fossil, like several other paleoanthropological finds, provides the evidence for the split of a single biological taxon of *H. heidelbergensis* that took place in the Levant during the Middle Pleistocene. The morphology of all fossils discovered in this area reveals a mosaic combination of various *H. sapiens* and *H. neanderthalensis* features. This mosaic pattern is explained by the dispersal of different hominin populations in the adjacent areas and settling in the same caves, which frequently resulted in assimilation. A similar process took place in Western Europe, where about ten different Middle Pleistocene species of hominins have been identified.

Layer E of Tabun Cave yielded a femoral diaphysis and a worn lower molar, which were attributed by E. Trinkaus to archaic people (1995). These fossils also exhibit a mosaic combination of morphological features.

More informative paleoanthropological evidence comes from Qesem Cave (Hershkovitz et al., 2011). Excavations produced a large number of lithics related to the Amudian industry; researchers of the cave suggested the local origin of the artifacts and no relation to the complexes in Africa or Europe (Barkai, Gopher, Shimelmitz, 2005; Gopher et al., 2005). Both maxillary and mandibular teeth were found. I. Hershkovits and his co-authors proposed three hypotheses to explain the morphology of teeth from Qesem Cave.

The first hypothesis: the cave dwellers belonged to the local archaic *Homo* population inhabiting

Southwest Asia 400–200 ka BP; their teeth, despite some plesiomorphism, indicate a greater degree of their affinity with the populations of Skhul and Qafzeh than with Neanderthals (Hershkovitz et al., 2011).

The second hypothesis: the evolution of *H. neanderthalensis* in Southwest Asia was as long as that in Europe, where the Neanderthal evolutionary lineage goes back to the Middle Pleistocene. The authors believe that the remains of the archaic modern humans from Skhul and Qafzeh are younger than those from Qesem Cave, but they are older than most Neanderthal fossils from the Levant. The cultural layers in the cave fall within the time range of 400–200 ka BP.

The third hypothesis: as compared to the maxillary teeth, the mandibular ones were located in lower horizons and were smaller in size. These did not show any plesiomorphic traits characteristic of younger maxillary dentition. Both chronological and morphological differences between the teeth may reflect interpopulation differences at the species level and point to the replacement of human population in the region.

In my view, the difference in the teeth sizes does not suggest an interpopulation difference at the species level, but rather the possible alternate occupation of the cave by representatives of two subspecies that evolved on the ancestral basis of *H. heidelbergensis*.

One of the latest anthropological finds is the left half of a maxilla from Misliya Cave, which dates back to 194–177 ka BP (Hershkovitz et al., 2018). The fossil retains most of the alveolar and zygomatic processes, part of the palate and nasal base, as well as a complete left dentition—starting with the first incisor (represented by a broken root) and ending with the third molar (Ibid.: 456).

The study of this fossil has led to some important conclusions.

1. The incomplete maxilla of Misliya 1 does not show any derived skeletal or dental features of Neanderthals (Ibid.: 458–459).

2. The comparison of the Misliya 1 dentition with maxillary and mandibular teeth from Qesem Cave revealed a number of differences. In particular, the Qesem incisor I^2 shows a prominent lingual cusp, more pronounced than that in the Misliya specimen. Qesem canine C1 is distinguished by its more distinct shovel-shape, the presence of a prominent lingual cusp and a mesial ridge. These morphological features distinguish the anterior teeth of Qesem from those of Misliya 1, and are most common of Neanderthals.

3. In most dental features, Misliya 1 resembles the younger *H. sapiens* fossils from the Levant, such as Skhul and Qafzeh, and differs from them in the degree of hypocone reduction.

4. Misliya 1 provides the oldest evidence of migration of members of the *H. sapiens* clade out of Africa.

I cannot agree with the latter conclusion. The earliest fossils, with the morphological features sometimes defined as "modern", come from Northeast Africa (Jebel Irhoud) and are aged to ca 300 thousand years (Hublin et al., 2017; Richter et al., 2017). But these fossils can only very tentatively be attributed to modern humans. Researchers of Misliya Cave compare its early Middle Paleolithic industry with the Middle Stone Age technocomplexes of the Maghreb (Jebel Irhoud), East Africa (Gademotta and Kulkuletti Formations in Ethiopia, and Kapthurin Formation in Kenya). However, the Misliya industries show a very distant resemblance to those of the Middle Stone Age of East and Northeast Africa, and even under the greatest assumption, they reveal no signs of continuity with the Jebel Irhoud industry.

According to the generally accepted view among archaeologists, physical anthropologists, and geneticists, modern humans evolved in Africa in the time range of 200–100 ka BP. Hence, the anthropological and archaeological finds from Misliya Cave cannot be considered as evidence of the migration of modern people to the Levant 194–177 ka BP. In my opinion, given the fossils from Misliya Cave can be associated with modern humans, it can be assumed that the taxon they represent evolved directly in the Levant, and the younger fossils from Skhul and Qafzeh should be considered a continuation of this *H. sapiens* evolutionary lineage.

One more inference by Hershkovitz and his co-authors, based on the results of an analysis of teeth from Qesem Cave (2011), is noteworthy: these fossils may have belonged either to a Neanderthal, or a modern human individual, or a hominin ancestral for both species. This conclusion suggests that the fossils from Misliya are younger than those from Qesem, and belong to the next stage of the evolution of *H. heidelbergensis* in the Levant toward the modern human lineage. The parietal bone and mandible, dated to the period of 120–140 ka BP, from Nesher Ramla (Hershkovitz et al., 2021) are among the finds that are difficult for taxonomical identification. The parietal bone shows morphological similarities to Asian *H. erectus*, and the mandible, to Neanderthals.

Thus, the sparse anthropological materials from the Levant, presumably dating back to 350–150 ka BP, do not provide reliable grounds for identification of any particular taxon: they show a combination of plesiomorphic and modern traits. These fossils represent the final phase of split of the ancestral taxon of *H. heidelbergensis* into two taxa—early modern humans and Palestinian Neanderthals.

In the Levant, during the late Middle to early Upper Pleistocene, phylogenetic history developed differently from the rest of Eurasia and Africa. The final split of *H. heidelbergensis* in the Levant occurred ca 250–100 ka BP. The younger paleoanthropological materials from the Levant, dating to the chronological range of MIS 5 and 4, are debatable. Some researchers believe that all the fossils belonged to a single population close to the anatomically modern humans (Arensburg, Belfer-Cohen, 1998; Kramer, Crummett, Wolpoff, 2001; and others); others attribute skeletal remains from Tabun, Amud, and Kebara to Neanderthals, and those from Skhul and Qafzeh to early *H. sapiens* (Tchernov, 1992; Jelinek, 1992; Vandermeersch, 1992, 1997; Stringer, 1992, 1998; and others).

Tabun Cave was presumably inhabited in the chronological range of 140–110 ka BP by hominins that slightly differed from one another in morphological type. Some inhabitants (Tabun II) were people of the anatomically modern type, similar to those whose bone remains were discovered in Skhul and Qafzeh Caves; while others (Tabun I) showed many plesiomorphic features along with *H. sapiens* traits and belonged to the Palestinian Neanderthals. This inference is of fundamental importance. Modern humans and Neanderthals lived in Tabun Cave during the period corresponding to the late MIS 6 to MIS 5. Consequently, Neanderthals did not migrate to the Levant from Western Europe (Stringer et al., 1989; Shea, 2001, 2003; and others), but evolved simultaneously with modern humans from the common ancestral base—*H. heidelbergensis*. Notably, the taxonomic affinity of fossils from Tabun Cave has often been the subject of debate, probably because of the morphological similarity between the finds. In addition, some scholars believe that modern humans, whose remains were found in Skhul and Qafzeh, and the Neanderthal individual Tabun I belong to the same chronological period (Grün et al., 2005; Ronen, Gisis, Tchernikov, 2011). This inference also supports the hypothesis as to the simultaneous dispersal of early modern humans and Neanderthals in the Levant.

Human bone remains found in Skhul and Qafzeh caves undoubtedly belong, according to many anthropologists, to the modern anthropological type. Skhul Cave yielded bone remains of ten individuals of various ages: eight men and two women. The cranial and postcranial morphology of these people is mosaic. Therefore, it is understandable that until recently some experts have associated these fossils with modern humans and Neanderthals. The former could have migrated to the Levant from Africa (Andrews, 1984), and the latter, from Europe (Vandermeersch, 1981).

Taking into account differences in the stratigraphic position of the remains, the Skhul hominins were suggested to be subdivided into two groups in accordance with the chronology: an earlier one (III, VI–X) and a younger one (I, IV, V) (McCown, Keith, 1939). This point of view was supported by A. Ronen (1976). According to D. Kaufman (2002), the recognition of these two groups does not necessarily imply that there was a long chronological gap between them.

The Skhul hominins demonstrate the anthropological characteristics typical of *H. sapiens*, such as a tall stature (173–179 cm), very low orbits, and large facial width (Zubov, 2004). At the same time, these hominins show many features similar to those of Neanderthals.

Skhul V is the best preserved skeleton in the sample. This was a tall, gracile built man 30–40 years old, with a cranial capacity of 1518 cm^3, skull with a high vault, low orbitals, and a rather high and wide face (Ibid.). The metric and non-metric traits of the supraorbital area in Skhul V link this individual to Mladeč 5 and Brno I, showing the morphological features characteristic of both Neanderthals and modern humans. The zygomatic region is typical of *H. sapiens*; the angle between the frontal and temporal processes, which equals 115°, also falls within the modern range. The shape of the frontal process links Skhul V to Oberkassel 1 and Broken Hill, whereas the comparative analysis of the angles defining neurocranial shape reveals affinities with Amud, Broken Hill, and Ngandong XI. In a number of parameters, the Skhul V mandible is similar to those of Amud, Le Moustier 1 and 2, Oberkassel 1 and 2, and other Neanderthal specimens.

The cranial and postcranial skeleton of Skhul V retained many Neanderthal features. Moreover, in particular individuals, the combination of evolutionarily derived and ancestral features was expressed differently in the facial and cerebral parts of the skull and postcranial skeleton. As noted by S.V. Vasiliev (2006), the statistical analytical data confirm that the evolution of the facial skeleton occurred faster than that of the braincase. In phylogenesis, metric traits changed faster than structural (descriptive) characteristics (Zubov, 2004: 163).

Qafzeh Cave revealed a larger cemetery than that found in Skhul Cave. It contained the remains of 15 modern hominins (Ronen, 2012). For these fossils, a TL-date of 92 ± 5 ka BP was generated on burnt flint. Direct dating of teeth through the ESR analysis provided more reliable estimates: 100 ± 10 and 120 ± 8 ka BP (Grün, Stringer, 1991).

The best preserved remains of Qafzeh 9 represent a woman aged ca 20 years. Next to her, a child (Qafzeh 10) was buried, suggesting that this was a double burial. The female skull is characterized by a high cranial vault, a gentle slope of the frontal bone, a relatively weak supraorbital relief, a strongly protruding, distinct chin; a rounded occiput without a chignon or bend; modern structure of the zygomatic region, a canine fossa, thin cranial walls, and a cranial capacity of 1554 cm^3 (Zubov, 2004: 348). The well-preserved skull of Qafzeh 6 also shows features typical of anatomically modern humans. Individuals from Qafzeh Cave demonstrate more *H. sapiens* traits than hominins from Skhul.

Excavations at Ras el-Kelb Cave, in the homonymous mountain range, revealed a Middle Paleolithic industry of the Tabun C type, including flakes detached from discoid cores; side-scrapers of various types, notched-denticulate pieces, and a few Levallois points and blades (Copeland, 1978). The layer containing these artifacts yielded three human teeth. One tooth belonging to a young man 16–20 years old was identified as a large premolar with a combination of *H. sapiens* and Neanderthal traits (Vallois, 1962). The other two teeth, an upper second molar from an individual ca 23 years old and an upper second deciduous molar, demonstrated more modern features than those of Neanderthals.

In the Levant, both *H. sapiens* and Palestinian Neanderthals developed. Western European Neanderthals of the period 120–50 ka BP were polymorphic in structural features of skull and postcranial skeleton. The Levantine Neanderthals differed from them in a greater number of apomorphic features and similarity to *H. sapiens*. In Western Asia, burials of Neanderthals were found in the caves of Amud, Kebara (Israel), Shanidar (Iraq), and Dederiyeh (Syria).

Above is a brief description of morphology of the female specimen from Tabun Cave (Tabun I). She had a height of 154 cm, cranial capacity of 1271 cm^3, low skull, sloping forehead, prominent supraorbital torus, and almost no mental protuberance. The ascending mandibular ramus is wide and robust, with a high and wide coronoid process and a shallow notch. These and other features suggest the definition of Tabun I skull as the closest to Neanderthal among all anthropological finds from Mount Carmel. Other fragmentary human fossils from Tabun Cave also demonstrate Neanderthal traits.

Amud Cave yielded the remains of several individuals, which included the skeleton of a young male (Amud I) buried according to a special rite. Morphological characteristics of other finds from this cave are indeterminate because of their fragmentation.

The skeleton of Amud I, discovered and analyzed by H. Suzuki and F. Takai, is morphologically more developed than those of Tabun I and Shanidar I, although it has some common features with them. In terms of cranial morphology and supraorbital torus size, Amud I resembles Skhul IV. Apart from the Neanderthal morphology, researchers noted significant differences between this individual and classic European Neanderthals (Suzuki, 1970; Takai, 1970).

The Amud I male skeleton was described by many anthropologists. Experts compared the taxonomic status of this individual with other finds from Africa and Europe and identified both plesiomorphic and apomorphic traits. The Amud I individual was about 180 cm tall, had a gracile skeleton and a cranial capacity of 1740–1800 cm^3. According to descriptive characteristics, his supraorbital region shows Neanderthaloid features (a low glabella and a virtual absence of supraglabellar groove) (Vasiliev, 2006: 150–151). In a number of metric parameters, Amud I shows similarities with the skeletal remains of Shanidar I, Skhul IV, Arago XXI, and Tabun I. Amud I shows a zygomatic notch, which is not typical of Neanderthals, and no bulging at the base of the frontal process of the maxilla. Metric parameters and indices of the zygo-maxillary region link the Amud I find with Oberkassel 1, Sungir 1, Fish Hoek, and Skhul V. In terms of trigonometry of the facial skeleton, it is similar to Skhul V, Florisbad, Sungir 1, and Gibraltar 1. The mandible shows sapient features in a number of parameters (even the mental protuberance can be recognized). S.V. Vasiliev notes a number of other traits that bring Amud I closer to both Neanderthals and *H. sapiens*. According to G. Bräuer scale, this specimen can be attributed to the "late archaic *H. sapiens*" (1984).

Descriptions of the Amud I skeleton made by other anthropologists suggest that both the cranium and the postcranial skeleton combine features typical of classic Western European Neanderthals and of early anatomically modern humans in Africa. The postcranial skeleton of Amud I appears to be unusual for European Neanderthals. This individual is significantly taller and has long lower and upper limbs, which brings it closer to the male individuals from Skhul and Qafzeh. One cannot but agree with the B. Arensburg and A. Belfer-Cohen arguing that the morphology of Amud I individual rather contradicts the proposed attribution of these fossils to the Neanderthal type, and indicates a divergence from this category (1998).

Based on the fact that no remains of anatomically modern humans younger than 80 (75)–40 ka BP have yet been found in the Levant, some researchers come to the conclusion that modern humans were replaced by Neanderthals migrating from southern Europe to this region. This conclusion is questionable. The replacement of modern humans by European Neanderthals should have entailed changes in the technical and typological complex of stone tools, because the European Mousterian that falls within this time range was significantly different from the late Middle Paleolithic of the Levant. The Tabun I and Tabun II fossils suggest that as early as about 100 ka BP, the Levant was inhabited by Palestinian Neanderthals and modern humans, who occupied the same caves. J. Schwartz and I. Tattersall classified the fossils from Qafzeh Cave into two groups: they identified anthropological individuals Qafzeh 1, 2, 9, and 11 as *H. sapiens*, and others not, because they definitely did not belong to this species (2005b). Consequently, this cave could have been alternately inhabited by groups of anatomically modern humans and Palestinian Neanderthals.

The examination of the anthropological finds of the Middle and Upper Pleistocene from the Levant and analysis of their morphological features revealed the need to clarify the previously formulated hypotheses: as to the regional origin of Neanderthals (Trinkaus, 1983), the existence of a single population close to anatomically modern humans (Kramer, Crummett, Wolpoff, 2001), and the attribution of Tabun I, skeletal remains from Amud and Kebara to Neanderthals, and those from Skhul and Qafzeh, to early *H. sapiens* (Tchernov, 1992; Jelinek, 1992; Vandermeersch, 1992, 1997; Stringer, 1992, 1998; and others). At present, many researchers support the idea of two parallel evolutionary lineages represented by modern humans and Palestinian Neanderthals (Rak, 1986, 1990; Arensburg, Belfer-Cohen, 1998; and others), but propose different chronological estimations for the dispersal of each of those populations in the Levant. The scarce anthropological materials discovered in Israel indicate that further evolutionary development of *H. heidelbergensis* continued in this region. This led to the development of early modern humans (Skhul, Qafzeh) and Palestinian Neanderthals (Amud, Kebara and, possibly, Tabun Cave, alternately inhabited by early modern humans and Neanderthals) (Derevianko, 2019, 2020, 2022).

More recently, J.M. Bermúdez de Castro and M. Martinón-Torres published an article in which, based on the study of Middle Pleistocene fossils from Africa and Eurasia, they came to the conclusion that the search for the ancestors of anatomically modern humans should be carried out not only in Africa, but also in Southwest Asia, especially in the Levant (2022: 91).

The thorough analysis of the evolutionary development of *H. heidelbergensis* in the Levant was necessary because this taxon played a major role in the origins of Neanderthals and Denisovans. Some representatives of this taxon, which was at the stage of the divergence process, at different periods migrated to Europe and East Asia, where Neanderthals and Denisovans evolved.

***Homo heidelbergensis* in Europe and development of the Neanderthal taxon**

About 700 (600) ka BP, some groups of the *H. heidelbergensis* population with the Acheulean industry migrated to Europe, where they met with the indigenous population—representatives of the late form of *H. erectus* with the pebble-flake industry*. The earliest anthropological materials in this area have been recovered from Sima del Elefante in Atapuerca: layer TE 9C yielded a fragment of the hominin mandible with several teeth, and a separate lower second premolar of the same individual aged 1.3–1.1 million years (Carbonell et al., 2008: 465).

Anthropological fossils (from four to six individuals, according to various sources) found by Spanish researchers in Atapuerca at the site of Gran Dolina (level TD 6 – Aurora) date back to a slightly younger period (800–900 ka BP). Fossils from TD 6 include 85 fragmented cranial and postcranial bones (Bermúdez de Castro, Nicolás, 1997).

On the basis of the analysis of these finds, the researchers attributed them to a new species, *H. antecessor*. J.M. Bermúdez de Castro and his co-

*For more details, see: (Derevianko, 2019: 437–470).

authors concluded that *H. antecessor* was the ancestor of *H. heidelbergensis*, which later became the ancestor of Neanderthals, anatomically modern humans, and Denisovans (J.M. Bermúdez de Castro et al., 2008, 2017a–c; 2019; Martinón-Torres et al., 2019).

The recognition of a new species, *H. antecessor*, based on the mandible from Sima del Elefante and fossils from horizon TD 6 at Gran Dolina, separated by a chronological gap of ca 300–400 thousand years, which, according to Spanish researchers, is the ancestor of *H. neanderthalensis, H. sapiens*, and *H. denisovan*, from our point of view, seems premature. Many anthropologists express doubts about the validity of such a conclusion. One can only agree with the identification of a late form of *H. erectus* and its designation as *H. antecessor*.

Homo heidelbergensis with the Acheulean industry migrated from the Near East to Europe, where he met with *H. antecessor* (indigenous population), a descendant of *H. erectus* with the pebble-flake industry. Both the newcomers and the aboriginal populations had an open genetic system, and over the course of 500 thousand years of their common settlement in the vast European continent, as a result of the assimilation of these two taxa, natural selection, genetic drift, and adaptation to changing environmental conditions, a new taxon of *H.s. neanderthalensis* originated.

In the period of 700–200 ka BP, about ten species of hominins have been identified, retaining important morphological information. These species demonstrate a mosaic pattern of morphological characteristics, indicating the complexity of the evolutionary process. Notably, all discovered fossils, on the basis of which the anthropologists identified species, are subspecies. Each species must have an ancestral form, which gives rise to a new taxon. New taxa were formed mainly as a result of assimilation of the indigenous population with the newcomers—*H. heidelbergensis*; mixed offspring were born, in which further hybridization occurred, leading to morphological mosaic pattern in the descendants, who in turn preserved the open genetic system.

In Europe, archaeologists have identified several industries existing in the chronological range of 700–200 ka BP: pebble-flake, Acheulean, small-sized tools, and others, which showed great variability. The mosaic pattern of morphology in hominins and the variability of their industries are explained by the complexity of the processes that took place in Europe in the Middle Pleistocene in connection with the evolution of a new taxon—*H.s. neanderthalensis* and the Mousterian industry. Difficulties in understanding the phylogeny are associated with the fact that there are rather few anthropological remains aged to the range of 700–200 ka BP, and they were found mainly in Western Europe. Moreover, these finds are fragmented and their chronological affiliation is problematic.

Let's discuss some of the most significant and oldest fossils. *H. heidelbergensis* emerged in Africa, but was named after the place where the mandible of this species was first found—in a quarry located by a place called Mauer, near Heidelberg, Germany. The mandible was originally described by O. Schoetensack (1908), who identified it as a new species, *H. heidelbergensis*. The mandible was large in size and combined ancient apomorphies of *H. erectus* and derived characteristics. E. Mayr proposed to classify this individual as late *H. erectus* (1963). F.C. Howell noticed more derived features in this fossil, and attributed it to *H. neanderthalensis* (1960).

The increase in the number of Middle Pleistocene fossils discovered in Africa and Eurasia allowed P.G. Rightmire to attribute a significant part of them to a new species that emerged in Africa ca 900–800 ka BP, and designate the species as *H. heidelbergensis*, after the place of the first find (1988). There has been a long lasting debate about the age of the Mauer mandible. Most researchers have accepted the date proposed by M. Day based on the study of the remains of animals adapted to warm climate—the end of the first interglacial or the onset of the second interglacial (~550–500 ka BP) (Day, 1986). According to the updated data, the age of this fossil is 609 ± 40 ka BP (Wagner et al., 2010).

The *H. heidelbergensis* population migrated to Europe and dispersed over a fairly large area. The northernmost anthropological find comes from the Acheulean site of Boxgrove in England (52°N). This is one of the informative Acheulean sites in Europe, with the largest number of Acheulean handaxes. The site has also revealed a shinbone. C. Stringer and his colleagues carefully studied the fossil and attributed it to the genus *Homo* (Roberts, Stringer, Parfitt, 1994). In some publications, this bone is dated to 524–478 ka BP (Ibid.), in others, 423–362 ka BP (Bowen, Sykes, 1994). It is very likely that in England *H. heidelbergers* encountered late *H. erectus*. At the same latitude, the sites of *H. erectus* with pebble-flake industry, dating back to 800–900 ka BP, have been reported. Another site with the pebble-flake industry was discovered in eastern England in Pakefield (Parfitt et al., 2005). An age estimate of about 700 ka BP was obtained for this locality through several methods. Thus, there is every reason to believe that *H. heidelbergensis* came into contact with late *H. erectus* in England, and the assimilation could have occurred between the newcomers and the indigenous population.

The grotto of Caune de l'Arago, located 30 km from Perpignan, near the small town of Tautavel in the Eastern Pyrenees, is one of the best explored localities. During the excavations (1964–2015), 148 fragments of human remains were found there (Lumley M.-A., 2015). The fossils were deposited in a clear stratigraphic sequence of 15 lithologic units (including the bottom of unit Q, dated to 550 ka BP, and the top of unit C, 400 ka BP) dating back to the period corresponding to MIS 14–11. During this long time, hominins experienced two periods of cold and dry climate, separated by a period of moderately humid climate.

Human remains are represented mainly by cranial fragments. These included the frontal part of Arago 21 skull, which provided the first insight into the physical appearance of the first Europeans. The entire set of finds from Caune de l'Arago—5 mandibles, 123 teeth (isolated or in the alveolar process), several fragments of postcranial skeleton, including 9 fragments of upper and 19 fragments of lower extremities—has been classified and attributed to 30 individuals: 18 adults and 12 children (Ibid.: 303).

This extensive anthropological material is supported by detailed field documentation clearly recording the locations of fossils in the stratigraphic sequence; and has a reliable geochronology. During field work and laboratory research, all finds discovered during excavations were studied by experts of various fields of sciences and humanities, using the most advanced techniques and equipment. The anthropological material was comprehensively studied by one of the most highly qualified physical anthropologists M.-A. de Lumley. She notes that the abundance of bone remains makes it possible to assess the biodiversity and composition of this population (Ibid.: 304).

M.-A. de Lumley draws the attention to the fact that the finds from Caune de l'Arago show certain archaic features not noted in the Mauer mandible. The particular value of these anthropological materials is that they provide the possibility to study the skull and lower limbs of a European Middle Pleistocene hominin simultaneously. Skulls with well-preserved facial parts found in the clear stratigraphic context are extremely rare. The skull of Arago 21, retaining facial bones, is the most complete and best preserved skull from the first half of the Middle Pleistocene in Europe.

The issue of taxonomic identification of the fossils from Caune de l'Arago has caused a lively debate. The first finds from the grotto were designated as pre-Neanderthal (Lumley M.-A., 1970, 1973). The skull of Arago 21 had many features resembling those of the late *H. erectus*. In particular, Arago 21 showed similarities to fossils from Morocco and Algeria. This led to the assumption of a genetic link between European and African hominins of the Middle Pleistocene (Aguirre, Lumley M.-A., 1977). In the course of further comprehensive studies of archaeological and anthropological materials from Caune de l'Arago, the leaders of the work, an outstanding French archaeologist A. de Lumley and his no less famous wife M.-A. de Lumley, came to the conclusion that these fossils should be classified as a separate taxon, *Homo erectus tautavelensis* (Lumley H., Lumley M.-A., 1979). They supported their conclusion with the following evidence: anthropological remains from Caune de l'Arago reveal morphological similarities between each other; the morphology of these hominins shows features characteristic of pre-Neanderthal populations of Europe and distinguishing them from the hominins that settled in Africa and Asia during the same period. These representatives of *H. erectus*, the first inhabitants of Europe, are the ancestors of Neanderthals and modern humans (Ibid.).

M.-A. de Lumley combined various fossils—Arago, Ceprano, Galeria, Swanscombe, Vértesszőlős, Bilzingsleben, Petralona, Biache-Saint-Vaast, and Lazaret—into the subspecies *H. erectus tautavelensis*, which replaced *H. antecessor*. For the developed European *H. erectus*, several stages of evolution can be distinguished, which ended with the emergence of Neanderthals 120 ka BP. M.-A. de Lumley believed that the phenomenon of Neanderthalization would be widely dispersed in Europe starting from 100 ka BP.

The extensive anthropological materials from excavations at Caune de l'Arago have aroused great interest among physical anthropologists. Fossils representing cranial, facial, and postcranial elements have opened up the possibility of comparison with other anthropological finds from Africa and Eurasia.

D. Johanson and E. Blake believe that the Steinheim skull is a reduced copy of Arago 21. They explain the slight difference in size by sexual dimorphism (Johanson, Blake, 1996). J. Schwartz and I. Tattersall argued that the mandibles from Mauer and Arago belong to the same species, despite the differences in the antero-posterior branch and some other details, and pointed out the necessity of comparison of the cranial specimens from Arago, specifically the facial portion of the skull of Arago 21, with other fossil hominin skulls and *H. heidelbergensis*. Given Arago 21 and its fragments as reference models, there are several other relatively well-preserved remains that would be candidates for inclusion in the class of *H. heidelbergensis* (Schwartz, Tattersall, 2005b: 503).

Another fossil dating back to the first half of the Middle Pleistocene was found in France—a mandible from the vertical gallery of La Niche in the Montmaurin Grotto. Excavations in the grotto revealed Mindel faunal remains (~540–470 ka BP) (Lumley M.-A., 2015). M.-A. de Lumley described this mandible as quite different from those of hominins from North Africa and East and Southeast Asia—Atlanthropus, Pithecanthropus, and Sinanthropus. It differs from fossils from East Asia by the curvature of the alveolar arch. European specimens are always characterized by a flattened wall anteriorly at the level of the incisors, while in Pithecanthropus, the front arch of the mandible is of a regular convex shape. In general, the Montmaurin mandible is robust; it retains six molar teeth. The researchers have found isolated teeth and a vertebra.

Based on the thickness of the bones in the symphysis, as well as the shape of the mental region (sharply receding at an angle of 73°), the large width of the ascending ramus, and the low position of the digastric fossa, A.A. Zubov and S.V. Vasiliev classified this mandible as the one close to *H. heidelbergensis*, and based on the size of the teeth, to the Steinheim skull, but more robust than the latter (Zubov, Vasiliev, 2006). Overall, the Montmaurin mandible appears archaic. G. Billy and A. Vallois noted that in some features this mandible was more primitive than those of *H. erectus*, but at the same time it showed a number of derived characteristics; this suggests its classification as "pre-Neanderthal" (Billy, Vallois, 1977).

A Middle Pleistocene hominin skull was first found in 1933 near Steinheim, 30 km north of Stuttgart, Germany. The fossil was discovered by anthropologist F. Berckhemer in the fluvial deposits of a gravel quarry on the banks of the Murr River. It was the skull of a young individual; most of its face, upper molars and premolars were deformed by fossilization. Some scholars attribute these deposits to the Mindel-Riss (Cela-Conde, Ayala, 2007), others estimate their age as ca 475 thousand years (Adam, 1985).

All researchers note a remarkable combination of primitive and advanced features in the Steinheim fossil. The skull demonstrates certain *H. erectus* traits: a small cranial capacity of 1100 cm^3, a low skull cap, a "sloping" forehead, and a robust supraorbital torus. The discoverer and the first researcher F. Berckhemer identified the find as a new species, *Homo steinheimensis* (1936). B. Campbell downgraded the specimen to the subspecies *H. sapiens steinheimensis* (1964). Some anthropologists classified the Steinheim hominin as Neanderthal. The antiquity of the fossil and some morphological features argued against such a taxonomic determination. According to M. Day, the position of the maximum width of the skull, the shape and thickness of its vault bring the Steinheim fossil closer to the Swanscombe find (1986).

The discussion concerning the taxonomic affinity and age of the Ceprano skull is a striking example of the discrepancy between various viewpoints of experts. This fossil was discovered in Central Italy, near the small town of Ceprano, approximately 100 km south of Rome. On March 13, 1994, I. Biddittu, a member of the Italian Institute of Human Paleontology, discovered the first fragment of the skull. In the course of subsequent excavations, researchers found about 50 fragments. The skull was reconstructed over a period of ca 5 years by several researchers (Ascenzi et al., 1996, 2000; Clarke, 2000).

The debate over the place of the Ceprano fossil in the hominin taxonomy stems from the fact that the find was initially dated to ca 0.8–0.9 Ma BP (Ascenzi et al., 1996; Ascenzi, Segre, 1997). The researchers, having studied the Ceprano skull, concluded that the main characteristics of this specimen are comparable with those of Asian *H. erectus*. The cranial vault is low, with a flattened sloping forehead. The supraorbital arches are robust and extremely prominent. They are continuously connected to the glabella, which is equally robust in structure. The bones are thick. Behind the supraorbital torus, there is an extended depression in the form of a groove; the postorbital constriction is pronounced. The inion coincides with opisthocranion; the maximum width is located very low—at the level of the well-developed supramastoid crest. The occipital squama is very large as compared to its width between the asterions. However, the researchers note certain characteristics that distinguish Ceprano skull from *H. erectus*. The capacity of the Ceprano skull is 1185 cm^3, while the largest *H. erectus* skull size rarely exceeds 1000 cm^3. The Ceprano skull does not show a distinct sagittal suture or parasagittal depression in the frontal squama, where, unlike the parietal bones, the vault maintains its continuity. A reduced postorbital narrowing and a relative reduction in the robustness of the vault in relation to the base were noted.

Some scholars proposed to include Ceprano, together with the Atapuerca fossils (TD 6), into the group of the oldest anthropological remains discovered in the Mediterranean region, and to designate these materials as a single species *H. antecessor*; however, they did not exclude the possibility of emergence of two different species in Europe in the late Early Pleistocene (Ascenzi et al., 1996; Clarke, 2000; Bruner, Manzi, 2005).

Finally, in the course of interdisciplinary research, the age of Ceprano skull was established within the range of 430–385 ka BP (Manzi et al., 2010). This result was unexpected for specialists and allowed them to significantly revise the previously stated hypotheses about the place of the Ceprano fossil in the phylogeny of Middle Pleistocene hominins. As it turns out, the Italian fossil dates back to the second half of the Middle Pleistocene rather than to the late Early Pleistocene. At the same time, along with the indisputable morphological features of Neanderthals, scientists noted certain similarities of the Ceprano skull to the Late Pleistocene finds from Western Europe. It has been concluded that the new Ceprano geochronological position indicates the diversity of Middle Pleistocene hominins and a more complex scenario for their evolution than previously thought.

The site of Sima de los Huesos (SH) is one of the most outstanding sites in Europe due to the abundance of hominin finds falling almost within the same time range. It is located in the Atapuerca sector 2 (Cueva Mayor), 500 m from sector 1 (Trinchera del Ferrocaril). Sima de los Huesos, according to one data, revealed about 4000 hominin remains, and according to other data, 3000 and 3600 fragments (Aguirre, 1995; Bermúdez de Castro et al., 1997, 2004; Rodríguez, Carbonell, Ortega, 2001; Falguères et al., 2001).

The SH collection of anthropological fossils is unique in both quantity and morphological diversity. J.M. Bermúdez de Castro and S. Sarmiento (2001) carried out a comparative morphological analysis of human teeth from two Atapuerca localities—Gran Dolina (TD 6) and SH. The SH site yielded 380 teeth, of which 98 were found *in situ*. Most of the teeth (*n*=376) are permanent. The authors of the first publications describing this analysis assumed that the teeth belonged to 32 individuals (Bermúdez de Castro, Nicolás, 1997). The further detailed analysis showed that the SH anthropological remains belonged to 27 individuals.

SH fossils date back to ca 430 ka BP (Arsuaga et al., 2014). The cranial and postcranial morphology of these hominins shares many features with Neanderthals. Therefore, some anthropologists assign SH fossils to this taxon. This hypothesis cannot be considered substantiated, because, according to the results of DNA sequencing, the hominins of the locality in question were in the process of development.

Extraction of an almost complete mtDNA sequence from the femur of a SH individual of such great antiquity should be considered a great achievement of researchers from the Max Planck Institute for Evolutionary Anthropology in Leipzig. The mtDNA sequence of this hominin turned out to be Denisovan rather than Neanderthal, as expected (Meyer et al., 2014). To test this result, the researchers created three phylogenetic trees based on the mtDNA sequences of SH hominin, anatomically modern human, early modern human, Neanderthal, Denisovan, chimpanzee, and bonobo. All three trees demonstrated a topology where mtDNA of the SH individual shared a common ancestor with mtDNA of Denisovan, while mtDNA of the other taxa was out of this process (Ibid.: 404).

Re-sequencing of DNA from two bones of the Sima de los Huesos hominin resulted in extraction of nuclear DNA of Neanderthals rather than Denisovans (Meyer et al., 2016). The nuclear DNA sequence extracted from the AT-5431 femur and an incisor suggests their affinity with the Neanderthal evolutionary lineage. The researchers concluded that the SH hominins were early Neanderthals or a group closely related to the ancestors of Neanderthals after diverging from their common ancestor with the Denisovans (Ibid.: 507).

DNA sequencing of the SH hominins revealed the presence of Denisovan mtDNA in their genome. However, mtDNA can be inherited as a separate unit passed from mother to her offspring; it doesn't fully represent the affinity between individual hominins and the population as a whole. The nuclear genome of SH individuals was sequenced from a femur fragment and an incisor. It was found out that in the genome from the femur, 87 % of the common branch of Neanderthals and Denisovans contains 43 % of the Neanderthal alleles and 9 % of the Denisovan alleles; in 68 % of the incisor, the share of the Neanderthal alleles is 39 % and that of Denisovan is 7 %. The results of genome sequencing are extremely important. These confirm that the SH individuals were not only ancestral to Neanderthals, but in their genome they also retained mtDNA and a small percentage of nuclear DNA of the Denisovans. The initial split of morphological and genetic heredity into two taxonomic lineages (Neanderthals and Denisovans) in *H. heidelbergensis* occurred when a part of their population dispersed to

Europe 700 (600) ka BP. In the course of development of a new Neanderthal taxon on the ancestral basis of *H. heidelbergensis*, the new taxon retained some part of the Denisovan mtDNA for a long time, despite the fact that Denisovans never populated Europe.

The duration of the process of development of the Neanderthal taxon is illustrated by other, younger anthropological fossils found in Europe.

In 1933–1935, excavations of an Acheulean site carried out in England near the small town of Swanscombe, 30 km east of London, in the valley of the Thames River, revealed an occipital bone, as well as left and right parietal bones of one skull. The bones of late Pleistocene animals and Acheulean tools were embedded in a stratum attributed to the second interglacial. First, the stratum was dated to 225 ka BP (Bridgland et al., 1985); later, a date of 423–362 ka BP was derived (Bowen, Sykes, 1994). The skull fragments belonged to a female individual. The cranial capacity is approximately 1325 cm^3. The skull is characterized by thick bones, a low vault, and a rounded occipital region, and combines primitive features and well-expressed features of modern humans. The mosaic combination of traits has sparked discussion about the taxonomic affinity of this fossil. W. Le Gros Clark, who first studied the fossil, and his co-authors designated it as *Homo* cf. *sapiens* (1938).

Later, A. Kennard classified the Swanscombe fossils as a separate species (1942). In many respects, the skull fragments from Swanscombe were similar to the skull from Steinheim (Germany), which showed a mosaic pattern of primitive features and those of modern humans.

F.C. Howell included the fossils from Swanscombe, Steinheim, and Fontéchevade in the group of early Neanderthals, on the basis of their great similarity (1951). M. Wolpoff had a different opinion: he attributed a large group of European Middle Pleistocene fossils from Swanscombe, Vértesszőlős (Hungary), Petralona (Greece), Steinheim, and Bilzingsleben (Germany) to *H. erectus* (1971). The scholar explained the presence of modern human traits in the Swanscombe skull by the fact that it belonged to a female individual, and the morphological differences in the group attributed by him to late *H. erectus* he associated with sexual dimorphism. M. Day, in his study of the Swanscombe fossils, concluded that they belonged to a female individual at the transitional stage between *H. erectus* and *H. sapiens*, which could be regarded as the base of a diverging branch leading to European Neanderthals (1986). There are also other viewpoints on the taxonomic affinity of this fossil. The case of the Swanscombe skull shows how different the conclusions may be, which is explained by the great morphological mosaicity of features in anthropological remains.

The distribution of late hominins bearing evident features of *H. erectus* and *H. sapiens* in Europe is also evidenced by other finds. The site of Vértesszőlős with a pebble-flake industry, located 50 km northeast of Budapest, yielded the teeth of a child in the main culture-bearing layer and the occipital bone from an adult individual in the overlying horizon. Initially, the cranial capacity of the adult individual was estimated as 1400 cm^3; according to the updated information, it is 1325 cm^3. This individual clearly shows some extremely archaic features: very thick bones and a well-protruded occipital torus. Among the deciduous teeth, the lower canine is distinguished by the large size and the absence of a cingulum. The fossils also showed pronounced derived sapient features, which gave reason to attribute these finds to late *H. erectus* and early *H. sapiens*.

In Germany, the Early Paleolithic site of Bilzingsleben revealed bone fragments, which were reconstructed and identified as belonging to two individuals showing significant differences from one another (Schwartz, Tattersall, 2005b). For the cultural layer, the dates of 228 ± 17/12 ka BP (Harmon, Gtazek, Nowak, 1980) and 414 ± 45 ka BP (Schwartz, 1988) were generated. J. Schwartz and I. Tattersall emphasized certain intriguing issues in the morphology of the bone fragments of these individuals.

The fossils were found in a single cultural layer and were initially attributed to a single individual. The head of the field research D. Mania and his co-author, like other specialists, identified this fossil as late *H. erectus* and compared it with Sinanthropus III and with fossil OH 9 from Olduvai, on the basis of the following features: archaic structure of the frontal bones (robust supraorbital torus, sloping forehead), and the abrupt bend of the occipital bones forming a prominent torus (Vlček, Mania, 1977). This site has revealed a rather peculiar lithic industry, consisting mainly of small-sized tools. Consequently, the site with the pebble-flake microindustry was inhabited by a population in which individuals were morphologically different from one another. Special attention should be drawn to this inference, since it is possible that throughout the Middle Pleistocene, two taxa populated Western Europe: late *H. erectus* (*antecessor*?) and *H. heidelbergensis*. Sometimes, they inhabited neighboring or close regions and, in the absence of hostile relations, they could meet, interbreed and produce fertile offspring. This created a highly mosaic pattern in the morphology of hominins in the second half of the Middle Pleistocene. Importantly, the lithic industry of these hominins was different from the Acheulean and Mousterian traditions.

A hominin skull of the final Middle Pleistocene was uncovered in Petralona Cave near Thessaloniki, Greece, in 1939. The skull was hanging from a stalactite, while the rest of the skeleton lay on the ground. Sadly, the skeleton bones were subsequently lost. Near these currently missing bones, a few Middle Paleolithic tools were found (Poulianos, 1971). Dozens of publications discussed the studies of the Petralona fossil. The find is of particular interest to physical anthropologists studying Middle Pleistocene hominins of Eurasia. The Petralona skull (the mandible is missing) is well preserved. Its age is assessed differently. The electron spin resonance method produced a date of more than 700 ka BP (Poulianos, 1978). The most reliable age determination obtained using the ESR method is 250–150 ka BP (Grün, 1996).

The skull from Petralona shows a mosaic combination of very archaic and distinctive *H. sapiens* features: a robust supraorbital torus and thick bones, a significant height of the vault, relatively low orbits, and the incipient canine fossae. A.A. Zubov and S.V. Vasiliev pointed to the "keel-shaped cranium and an abrupt bend of the occiput, with a strongly prominent torus (a feature more typical of *H. erectus*), as well as some Neanderthaloid features (oblique zygomatic region and broad nasal opening). The cranial capacity is 1220 cm^3 (Zubov, Vasiliev, 2006). Because of this combination of archaic and *H. sapiens* features, researchers have differently assessed the taxonomic affinity of this fossil. Anthropologists characterize it as having well-defined features of Neanderthals (Kokkoros, Kanellis, 1960), the earliest representatives of *H. sapiens* (Stringer, Howell, Melentis, 1979), and advanced late *H. erectus* (Hemmer, 1972).

The Petralona fossil is often used in comparative analyses of Middle Pleistocene hominin remains from Africa and Eurasia. I consider it necessary to briefly dwell on the conclusions of J. Schwartz and I. Tattersall based on the results of their comparative analysis of Middle Pleistocene hominins. Considering the affiliation of fossils from Africa and Eurasia to *H. heidelbergensis*, the scholars noted that among other European specimens the first candidate for inclusion in this species is the Petralona skull. Among African fossils, the obvious candidates are the skulls from Bodo, Kabwe, and Saldanha; among the Asian finds, the skulls from Dali and Jinniushan. All of them are comparable in skull size and proportions of facial part relative to the cranium. The Petralona specimen is particularly similar to Arago 21. The same can be said of the finds from Bodo, Kabwe, Saldanha, and Dali. Finds from Jinniushan show less similarity. These are a half of the Narmada skull and part of the Maba skull vault.

J. Schwartz and I. Tattersall thoroughly examined the signs of similarity and difference, and came to the conclusion as to the "fundamental structural similarity among most of them" (2005b). I cite this conclusion in order to emphasize once again that Middle Pleistocene hominins were the descendants of one ancestral species *H. erectus* and retained many common traits evolving along the *H. sapiens* lineage, despite the great divergence and differences in environmental and climatic conditions of their habitats. Middle Pleistocene African-European hominins can be grouped into a single species, *H. heidelbergensis/rhodesiensis*. Asian hominins of this period also evolved into the *H. sapiens* lineage; their morphology shows many derived features similar to those of the *H. heidelbergensis/rhodesiensis* population; there are also differences resulting from divergence.

The possibility of a single evolutionary line of development of hominins in Eurasia toward sapienization was also assumed by other researchers. For example, G. Rightmire noted that "Petralona and Broken Hill crania differ only slightly in orbit size, frontal proportions, and prominence of the torus crossing the occipital bone; in general, they are remarkably alike" (2001: 133). Similarities in the morphology of the late Middle Pleistocene hominins can be traced not only in the African-European anthropological remains, but also in Chinese fossils. Rightmire and some other anthropologists attributed the Dali and Jinniushan fossils from China to *H. heidelbergensis*. The morphological similarity between them is the result of the common pattern of human evolution along the *H. sapiens* lineage, despite divergence, assimilation, and a regional component. It is no coincidence that D. Johanson considered it possible to attribute the Dali skull to *H. sapiens* (Johanson, Blake, 1996). C. Groves argued that the Dali and Jinniushan fossils are similar to specimens of the same age from Africa and Europe rather than to the more ancient hominins from Zhoukoudian and Hexian (Groves, 1994).

Many anthropologists are convinced that the evolution of Neanderthals took place mainly in Western Europe. This is confirmed by anthropological materials from this region, indicating the gradual development of Neanderthaloid features in the morphology of late Middle Pleistocene hominins; furthermore, a Neanderthal nuclear genome was derived from SH hominins. However, there are several hypotheses as to the time when *H. neanderthalensis* began to exist as a separate taxon. Some scholars believe that Neanderthals emerged in Europe as early as the mid-Middle Pleistocene, and F.K. Howell (1960) even considered the Mauer mandible as *H. neanderthalensis*. M.-A. de Lumley attributed the anthropological finds from Lazaret, aged 170–150 thousand years and associated with the handaxe industry, to late *H. erectus* showing features of Neanderthalization, which is designated as pre-Neanderthal (Anténéandertalien). In her opinion, this hominin had cognitive abilities corresponding to conceptual thinking and social organization. He was on the way to a "surge in symbolic thinking" (Lumley M.-A., 2015).

In connection with determining the boundaries of the initial stage of development of the Neanderthal taxon, the discussion of the taxonomic affinity of fossils found in the south of the Peloponnese Peninsula is noteworthy. Two skulls dating to ca 160 ka BP were found in breccia that filled the space between the walls of Apidima A Cave (Pitsios, 1999). M.-A. de Lumley attributes Apidima 1 and Apidima 2 skulls, as well as the human remains from Lazaret, to a population of late European *H. erectus* at the stage of Neanderthalization. In her opinion, they preceded the classic Neanderthals (Lumley M.-A., 2019). She dates classic Neanderthals in Western Europe to 120–37 ka BP. A similar point of view on the taxonomic affinity of anthropological finds from Apidima Cave is shared by G. Bräuer and co-authors: "…from our results it can be concluded that the Apidima crania should be classified as early Neanderthal and taxonomically, as *H. sapiens neanderthalensis* based on a concept of *H. sapiens* s.l." (2020: 1390).

K. Harvati and her co-authors studied virtual reconstructions of both skulls along with the detailed description and the analysis of their morphological features, as well as U-series dating results (2019). The researchers attributed the skull Apidima 2 to the Neanderthal-like type and dated it back to a period prior to 170 ka BP. The skull of Apidima 1, which is over 210 thousand years old, shows a mixture of modern and primitive features. The available data suggest that two groups of hominins inhabited the cave area in the terminal Middle Pleistocene: at first, a population of early *H. sapiens*, and then Neanderthals. The authors of the paper believed that their findings indicated the repeated migrations of anatomically modern humans from Africa to Europe (Ibid.: 500). The conclusions of Harvati and her co-authors as to the taxonomic affinity of Apidima 1 and Apidima 2 are very controversial, since there is no evidence of such early repeated migrations of modern humans from Africa to Europe.

The brief review of various viewpoints on the evolution of Neanderthals in Europe reveals the following attribution of fossils dating to the terminal stage of the Middle Pleistocene: pre-Sapiens, pre-Neanderthals, Anténéandertalien, and late *H. erectus* undergoing the process of Neanderthalization. I am not aware of any anthropological finds older than 200 ka BP attributable to Neanderthals anatomically and genetically. Possibly, the Neanderthal taxon was finally formed by ca 150 ka BP.

Based on the available materials, I propose the following scenario for the development of this taxon. About 700 (600) ka BP, some part of the *H. heidelbergensis* population with the Acheulean industry migrated from the Near East (Levant) to Europe, where they met with *H. antecessor*. The populations of migrants and the indigenous population were small; representatives of these two taxa interbred and produced fertile mixed offspring. Almost all of the so-called species (Mauer, Boxgrove, Arago, Sima de los Huesos, Steinheim, and others) are the result of this assimilation process. Thus, these were not separate species, but subspecies—the result of evolutionary processes associated with the development of a new taxon of *H. neanderthalensis* in Europe. Apparently, in some areas of Europe, there remained small groups with clear erectoid traits (Vértesszőlős, Hungary), which produced a pebble-flake industry.

When considering the hominin industry of the second half of the Middle Pleistocene in Europe, it is important to understand the issue of emergence of the Levallois primary reduction technique. R. Foley and M. Lahr believe that this technology was introduced in Europe owing to the migration to this region of representatives of the hypothetic taxon—*H. helmei* (1997). I am of different opinion: ca 400–350 ka BP, a part of the *H. heidelbergensis* population from the Near East (Levant), which underwent the evolutionary process of division into two lineages—anatomically modern humans and Palestinian Neanderthals—migrated with the Levallois primary reduction technique to Europe. The first migration wave of *H. heidelbergensis* from the Near East (Levant) 700 (600) ka BP brought the Acheulean industry to Europe, and the second wave ca 400–350 ka BP introduced the Levallois primary reduction. Approximately in the same chronological range (400–350 ka BP), another part of the *H. heidelbergensis* population from the Near East (Levant) began to settle over Central Asia. The dispersal of *H. heidelbergensis* into the Near East ca 800 ka BP marked the divergence of modern humans from Neanderthals and Denisovans, which is confirmed by genetic studies (Reich et al., 2010; Meyer et al., 2012), while the migration of one part of *H. heidelbergensis* to Europe, and the other to East Asia, marked the final split of the common ancestral taxon (*H. heidelbergensis*) into two taxa—Neanderthals and Denisovans. Analysis of the sequenced Denisovan genome showed that the split of the population into Denisovans and Neanderthals occurred 430–380 ka BP (Prüfer et al., 2014; Meyer et al., 2014). *H. heidelbergensis* settled in Central Asia and assimilated with late *H. erectus*, which led to the development of the Denisovan taxon (Derevianko, 2022).

The ultimate genetic and anatomical formation of the Neanderthal taxon took place ca 150 ka BP. The oldest Neanderthal mtDNA, which is considered basal for all Neanderthals, was extracted from the remains of the Hohlenstein-Stadel individual, who lived 124 ka BP in the territory of Germany (Posth et al., 2017; Peyrégne et al., 2019). I consider it necessary to emphasize that the process of evolution of the Neanderthal taxon took more than 500 thousand years, and all the identified intermediate forms differed from one another in certain morphological features, but the ultimate anatomical and genetic development of the Neanderthal taxon took place later than 200 ka BP. This process occurred mainly in Western Europe, where most fossils of intermediate forms were discovered. In Eastern Europe and the Caucasus, the earliest age of the Neanderthal remains does not exceed 100–120 thousand years.

A thorough analysis of the origin of the Neanderthal taxon is necessary for consideration of the main issue raised in the present paper—the validity of identifying a special group of Altai Neanderthals among Neanderthals.

Neanderthals of the Altai: Myth or Reality?

In 1984, in the course of field research in the Altai, Okladnikov Cave with Mousterian industry was found (Derevianko, Markin, 1992). The cave revealed anthropological remains, whose sequenced DNA showed that they belonged to Neanderthals (Krause et al., 2007). In 2007, S.V. Markin discovered another, Chagyrskaya Cave, which also yielded Mousterian industry and Neanderthal bone fossils. The migration of classic Neanderthals designated as the Chagyrskaya Neanderthals to the Altai occurred ca 60 ka BP (Derevianko, Markin, Kolobova et al., 2018). In addition to this group of Neanderthals, on the basis of DNA sequencing of anthropological finds and of samples taken from culture-bearing deposits, another Neanderthal group was identified in Denisova Cave—the Altai Neanderthals.

The complete genome sequence of the Altai Neanderthal was derived from the fossil Denisova 5 (proximal phalanx of the toe) (Prüfer et al., 2014) found in the East Chamber of the cave, in the bottom of cultural layer 11.4 dating to 123 ± 7 ka BP (Jacobs et al., 2019: 594, fig. 3).

M.B. Mednikova, who studied the find, came to the conclusion that this toe phalanx is more developed in width than in height (2011a). This feature distinguishes the hominin from Denisova Cave from most modern humans and brings it closer to Pleistocene *Homo* of various taxonomic affinities. The bone is more robust and wide than those of Neanderthals and anatomically modern humans. The Altai Neanderthals show indications of hypertrophy in plantar ligaments and muscles. The metatarsal facet is canted dorso-proximally rather than proximally as in most modern humans, which may be explained by the habit of a kind of “athletic” or “marathon” (heel off) running (Ibid.: 138). So far, according to Mednikova, this phalanx finds the “closest” morphological parallels in the structure of the corresponding skeleton elements of West Asian Neanderthals from Shanidar Cave and early modern humans from Tianyuan Cave, China (Ibid.: 134).

DNA sequencing from Denisova 5 showed the Neanderthal affinity. This find provided the grounds for identification of a special group of the Altai Neanderthals (Prüfer et al., 2014). It was established that the evolutionary lineage of Neanderthals was ca 20 % shorter than that of Denisovans. This made it possible to assume that the toe phalanx of the Neanderthal (Denisova 5) is older than the phalanx of the little finger of the Denisovan hand (Denisova 3) from layer 11.2 of the East Chamber of Denisova Cave. The comparative analysis of the mtDNA of Denisova 5 and that of other Neanderthals has shown that Denisova 5 is most closely related to the mtDNA of child 1 ca 60–70 thousand years old from Mezmaiskaya Cave in the Caucasus (Ibid.).

The Altai Neanderthal genome contains several long runs of homozygosity indicating that the parents of this individual were close relatives. Since the individual found in the Altai was a woman and her X chromosome had a long run of homozygosity, it can be assumed that both X chromosomes were inherited from close common ancestors—two consecutive males in the pedigree (father and grandfather). The parents of the individual under study were either half-siblings with a common mother, or double first cousins, or uncle and niece, or aunt and nephew, or grandfather and granddaughter, or grandmother and grandson. The experts believe that such marriage relationships were common among Neanderthals (Ibid.: 45).

DNA sequencing has shown that heterozygosity in Denisovans is increased in those regions of the genome where there is one allele from a Neanderthal and one from a Denisovan. This indicates the gene flow from Neanderthals into the Denisovan population, and that at least 0.5 % of the Denisovan genome is the Neanderthal contribution. The Denisovan genome shares more alleles with those of the Altai Neanderthal than with the Vindija Neanderthal (33.19) from Croatia, or with the Neanderthal genomes of the Caucasus; this suggests a gene flow from the Altai Neanderthal population into the Denisovan population (Ibid.: 46–47). In this regard, I consider it necessary to note that this finding may indicate not the flow of genes from Neanderthals to Denisovans (this is quite possible, since both had the open genetic systems), but the residual ancestral heritage of Denisovans from *H. heidelbergensis*, which was common to both Denisovans and Neanderthals.

When studying more than 2 thousand bone fragments from Denisova Cave layer 12 through the technique of peptide mapping for protein identification using mass spectrometry, a small fragment of a hominin bone (24.7 mm long and 8.39 mm wide) designated as Denisova 11 was identified (Brown et al., 2016). During the preliminary genetic analysis of Denisova 11 and comparison with the available complete Neanderthal mtDNA, it was established that the sample from Denisova Cave has five differences from the Neanderthal Okladnikova 2, 12–17 differences from the Neanderthals of Western and Southern Europe, and 31 difference from Mezmaiskaya 1 in the Caucasus and from the Neanderthal Denisova 5 from layer 11.4 of Denisova Cave (Brown et al., 2016: 4).

The mtDNA sequencing from Denisova 11 showed that it was a female (first generation) hybrid, whose father was a Denisovan and mother was a Neanderthal (Slon et al., 2018). The direct radiocarbon analysis produced the date of more than 49.9 ka BP (OxA-33241) for the fossil, while the bone was recovered from layer 12.3 accumulated in the chronological range of ca 140–135 ka BP. The thickness of compact tissue showed that Denisova 11 individual was at least 13 years old at the time of death (Ibid.).

To identify the group of hominins from which Denisova 11 originated, the researchers used the DNA fragments derived from the analysis of bone materials from Denisova Cave, as well as the genomes of modern Africans, and studied the ratio of proportions of alleles in the genome of the Altai Neanderthal (Denisova 5) and the Denisovan (Denisova 3). For Denisova 11, phylogenetic information sites show 38.6 and 42.3 % of alleles from the genome of Neanderthals and Denisovans, respectively, which suggests approximately the same contribution of the two populations to the genetic material of this individual (Ibid.: 113).

According to the researchers, it is unlikely that the genomes of the Altai Neanderthal (Denisova 5) and the Denisovan (Denisova 3) were identical to those of the individuals who contributed to the genetic material of Denisova 11. Therefore, several experiments were carried out; the derived data indicated that the father of Denisova 11 had some Neanderthal ancestral genetic material. Most likely, there was more than one Neanderthal ancestor in his genealogy. Notably, heterozygosity in the runs of Neanderthal origin in Denisova 11 is higher than in the same runs in Vindija 33.19 or in the Altai Neanderthal (Denisova 5); this suggests that the Neanderthal ancestors of Denisova 11's father and mother belonged to different populations.

In connection with the latest inferences, I propose another solution to this issue. As noted, the Neanderthal genomic heritage in Denisova 11's father was the result not of direct interbreeding with Neanderthals, but of preservation of ancestral residual DNA. The Neanderthal mother of Denisova 11 originated not from the Altai Neanderthals, but from the later classic European Neanderthals—Chagyrskaya.

In order to clarify how the Denisova 11's mother is related to the two Neanderthals (Denisova 5 and Vindija 33.19), whose high coverage genomes are now available, the portions of the Denisova 11 genome fragments that matched the derived alleles from either of the two Neanderthal genomes were examined. In the genome of Denisova 11, the proportion of the derived alleles common with the genome of the Altai Neanderthal (Denisova 5) is 12.4 %, while in the genome of Vindija 33.19 this figure reaches 19.6 %, indicating that the mother of Denisova 11 comes from a population that is closer to Vindija 33.19 than to the Altai Neanderthals. The results of sequencing of mtDNA from the specimen of Chagyrskaya 8 support the fact that the mother of Denisova 11 belonged to the late classic Neanderthals, in particular, to the Chagyrskaya Neanderthals in the Altai. It was found that the genome of Chagyrskaya 8 has more derived alleles with the genome of the Denisova 11's mother than that of Vindija 33.19. Moreover, among the currently known Neanderthals, Chagyrskaya 8 is genetically most closely related to the mother of Denisova 11 (Mafessoni et al., 2020: 15133).

The proposed brief review of the genetic and morphological features of the Altai Neanderthals shows the insufficiency of data for a full characterization of this taxon. First of all, the question arises of when and where the so-called Altai Neanderthals migrated from, who are genetically different from Chagyrskaya Neanderthals, although show some common features with them.

A great achievement of paleogeneticists from the Max Planck Institute for Evolutionary Anthropology in Leipzig is the technique developed under the leadership of Svante Pääbo for the extraction of mtDNA directly from culture-bearing layers (Slon et al., 2017).

I am forced to note that our colleagues-geneticists, with whom we have been collaborating for many years, are not familiar with the results of archaeological research, and when discussing joint publications it is almost impossible to convince them of the fairness and validity of our viewpoint if it does not correspond to the sequencing results. Disagreements arise due to a lack of hard evidence in favor of one opinion or another, and more often due to the belief of researchers, representing different scientific disciplines, in the greater significance of their finds.

Paleogenetics is of great importance in the studies of evolution of the genus *Homo* and the origin of modern humans. But this branch of molecular biology is still very young. Its study methods are constantly being improved, new instrumentation is emerging, making it possible to extract the maximum amount of information about DNA from a fossil under study and, more recently, about DNA obtained directly from the lithological layer.

In Denisova Cave, Neanderthal DNA was extracted from cultural deposits in the Main Chamber, accumulated 168–86 ka BP (layers 19, 17, and 14); East Chamber, 205–172 ka BP (layer 14); and from the fossils found in the East Chamber (Denisova 9 – 118–150 ka BP, and Denisova 5 – 93–132 ka BP) (Jacobs et al., 2019: 596).

Establishing the time of the earliest habitation of Denisova Cave is extremely important for solving the issue of existence of the Altai Neanderthals. Z. Jacobs and her co-authors provide information about the extraction of Neanderthal mtDNA from layer 14 of the East Chamber, dated to the range from 193 ± 12 to 187 ± 14 ka BP (2019: 596, fig. 3). E. Zavala and co-authors attribute the sample from layer 14 to layer 11.4 (2021); but the reasons for this remain unclear. They make a reference to Appendix 1 to their publication, which should contain a corresponding explanation, but it also does not provide arguments justifying such a change. Moreover, another paper addressing the issues of collection of samples from the stratigraphic sequence for endogenous analysis and presenting the results of this analysis reports the extraction of Neanderthal mtDNA from layer 14 (Slon et al., 2017).

Jacobs argued that the cave was inhabited by Denisovans between 287 ± 4 (or at least 203 ± 14) and 55 ± 6 ka BP and later, while Neanderthals settled there in the range from 193 ± 12 to 97 ± 11 ka BP (Jacobs et al., 2019: 597). K. Douka and co-authors also came to the conclusion that Neanderthals settled in Siberia at the end of the warm stage of MIS 7 (about 190 ka BP) (2019: 644).

Researchers draw attention to "the presence of Neanderthal mtDNA before 175 ka" (Zavala et al., 2021: 403). Thus, Neanderthals started to inhabit the cave with Denisovans prior to 175 ka BP. I consider it necessary to cite another conclusion of the researchers: sediments of Denisova Cave, belonging to the chronological range of 130–100 ka BP (and maybe even a longer period, taking into account the hiatus in sedimentation recorded in the interval 97–80 ka BP), contain mtDNA and fossil evidence only of Neanderthals (Ibid.: 401).

The genetic age of the most complete mtDNA sequence of a Neanderthal from the Main Chamber (M65) is 140 thousand years (Ibid.: 401). The mother of Denisova 11 came from a population that was closely related to Neanderthals living in Europe (Vindija 33.19), rather than to the earlier Neanderthals from Denisova Cave. This points to the migrations of Neanderthals from the eastern and western parts of Eurasia about 120 ka BP (Slon et al., 2018: 113).

There are also other arguments of geneticists that confirm the Altai Neanderthal occupation of Denisova Cave in the late Middle Pleistocene. Ultimately, on the basis of genetic research, experts are convinced of the following: 1) Neanderthals began living in the cave prior to 175 ka BP; 2) Neanderthals and Denisovans inhabited the cave in succession, replacing each other; 3) there were long periods when the cave was inhabited exclusively by Altai Neanderthals; 4) the Middle Paleolithic industry of Denisova Cave could have been produced by Denisovans and Neanderthals.

All the four conclusions contradict the data derived during excavations in Denisova Cave and other Paleolithic sites in the Altai, as well as the available information about the origin of the Neanderthals, their material culture, and their dispersal in Eurasia in general. Let's consider some of the inferences.

Neanderthals gained their anatomical and genetic features in Western Europe no earlier than 200–150 ka BP. They produced the Mousterian industry, which is characterized (despite the great variability) by special techniques of primary reduction, particular types of tools, and methods of their manufacture. The dispersal of representatives of the Neanderthal taxon from Western Europe to the east of Eurasia proceeded slowly because of their small number. It took a long time to cover the huge distance of several thousand kilometers to the Altai. No remains of Neanderthals older than 100–120 thousand years have been discovered anywhere in Eastern Europe and West Asia so far. Perhaps the earliest Neanderthal fossil is a tooth from occupation layer 5c of Matuzka Cave in the Caucasus, but the geochronology of these deposits remains controversial. This particular layer has not been dated, but the age of the overlying layer 4d was determined to be 191 ± 29 thousand years (LU); the underlying layer 7 produced the IR-OSL date of 80.1 ± 8.3 ka BP (RLQG-2497-048); and layer 6, the date of 77.5 ± 6.1 ka BP (RLQG-2498-048) (Golovanova et al., 2022: 174). Consequently, the age of this fossil is not older than 100 thousand years.

Currently, no sites with the Mousterian industry or, even more so, Neanderthal anthropological remains older than 100 thousand years have been found either in Central Asia or the Urals, i.e., along the possible transit route of Neanderthal dispersal. The only find is the bone remains of a Neanderthal child from Teshik-Tash in Uzbekistan; these are younger than 70 thousand years old. Thus, the available archaeological data indicate that the assumption as to the settlement of Altai Neanderthals in Denisova Cave 175–150 ka BP is not supported by any evidence.

Archaeological materials convincingly prove that the early Middle Paleolithic industry discovered in the lowest archaeological layer 22 was produced by Denisovans. In the course of forty years of excavations at Denisova Cave, a huge amount of materials has been accumulated (Derevianko, Shunkov, Agadjanian et al., 2003; Derevianko, 2022; and others). The uniqueness of Denisova Cave lies in the fact that it contains 14 cultural layers in three "rooms": Main Chamber, East Chamber, and South Chamber. Culture-bearing layers yield different amounts of stone tools and bones of wild animals. The Upper Paleolithic layers also contain bone items and various kinds of personal ornaments made of stone, bone, and shells. Based on finds from culture-bearing layers, five stages of development of the lithic industry have been identified: early, middle, and late Middle Paleolithic, transitional Middle to Upper Paleolithic, and initial Upper Paleolithic. Most importantly, the entire set of evidence discovered in Denisova Cave is a homogeneous complex clearly demonstrating the development continuity of the industry at all the stages of the Middle Paleolithic, the Middle to the Upper Paleolithic, and the initial Upper Paleolithic. This well-developed industry was produced by the Denisovans. This population took part in the evolution of modern humans, and thus should be designated as *H.s. altaiensis* (Derevianko, 2012, 2019, etc.).

The continuity of the Denisova Cave lithic industry is evidenced by its homogeneity. There is no reason to assume that any representatives of another taxon (Altai Neanderthals) with a different industry lived in the cave. In the Middle Paleolithic, Denisovans and Neanderthals produced completely different lithic industries; hence, occupation of Denisova Cave by Neanderthals with a different industry would immediately lead to a change in the technical and typological complex of lithics. Therefore, the assumption as to the long-term residence of Neanderthals in the cave, and especially the identification of certain periods when only Neanderthals inhabited the cave, contradicts the archaeological evidence. Based on the results of DNA sequencing, the researchers conclude that in the chronological range of 130–100 ka BP Denisova

Cave was populated only by Neanderthals (Jacobs et al., 2019; Zavala et al., 2021). In the East Chamber of Denisova Cave, this interval is represented by cultural layers 12.3, 12.2, 12.1, and 11.4, which yielded the fossils of a Denisovan (Denisova 8), Altai Neanderthals (Denisova 9, Denisova 5) and a hybrid (Denisova 11); in the Main Chamber, by layers 17, 14.3, 14.2, and 14.1, which produced the mtDNA of Altai Neanderthals. Researchers of Denisova Cave have no doubt that the lithic industry of all the listed cultural layers is homogeneous, corresponds to the Denisova Middle Paleolithic culture, and is completely different from the Mousterian. All the archaeological materials indicate habitation of Denisova Cave exclusively by Denisovans with their Middle Paleolithic industry during that period.

Due to the fact that the results of genetic and archaeological studies reveal significant contradictions, I have proposed the following hypothesis (Derevianko, 2019, 2022). Denisovans and Neanderthals evolved on a single ancestral basis—*H. heidelbergensis*; representatives of this taxon with the Acheulean industry migrated from Africa to Eurasia ca 800 ka BP. The process of morphological and genetic development of Denisovans and Neanderthals took more than 500 thousand years. Moreover, in the course of dispersal in Eurasia, they interbred with late *H. erectus*. During the evolution of the genetic sequence, Denisovans and Neanderthals retained parts of their ancestral heritage for a long time. This is evidenced by the results of DNA sequencing of hominins from Sima de los Huesos in Spain, dating back to more than 400 ka BP: their mtDNA turned out to be close to Denisovan, and nuclear DNA to Neanderthal (Meyer et al., 2014, 2016). In the course of development of the genetic sequence, Denisovans could also retain part of their ancestral heritage for a long time.

Two finds are important evidence that forms the basis for the assumption of Neanderthal habitation in the cave: the phalanx of a toe (Denisova 5) from layer 11.4, and a small bone of a hybrid (Denisova 11) born from a Denisovan father by a Neanderthal mother, from layer 12.3. The occurrence of these fossils in culture-bearing layers 12.3 and 11.4 can be explained only by post-depositional disturbances of the stratigraphic sequence: these materials were shifted from the upper sediments to the underlying layers. This version is supported by the results of DNA sequencing of Denisova 11; according to them, the mother of this individual came from a population that was closer to Vindija 33.19 than to the Altai Neanderthals (Slon et al., 2018: 115). This suggests the possible interbreeding between a Denisovan father and a mother descended from the Chagyrskaya Neanderthal population, which migrated to Altai from Europe ca 60 ka BP (Derevianko, Markin, Kolobova et al., 2018). Furthermore, individual Chagyrskaya 8 is genetically most closely related to the mother of Denisova 11 (Mafessoni et al., 2020: 15133), which suggests its origin from the Chagyrskaya Neanderthals. According to geneticists, the split between the population to which the mother of Denisova 11 belonged and the population of Denisova 3 took place approximately 7 thousand years before the birth of the latter, i.e. ca 60–55 ka BP (Jacobs et al., 2019).

Individual Denisova 11 was a female, same as Denisova 5. It is very likely that the inhabitants of Denisova Cave accepted only women from the Chagyrskaya group of Neanderthals. The absence of the Mousterian industry in the cave in the period of 60–40 ka BP is a reasonable ground for this assumption. Small fossil fragments might have shifted from overlying layers into the underlying sediments, which is indicated by depositional stratigraphic changes. For example, researchers note that the Denisova 11 sample is very small in size and could have moved down from the overlying layer (Zavala et al., 2021).

Thus, all the above arguments allow us to draw the following conclusion: the identification of Altai Neanderthals in Denisova Cave on the basis of genetic studies is not supported by archaeological materials from Denisova Cave and other Middle Paleolithic sites of the Altai, as well as by the data of analyses of anatomy and genome of the Neanderthal taxon in Western Europe and the time of dispersal of Neanderthals in Eurasia.

Conclusions

The creative team of experts in four scientific disciplines—archaeologists, physical anthropologists, paleogeneticists, and geochronologists—is of utmost importance for solution of many issues of the evolution of the genus *Homo*, development of new taxa, dispersal of new human populations over Europe, and relationships between the indigenous population and the migrants. Interdisciplinary research requires that the involved scholars show respect for the findings of their colleagues, especially in discussion of controversial issues.

I have always acknowledged that many significant discoveries have been made owing to the creative collaboration between Svante Pääbo and his team and the Institute of Archaeology and Ethnography SB RAS. The most important breakthrough is the identification of a new taxon—Denisovans. Creative collaboration between scientists is important and effective; it can be even more fruitful if the data of archaeological research are fully taken into account in the discussion of final conclusions.

This article is based on the assumption that hominins were an open genetic system and were able to interbreed and give birth to fertile offspring throughout the almost three-million-year evolution of genus *Homo*. This idea is based on the existence of three hominin taxa at the final stage of the phylogenetic history of the genus *Homo*, 200–100 ka BP: early modern humans in Africa, *H. sapiens neanderthalensis* in Europe; *H. sapiens denisovan* in Central and Northern Asia. Representatives of these taxa interbred, and the hybrids were fertile. And this was not interspecific, but intraspecific assimilation. Consequently, throughout the entire evolutionary process from *H. erectus* to *H. sapiens sapiens*, hominins retained an open genetic system and ability to assimilate, and were able to produce fertile offspring.

From my point of view, the most debatable issues are the identification, on the basis of genetic studies, of the Altai Neanderthals, who migrated to Southern Siberia from Europe prior to 175 ka BP; and the possibility of alternate occupation of Denisova Cave by the Altai Neanderthals and the Denisovans. I have made my conclusions on the basis of archaeological realities, and I hope that future research will clear up these issues.

Neanderthals and Denisovans had a common ancestor—*H. heidelbergensis*, who was formed in Africa ca 900 (800) ka BP on the ancestral basis of late *H. erectus*. During the same period, *H. heidelbergensis* with the Acheulean industry migrated to the Near East in Eurasia. About 700 (600) ka BP, part of them, with the Acheulean industry, started settling in Europe; as a result of assimilation with the indigenous population (*H. antecessor*), natural selection, and regional specificity of hominins, 200–150 ka BP, a new taxon was developed—*H.s. neanderthalensis*.

1. At such an early time, Neanderthals could not have expanded so far east up to the Altai from the center of their origin in Western Europe, because morphological and genetic evolution of this taxon was finished no earlier than 200–150 ka BP. Moreover, no anthropological remains of Neanderthals nor archaeological sites with the Mousterian industry older than 100–120 thousand years have been discovered in Eastern Europe; and in the transit region of Central Asia, only the anthropological remains of a child from Teshik-Tash Cave younger than 70 thousand years have been found. The dispersal of Neanderthals over the Altai prior to 100 ka BP was possible only through charter flights connecting Western Europe with Denisova Cave.

2. Occupation of Denisova Cave simultaneously or alternately by Denisovans and Altai Neanderthals, moreover, habitation of the cave exclusively by Neanderthals ca 130–100 ka BP should have been supported by the occurrences in the cave of two lithic industries—the Denisovan Middle Paleolithic and the Neanderthal Mousterian, with different technical and typological characteristics. The stratigraphic sequence of Denisova Cave (layers 22–11) clearly shows the continuity in the development of the Middle Paleolithic industry from the early stage (300 ka BP) to the initial Upper Paleolithic of 55 (50)–45 ka BP. And there is absolutely no basis for the assertion as to the presence of the Mousterian industry in the stratigraphic sequence of the cave; hence, the possibility of habitation of the cave by representatives of any taxon other than Denisovans is excluded. Only with the emergence of Chagyrskaya Neanderthals in the Altai ca 60 ka BP, their assimilation with the indigenous population, the Denisovans, became possible.

3. The only possible explanation of the presence of Neanderthal mtDNA in the culture-bearing layers of Denisova Cave is the specific anatomical and genetic evolutionary development of the Neanderthal and Denisovan taxa. Both of them originated from a single ancestral basis—*H. rhodesiensis/heidelbergensis*. It was developed in Africa ca 900 (800) ka BP; then, ca 800 ka BP, part of this population (*H. heidelbergensis*), with the Acheulean industry, moved to the Near East (Gesher Benot Ya'aqov). After 700 (600) ka BP, a part of the *H. heidelbergensis* population, with the Acheulean industry, migrated to Europe and mixed with the indigenous *H. antecessor* population. In the process of assimilation of these two taxa, natural selection, adaptation to changing environmental and climatic conditions in Europe, new taxon *H.s. neanderthalensis* evolved over 500 thousand years, by 200–150 ka BP. The Neanderthal taxon gradually formed the increasing amount of derived Neanderthaloid morphological features and the Neanderthal genetic sequence. However, Neanderthals also retained some ancestral genetic heritage for a long time. This is confirmed by the results of mtDNA sequencing of hominin remains from Sima de los Huesos (Spain), dating back to

more than 400 ka BP. These hominins had Denisovan mtDNA (although Denisovans never settled in Europe) and Neanderthal nuclear DNA.

H. heidelbergensis from the Near East began to migrate to East Asia ca 400–350 ka BP. In Central Asia, they met the indigenous population—late *H. erectus*; a as a result of the assimilation of two taxa, natural selection, adaptation to changing environmental conditions, over the course of 300–200 thousand years, a new taxon emerged—*H.s. denisovan*. We don't know its morphology yet. However, it is known that part of the ancestral heritage was preserved in the emerging genetic sequence of the new taxon. This is precisely what was reflected in the Neanderthal mtDNA extracted from the cultural layers of the cave. In the sample from layer 15 of the East Chamber, in the Denisovan genomic sequence, 5 % of the Neanderthal genetic heritage was recorded (Slon et al., 2017: 3), which indicates that not only mtDNA, but also nuclear DNA of Neanderthals was preserved in genome of the emerging Denisovan taxon.

The proposed scenario for the genesis of the Denisovan taxon and the explanation of identification of the Neanderthal mtDNA in the deposits of Denisova Cave contradict the findings of genetic studies. But the available archaeological materials exclude the identification of any group of the Altai Neanderthals in the Altai apart from the Chagyrskaya Neanderthals.

The miniature bone, discovered in layer 12.3, of individual Denisova 11, whose father was a Denisovan and whose mother was a Neanderthal, is considered a confirmation of the assumption that Denisova Cave was inhabited by the Altai Neanderthals. The occurrence of this sample in layer 12.3 is explained by depositional stratigraphic disturbances. The age of the find is 50–60 thousand years. This age estimation confirms the assumption that the mother of the Denisova 11 hybrid was genetically close to Chagyrskaya Neanderthals, rather than to the Altai Neanderthals. Among the currently known Neanderthals, individual Chagyrskaya 8 is most closely related to the mother of Denisova 11 (Mafessoni et al., 2020: 15133). Neanderthals who migrated from Europe ca 60 ka BP interbred with Denisovans, and produced fertile offspring. The mtDNA sequenced from the female phalanx of the fourth or fifth toe (Denisova 5) from layer 11.4 of the East Chamber of Denisova Cave and compared with the mtDNA of other Neanderthals has shown the closest relationship with the mtDNA of a child from Mezmaiskaya-1 Cave (Caucasus) aged ca 60 thousand years. This individual possibly belonged to the late classic European Neanderthals, too. The fossil comes from the overlying layer, same as Denisova 11 does. On the basis of archaeological findings, we can conclude: the Altai Neanderthals identified by genetic studies are a myth, not a reality.

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The Origin of Biogenic Horizons in the Pleistocene Strata of Denisova Cave: Mineralogical and Geochemical Markers Help to Reconstruct the Sources of Matter

We outline the results of mineralogical and geochemical analyses of Middle Pleistocene sediments of layer 21 in the Main Chamber of Denisova Cave, Altai. The aim of the study was to reveal a set of mineralogical and trace element markers of the black-colored horizons or lenses and to distinguish them from other types of cave sediments. Results were matched with those relating to a similar set of markers of black-colored horizons in the Holocene part of the section in the East Chamber. Results indicate probable sources of organic and organogenic substances in layer 21. The preservation of geochemical marks was assessed for Pleistocene in comparison with Holocene strata, where those markers are distinct. Black-colored lenses in layer 21 resemble biogenic sediments from Holocene section of the East Chamber. Both layers are characterized by high contents of N-bearing organic matter, P, Zn, Cu, and Cd. In bulk samples from Holocene sediments, numerous fragments of chitin (insect exoskeletons) and patches of newly formed Ca and Ca-Mg phosphates were found. We conclude that these peculiar lenses consist mostly of guano from insectivorous bats, and had undergone deep biodegradation. All black-colored horizons and lenses studied in Denisova Cave have a similar set of geochemical markers and distinctly differ from the adjacent strata by their phase, macro- and trace element compositions.

Keywords: *Denisova Cave, Pleistocene, Holocene, mineralogical and geochemical markers, guano of insectivorous bats, biodegradation.*

Introduction

Paleolithic sites in rock shelters are among the most informative sources for studying ancient cultures of prehistoric man and his environment. As a rule, caves containing archaeological material are multi-layered and reveal complex stratigraphy of loose sediments. Artifacts and other evidence of anthropogenic activity are often embedded in the entire sedimentary sequence filling the karst cavity. The low rate of cave sedimentation promotes merging of different habitation horizons. Distribution of cave facies exhibits high variability, and stratigraphy is extra puzzled by the alternation and mutual penetration of different horizons. Sedimentation in various parts of a cave is controlled by the shape and size of the cavity and its location in the karst system. Post-depositional alteration of the sediments are under biological control. It is important to reveal stratigraphic markers for identification and correlation of cave sedimentary horizons.

Cave deposits bearing artifacts (cultural members) have been targeted by numerous studies realized by means of natural sciences' methods and approaches. This strategy provides good results in Denisova Cave (Altai), which is a key site in the studies of the prehistory of North and Central Asia.

Studies of culture-bearing cave deposits are a remarkable example of an interdisciplinary research. A new stage in the study of cave sedimentation and post-depositional alteration is connected with the discovery of diverse phosphate mineralization in the Holocene and Late Pleistocene sediments of the East Chamber and the reconstruction of their formation conditions (Shunkov et al., 2018; Sokol et al., 2022). Two main biogenic sources responsible for abnormally high phosphorus levels in the cave sediments (up to 33 wt% P_2O_5) have been identified: these are guano of insectivorous bats and bone remains. At certain stratigraphic levels of reference sections of Denisova Cave, phosphorus-rich sediments are accompanied by thin black or dark-brown horizons enriched in organic matter ($C_{org.}$ up to 32 wt%). Their specific appearance and composition allow one to use them as marker horizons for correlating cave sections. To prove the relevance of this approach, we should characterize these sediments, determine the ranges of the content of major and trace elements, and reconstruct the origins of each horizon in the excavated sections of Denisova Cave. Despite a similar appearance, these horizons could have different sources of organic matter (guano, charcoal, plant detritus, etc.).

The purpose of this study is to identify a set of characteristic mineralogical and geochemical features of the black-colored horizons, which distinguish them from all other types of sediments in Denisova Cave. Earlier, in the section of the East Chamber, the following strata were identified: those enriched with siliciclastic material (mainly clayey and sandy), proto-horizons of guano of insectivorous bats, chemogenic sediments that emerged in zones of intense phosphate leakage (caused by the biodegradation of organic component of guano), and layers with a notable amount of limestone' debris (Sokol et al., 2022). The mineralogical and geochemical characteristics of black-colored lenses from the base of layer 21.2 in the Main Chamber (Fig. 1) were established for the first time and compared with those of similar horizons in the Holocene part of the East Chamber section (Ibid.). This set of data allowed one to reconstruct depositional conditions and the most probable sources of organic and organogenic substances in the subunits of layer 21. The objectives of the work are also to estimate the states of preservation of geochemical marks in Pleistocene sediments and to compare them with Holocene ones, where these markers are obvious.

Materials and analytical techniques of studying cave sediments

The analyzed sedimentary column of the East Chamber is located in its entry zone, where the intensity and depth of penetration of phosphate solutions triggering the diagenetic alteration of primary sediments reach maximal values. Sediment samples were collected from layers 6–11.3, including two proto-horizons of insectivorous bat guano with relatively constant thickness—in layers 6 and 8. Cave deposits in the Main Chamber were collected from the column of layers 14–22.3.

The soil profile was sampled at the Ust-Karakol site, 1.8 km southeast of Denisova Cave. Six horizons of various colors in the section of the Late Pleistocene–Holocene sediments with a total thickness of 1.5 m were sampled. Samples were dried at 30 °C and then stored in air- and water-proof plastic bags.

The analytical work was carried out mainly at the Analytical Center for Multi-Elemental and Isotope Research (Sobolev Institute of Geology and Mineralogy (IGM), Novosibirsk, Russia). Identification and analysis of minerals, as well as recognition of organic matter, were carried out by the scanning electron microscopy (SEM) technique on a MIRA3-LMU scanning electron microscope (TESCAN ORSAY Holding) with an AZtec Energy Xmax-50+ microanalysis system (analysts M.V. Khlestov and V.A. Danilovskaya). The content of major elements was determined by the atomic emission technique on an atomic emission spectrometer with IRIS Advantage inductively coupled plasma (analyst N.G. Karmanova). Quantitative X-ray phase analysis of the sediments was carried out on a SHIMADZU XRD-6000 diffractometer (CuKα radiation with a graphite

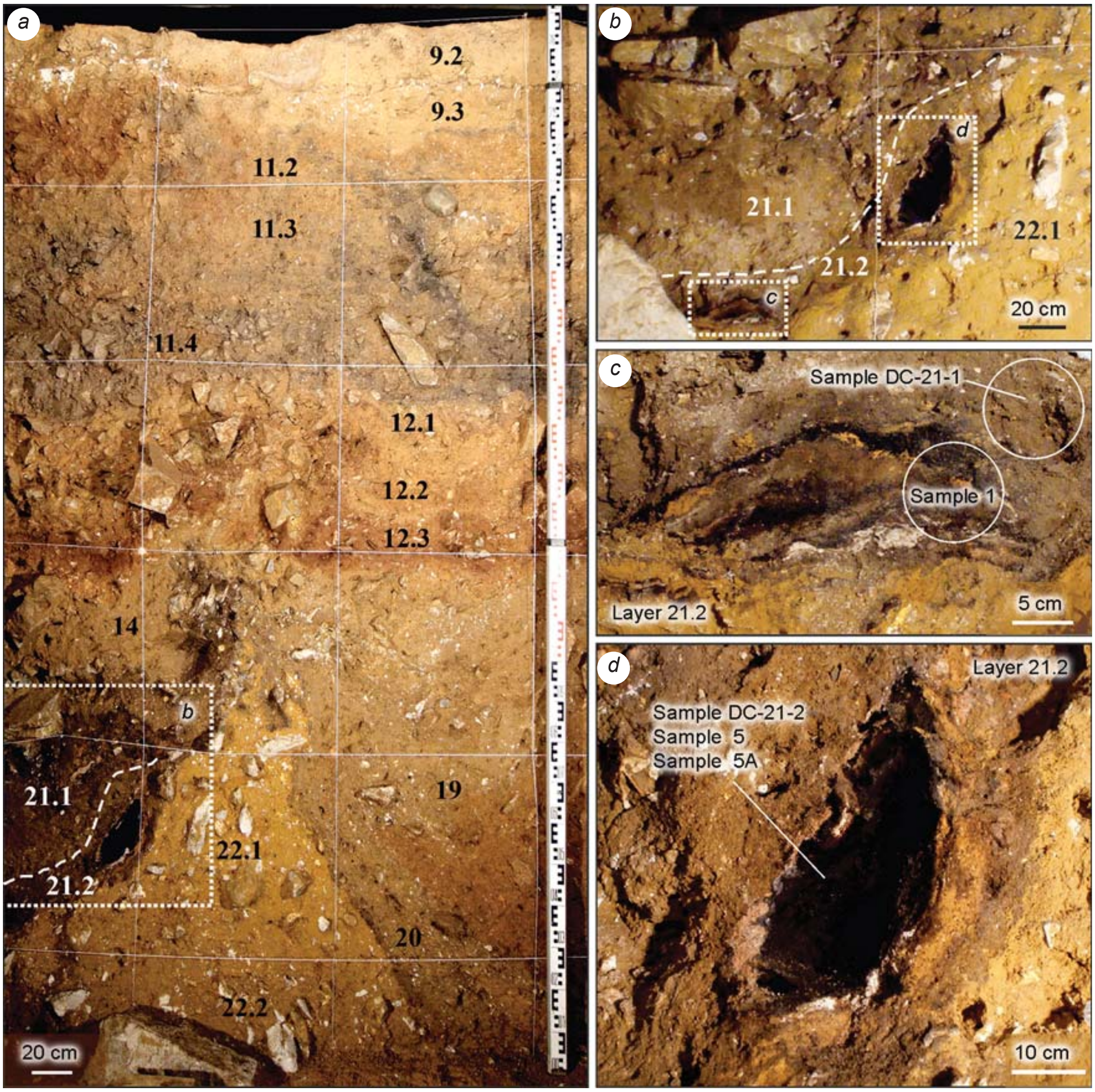


Fig. 1. Profile view of excavated Pleistocene sedimentary sequence (*a*) and black-colored lenses at the base of layer 21.2 with sampling locations (*b*–*d*) in the Main Chamber of Denisova Cave.

monochromator) at the South Ural Research Center of Mineralogy and Geoecology (SU FRC MG, Miass, Russia). SIROQUANT V.4 software was used to calculate the proportions of minerals.

The trace element composition of sediments was determined by inductively coupled plasma mass spectrometry (ICP-MS), using an Agilent 7700x spectrometer at the South Urals Federal Research Center of Mineralogy and Geoecology UB RAS, and a NexION 300S quadrupole inductively coupled plasma mass spectrometer (Perkin Elmer; analyst D.A. Kiseleva) at the Center for Collective Use "Geoanalyst" of the Institute of Geology and Geochemistry UB RAS. Elemental analysis (C, N, H, S) of organic matter was carried out at the Novosibirsk Institute of Organic Chemistry SB RAS using an EURO EA 3000 automatic CHNS analyzer according to the procedure (Fadeeva, Tikhova, Nikulicheva, 2008). For analytical details, see (Sokol et al., 2022).

Material characteristics of sediments of black-colored lenses from layer 21.2

In the East Chamber, thin black and brown horizons, which replaced highly degraded guano layers, are best preserved in the Holocene part of the section, on top of layers 6 and 8.

These horizons are contrast to adjacent layers in phase, macro- and microelement compositions: they are highly enriched in C, N, P, Zn, and Cu, depleted in silicate matter (Si, Ti, Al, Mg, K, Na), and contain numerous fragments of the chitin exoskeleton of insects (Ibid.). These features are best pronounced in the black-colored horizon on top of layer 8 (sample 10, which was used in this work as a reference one). In the Main Chamber, black-colored lenses of similar appearance are located at the base of the Pleistocene sequence—layer 21.2 (Fig. 1). High content of $C_{org.}$ was registered in these sediments by Nikolaev (1994), who assumed that the main source of organic matter was aerophilic lower plants.

The Pleistocene sequence in the Main Chamber consists of three units. The lower part of the section, including sublayers of layer 22 up to 2 m thick, is composed of heavy reddish-yellow to dull light yellow loams. The top of the layer has the OSL-date of 287 ± 41 ka BP (Jacobs et al., 2019). The medial part (layers 21–11 up to 2 m thick) is composed of multicolored loams with abundant fragments of limestone. These sediments were deposited after a prolonged hiatus. The medial layers are separated from layer 22 by a distinct horizon of dark-colored loam—layer 21 with a variable content of dispersed carbonaceous matter and black-colored lenses at the base, where the content of $C_{org.}$ reaches 32.3 wt% (absolute maximum for the sediments in Denisova Cave, Fig. 1, *b–d*, Table 1). The OSL-age of layer 21 is estimated as 250 ± 44 ka BP (Ibid.). The upper part of the section is layer 9 composed of light loess-like loams up to 0.5 m thick.

Layer 21.2, of varying thickness, is subdivided by color into brown and black horizons. According to XRD and SEM analyses, its composition is dominated by

Table 1. **Chemical composition of Pleistocene (layers 9–11.3) sediments in the East Chamber, Pleistocene (layers 14–22.3) and Holocene (layers 6–8) sediments in the Main Chamber in Devisova Cave, wt%**

Layer	Sample	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	SO_3	LOI	TOTAL	$C_{org.}$	$N_{org.}$
East Chamber																
6	15*	4.34	0.03	0.87	0.39	0.09	0.44	29.22	0.07	0.51	32.31	1.77	29.93	99.97	7.68	2.17
7	12**	7.28	0.13	1.91	0.88	0.05	0.85	37.55	0.10	0.87	26.53	4.76	19.05	99.96	0.69	<0.3
7	11	15.83	0.22	4.38	1.67	0.05	0.72	34.23	0.32	1.37	33.27	1.14	6.76	99.96	0.81	0.33
8	10*	8.17	0.11	1.93	0.89	0.02	0.34	21.66	0.12	0.53	12.94	2.14	51.04	99.89	27.84	7.88
8	9**	41.45	0.59	9.82	4.07	0.15	0.39	12.12	0.72	2.53	10.92	0.55	16.59	99.91	4.77	0.95
9	7	50.74	0.64	12.12	4.81	0.03	0.16	4.38	0.72	5.28	10.89	0.15	10.19	100.10	1.09	<0.3
9	6	21.20	0.33	10.21	4.59	0.03	0.05	7.57	0.47	5.62	31.99	0.13	17.72	99.89	1.79	1.52
9	4	35.75	0.48	9.13	3.56	0.18	0.35	19.13	0.59	2.10	16.41	0.45	11.82	99.96	1.83	0.42
11.1	3	25.71	0.36	7.26	2.67	0.14	0.06	27.55	0.39	1.54	19.32	0.92	13.82	99.74	2.49	0.52
11.2	2	31.87	0.43	8.30	2.88	0.08	0.87	25.77	0.42	1.54	12.49	0.73	14.59	99.96	3.43	0.68
11.2	1	33.96	0.43	7.88	3.64	0.06	1.01	24.29	0.40	1.79	11.29	0.92	14.33	99.97	3.50	0.68
11.3	1	23.76	0.33	5.89	2.68	0.06	1.10	27.32	0.79	1.17	7.79	0.88	27.67	99.45	12.07	1.16
11.3	2	24.01	0.33	6.06	2.89	0.06	1.03	30.81	0.88	1.13	11.80	2.57	17.85	99.46	5.43	0.59
Main Chamber																
14	1	34.67	0.46	8.31	3.77	0.09	1.48	24.95	1.05	1.76	6.73	0.95	14.96	99.20	–	–
19	2	35.35	0.48	8.79	3.98	0.08	1.66	22.50	1.07	1.76	6.17	1.33	16.21	99.38	3.97	0.38
20	2	30.51	0.43	7.73	3.48	0.06	1.40	28.87	0.75	1.51	2..44	0.23	22.34	99.74	2.31	0.41
21.1	1	39.42	0.55	9.71	4.30	0.08	1.65	20.17	1.04	1.94	4.49	0.88	15.03	99.25	2.54	0.34
21.2	DC-21-1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
21.2	1**	20.04	0.25	4.59	2.18	0.08	1.15	29.31	0.80	1.27	17.17	1.56	21.42	99.82	8.29	1.80
21.2	DC-21-2*	6.91	0.08	1.44	0.78	0.10	0.73	23.85	0.59	0.49	12.31	1.18	50.03	98.47	32.27	6.34
21.2	5*	9.64	0.12	2.30	1.17	0.09	1.08	29.42	0.80	0.69	17.23	1.05	35.94	99.52	–	–
21.2	5A*	14.28	0.18	3.36	1.67	0.09	1.40	32.64	0.94	0.99	19.84	1.02	22.87	99.28	–	–
22.1	3	43.42	0.64	12.23	5.63	0.10	1.66	16.11	0.48	2.20	2.03	0.86	14.73	100.10	2.95	<0.3
22.2	3	52.34	0.81	15.03	6.94	0.13	1.85	7.34	0.25	2.70	1.85	0.65	9.33	99.23	1.95	<0.3
22.3	1	56.57	0.82	15.03	6.79	0.17	1.83	5.56	0.19	2.77	1.42	0.49	8.09	99.73	0.86	<0.3

*Black-colored horizons with high content of organic matter.

**Brown horizons containing organic matter.

dispersed organic matter and Ca phosphates of different degrees of crystallinity (the total content of X-ray amorphous matter reaches 40 %), while the amount of layered silicates and quartz does not exceed 7 % and 4 % of the total content of crystalline compounds, respectively.

In black lenses of layer 21.2, bulk contents of $C_{org.}$ and $N_{org.}$ reach 32.3 wt% and 6.3 wt%, respectively (sample 21-2). Small lenses of compressed organic matter, which are Zn- and N-rich (N – up to 4 wt% and Zn – 2000–3700 ppm), are disseminated in the finely dispersed organic matter (Fig. 2). Numerous fragments of insect exoskeletons were found in the black-colored lenses. Chitin particles are usually compressed, and their surface relief is smoothed or totally obliterated, in contrast to similar material from the black-colored horizons of the Holocene part of the section in the East Chamber (Fig. 2, *b–f*). However, in the older sediments, chitin also kept geochemical markers (enrichment in nitrogen and zinc) typical of the samples of younger cave horizons and modern insects (Forest insects…, 2010; Wurster et al., 2015). Plant detritus was not found via detailed SEM examination of the black-colored lens, which refutes the previously assumption that plants were the source of $C_{org.}$ in these sediments (Nikolaev, 1994).

The black-colored sediment of layer 21.2 mainly consists of organic and biogenic materials, with minor admixture of clayey and sandy components. In contrast to the Holocene sediments from the East Chamber section with abundant crystals of Ca, Mg, Fe, Al, K phosphates (Shunkov et al., 2018; Sokol et al., 2022), the sediments of layer 21.2 are dominated by Ca and Ca-Mg phosphates (crystalline and semi-amorphous) and partially preserved bone detritus. Newly formed Ca phosphates occurred as clots, flakes, and biomorphic forms (Fig. 3). The dominant carbonate-bearing apatite is the so-called dahllite ($Ca_5(PO_4,CO_3)_3(OH)$), whose amount exceeds 40 % and approaches its absolute maximum revealed in the black-colored horizon of the East Chamber (layer 8, sample 10, ~50 % dahllite). The low degree of crystallinity of such apatite is confirmed by IR spectroscopic and X-ray examination (Fig. 4). The surface of chitin fragments and plates of compressed organic matter is sometimes encrusted with tiny crystallites of apatite and whitlockite (up to 0.5–1.0 μm) (see Fig. 2, *a*, *d*). Bone detritus, often corroded, probably by organic acids was also revealed in black-colored lenses. Recrystallization of bone apatite has occasionally occurred (Fig. 5, *b*). The content of calcite in bulk samples of the sediments of layer 21.2 does not

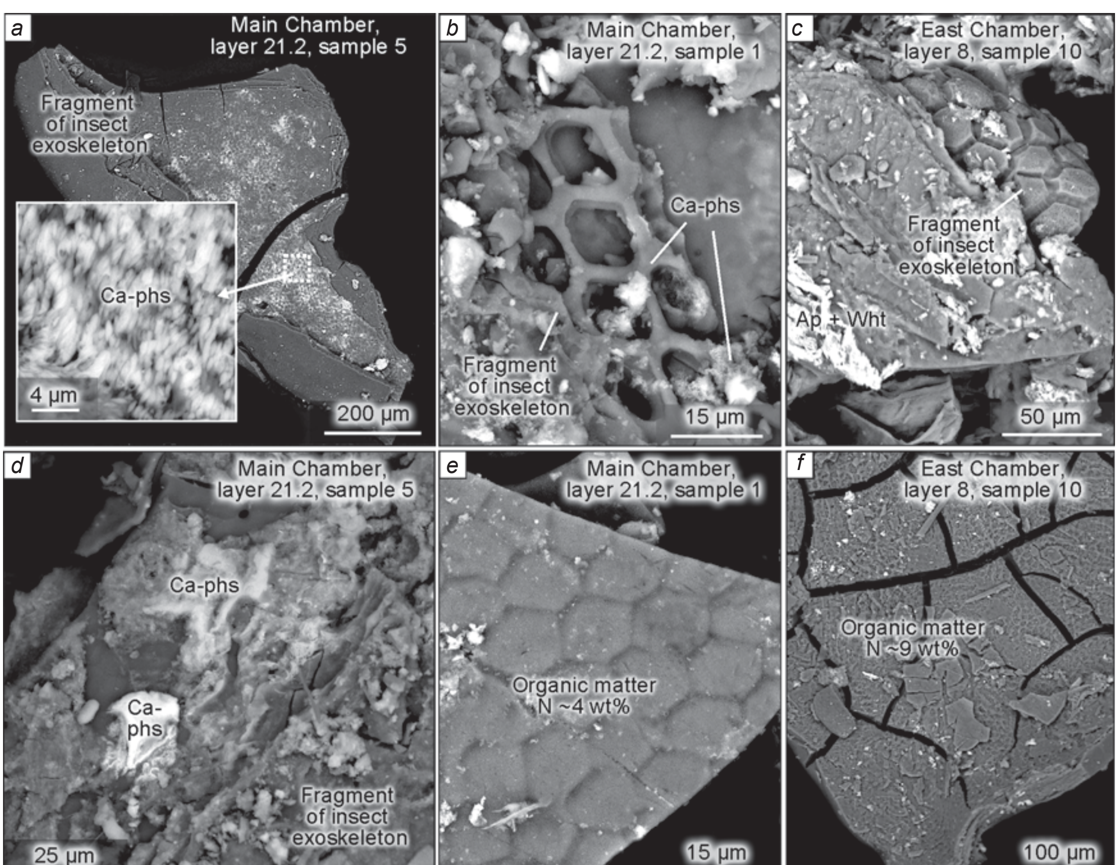


Fig. 2. Morphological diversity of organic remains from black-colored horizons of the sedimentary sequence of the Main Chamber (*a*, *b*, *d*, *e*) and the East Chamber (*c*, *f*) of Denisova Cave. Back-scattered electron (BSE) images.

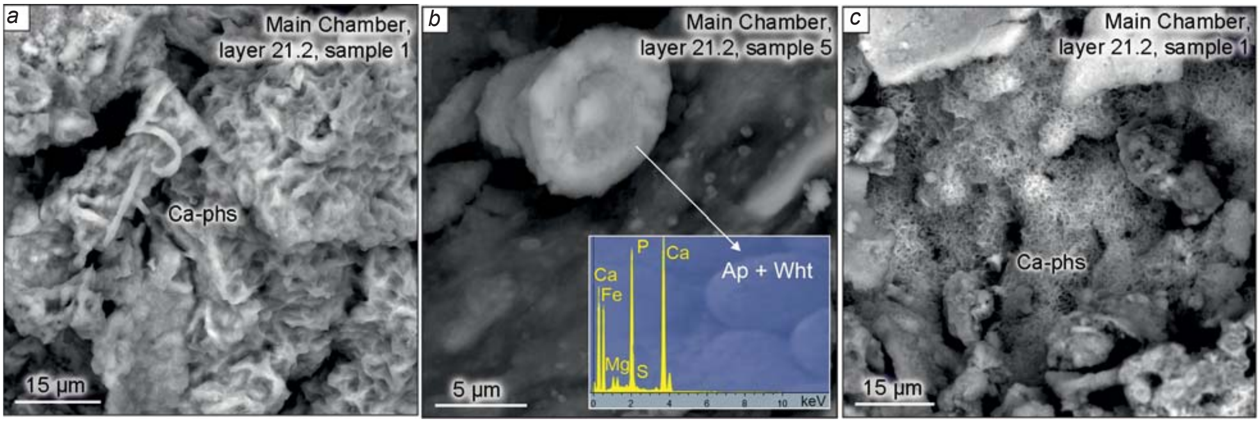
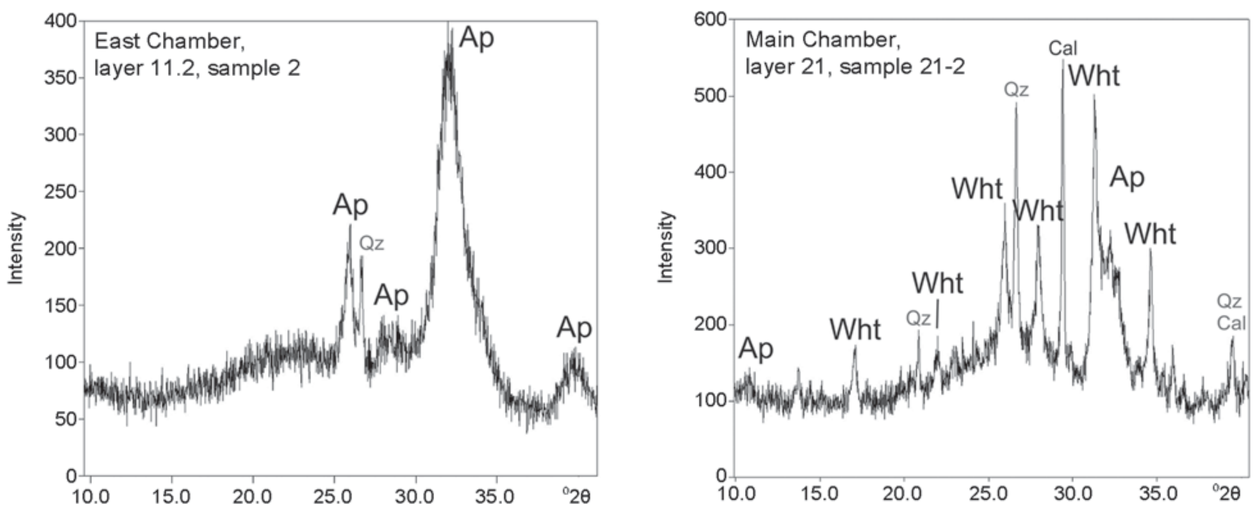


Fig. 3. Biomorphic segregation of Ca and Ca-Mg phosphates of low crystallinity (Ca-phs). Back-scattered electron (BSE) images. Ap – carbonate-bearing apatite – dahllite, Wht – whitlockite.



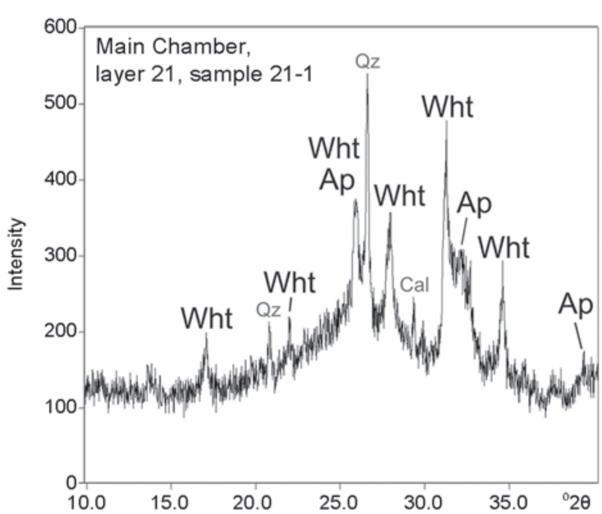


Fig. 4. Fragments of X-ray diffraction patterns of Ca and Ca-Mg phosphates of low crystallinity. The diffraction patterns show sharp peaks of well-crystallized whitlockite (Wht) and diffuse reflections of apatite (Ap). An intense halo indicates the predominance of the X-ray amorphous component. Cal – calcite, Qz – quartz.

exceed 6 %. The preserved small fragments of limestone are corroded and partially replaced by Ca phosphates.

Another horizon of layer 21.2 (sample 21-1) varies in thickness and consists of brown sandy loam with numerous whitish clots of Ca phosphates, and small fragments of partially replaced limestone and newly formed micritic calcite (Fig. 5, *c*). The sediment contains abundant bone detritus, which is largely avoided chemical etching and recrystallization. The surface of bone fragments are sometimes encrusted with dendrites of Mn (oxy)hydroxides. Infrared spectroscopy indicates that these sediments, as well as the material of the black lenses (sample 21-2), contain complex organic compounds, including nitrogen-bearing ones, which are most likely the products of destruction of the original protein compounds.

In the brown sediments of layer 21.2, single fragments of charcoal (up to 4 mm in size) with well-preserved tissue structures were found along with N-bearing structureless organic matter (Fig. 5, *a*). Owing to the fragility of charcoal under mechanical stress, it was most likely crushed to powder and dispersed in the host sediment;

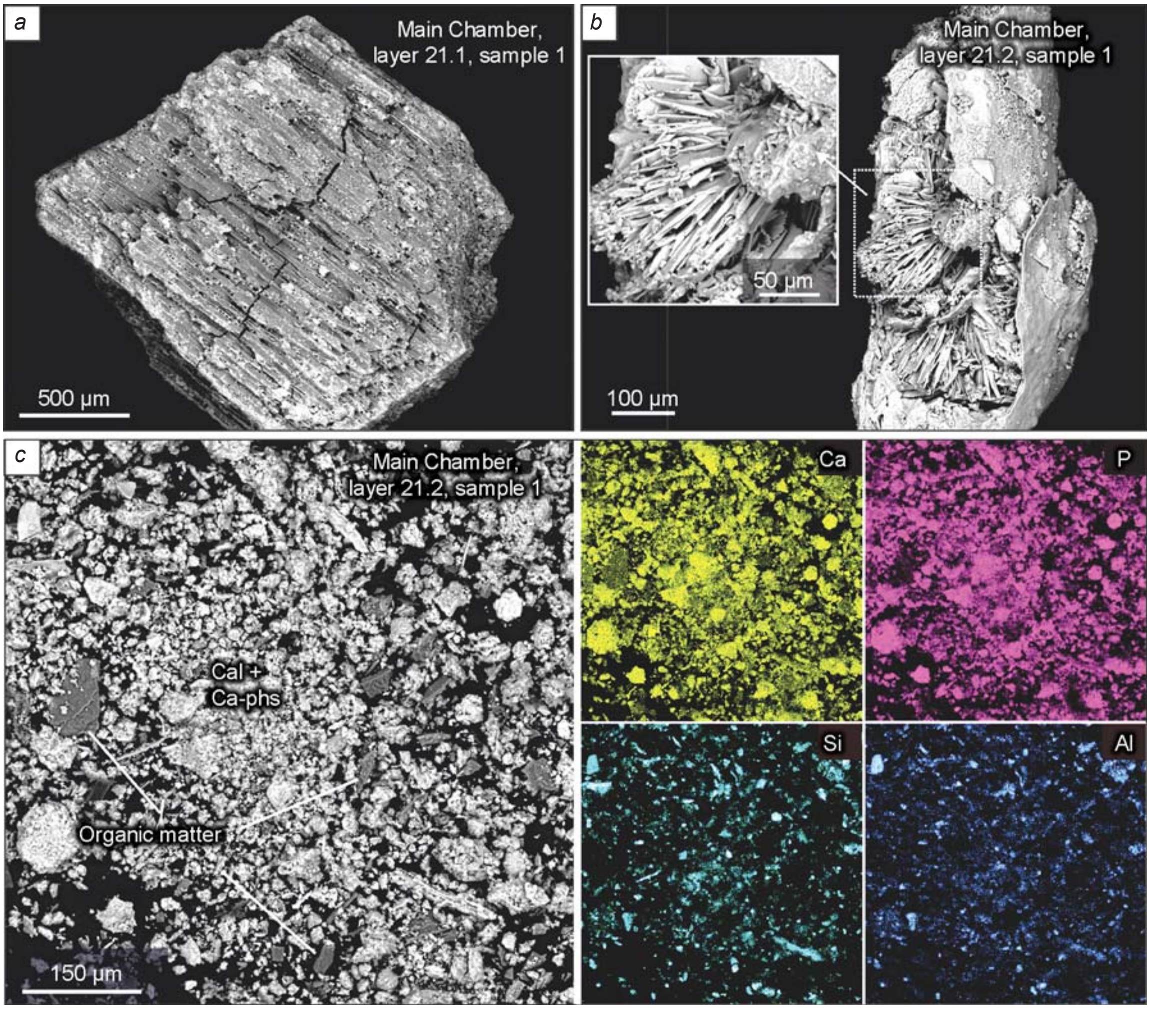


Fig. 5. Samples from layer 21 of the Main Chamber of Denisova Cave.
a – fragment of charcoal from layer 21.1; *b* – recrystallized bone fragment from layer 21.2; *c* – the ratio of organic matter, Ca phosphates, and siliciclastic material in the bulk sample of the brown horizon of layer 21.2. Images in back-scattered electrons (BSE) and element (Ca, P, Si, Al) maps.

therefore, its larger fragments have been rarely found. However, the contribution of this component to the total $C_{org.}$ budget of layer 21.2 is beyond doubt and should be taken into account in the future.

The overlying sediments of layer 21.1 (sample 1) contain ordinary concentrations of both $C_{org.}$ (2.5 wt%) and N (0.3 wt%), which are also typical of light-colored and organic-poor sediments of the Denisova Cave sedimentary sequence (Table 1).

Chemical composition of layer 21 in the Main Chamber and layer 8 in the East Chamber of Denisova Cave, comparatively

Comparison of major and trace element composition of the sediments of the upper part (layers 6–11.3) of the East Chamber sequence and lower and middle parts of the Main Chamber sequence (layers 14–22.3) (Table 1, 2) shows that reference sample 10 from layer 8 in the East Chamber, representing the bat-guano protohorizon, has unique chemical composition. It is characterized by the highest value of loss on ignition (LOI) – 50.5 wt%, which is mainly ensured by nitrogen-rich organic matter (in wt%: C – 27.9; N – 7.9; H – 1.9; S – 0.4); low content of all major elements connected with the sandy-clayey component of the sediment (SiO_2, TiO_2, Al_2O_3, Fe_2O_3, Na_2O, K_2O); moderate amount of phosphorus (~13 wt% P_2O_5); and abnormally high concentrations of essential trace elements (Zn, Cu, and Ni) involved in the metabolism of mammals.

The matter of black-colored lenses from layer 21.2 of the Main Chamber is generally similar to the one described above. The difference in the contents of major components (SiO_2, Al_2O_3, Fe_2O_3, K_2O, P_2O_5), as well as the LOI value in the compared sediments, does not exceed 20 rel%, and that of the concentrations of minor components (TiO_2, MnO, MgO, Na_2O, SO_3), 50 rel%. Contents of both $C_{org.}$ (27.8 and 32.3 wt%) and $N_{org.}$ (7.9 and 6.3 wt%) in the black-colored horizons and lenses are the largest and an order of magnitude higher than those in other types of sediments in Denisova Cave—sandy-clayey, calcareous, and phosphate (Sokol et al., 2022). The amounts of zinc and copper, the accumulation of which in cave sediments is connected with insect remains (proteins and chitin) (Wurster et al., 2015), reach their maximum values in these layers (~1000–3000 ppm Zn and ~200–1800 ppm Cu) (Table 2). On the contrary, concentrations of microelements connected

Table 2. **Concentrations of trace elements in bulk sediment samples from the Main Chamber and East Chamber of Denisova Cave, and from the soil profile at Ust-Karakol, ppm**

Layer	Sample	Zn	Cd	Cu	Ni	Co	Mo	U	Sc	Ga	Zr	Nb
Denisova East Chamber												
6	15*	822	1.43	235	28.3	7.40	5.76	1.36	7.57	6.33	45.8	5.43
7	12**	2553	1.68	507	7.43	1.94	11.5	0.37	2.48	2.34	15.7	1.78
7	11	3189	2.55	497	12.9	3.31	14.8	0.75	4.17	4.30	18.3	3.81
8	10*	3030	6.85	1837	204	29.5	6.54	1.64	2.05	2.22	8.64	1.61
8	9**	835	1.48	235	93.6	25.9	15.3	2.08	11.4	11.0	88.7	7.69
9	7	579	0.54	54.8	27.9	8.29	7.61	2.49	15.0	13.5	102	10.6
9	4	663	0.79	83.1	39.3	11.1	13.3	1.64	9.12	9.17	43.9	7.04
11.1	3	239	0.51	53.8	26.4	8.28	15.1	1.14	2.06	8.87	4.93	4.37
11.2	2	257	0.39	44.2	25.6	8.43	5.44	1.13	8.94	7.96	28.7	1.71
11.2	1	254	0.40	42.5	27.0	8.82	6.06	1.14	9.28	6.31	32.7	1.94
Denisova Main Chamber												
14	1	140	0.40	34.0	26.0	8.02	1.80	1.10	5.00	7.04	52.0	5.03
19	2	196	0.35	48.3	30.7	10.6	1.66	1.78	9.10	11.0	58.2	5.80
20	2	423	1.05	147	63.7	22.2	2.37	2.68	13.9	15.8	81.7	7.10
21.1	1	313	0.42	89.0	41.1	12.3	1.95	1.92	11.0	13.4	69.7	7.30
21.2	DC-21-1**	1230	0.88	108	13.0	3.47	2.12	0.82	1.03	1.20	1.93	0.20
21.2	1**	1210	1.39	408	48.4	18.3	7.03	1.39	3.60	4.65	7.20	2.00
21.2	DC-21-2*	2009	2.05	498	49.8	8.87	3.53	0.85	1.47	1.39	2.17	0.27
21.2	5*	800	1.04	310	27.0	9.04	3.20	1.10	0.23	0.90	2.63	1.01
21.2	5A*	900	1.33	270	30.2	7.99	7.00	1.02	1.30	2.30	10.0	2.00
22.1	3	182	0.37	65.3	49.8	15.3	1.36	2.10	13.1	14.9	80.8	5.30
22.2	3	216	0.43	70.8	56.5	18.0	2.17	2.36	16.6	18.5	101	5.60
22.3	1	168	0.47	61.8	52.4	22.5	3.39	2.60	15.3	17.2	100	8.60
Ust-Karakol												
UK-1	1	74.0	0.17	27.8	40.0	15.3	0.98	1.57	13.4	15.9	76.8	9.60
UK-2	2	78.0	0.22	29.0	45.2	16.5	1.02	1.59	13.9	17.3	77.3	10.0
UK-3	3	74.0	0.17	28.2	43.4	14.9	0.91	1.49	12.0	15.4	73.2	8.90
UK-4	4	74.0	0.20	30.9	43.8	15.0	0.99	1.55	12.2	15.8	75.9	9.10
UK-5	5	71.0	0.35	29.7	41.2	15.7	1.24	1.66	13.3	15.7	77.5	9.80
UK-6	6	73.0	0.20	27.8	44.6	15.3	1.22	1.82	12.2	15.8	87.6	10.2
	X_{avg}	74.2	0.22	29.1	42.7	15.5	1.03	1.57	13.0	16.0	76.1	9.48
	S	2.28	0.07	1.23	2.02	0.59	0.14	0.12	0.80	0.67	4.94	0.51

*Black-colored horizons with high content of organic matter.

**Brown horizons containing organic matter.

X_{avg} – average content of elements (n=6); S – standard deviation.

with sandy-clayey matter are the lowest (0.3–1.6 ppm Nb; 1.5–2.1 ppm Sc; 1.3–2.2 ppm Ga), which independently confirms the small contribution of the siliciclastic component to biogenic black sediments.

The normalization procedure is widely used to analyze the distribution of macro- and microcomponents in sedimentary rocks, reconstruct the sources of matter, and identify typical anomalies (Interpretatsiya…, 2001). In this case, the vertical axes of the graphs show the ratios between the absolute concentration values in the sample and in some reference composition (Fig. 6). To reveal trace element features of cave sediments, their compositions are commonly normalized on the corresponding concentration of elements in the soil of adjacent areas (the so-called background concentrations). In this study, the geochemically homogeneous soil profile at the site of Ust-Karakol was used as the background (Table 2).

The normalizing procedure for major components reveals a sharp enrichment of all black-colored and brown (biogenic) cave horizons with phosphorus (60–100-fold) and sulfur (up to 10-fold), with minimal input of sandy-clayey matter (coefficients for Ti, Al, Fe, Na, K are in the range of 0.1–0.5) (Fig. 6, *a*). The normalization also allows us to subdivide indicator trace elements into two groups with contrasting distribution in the studied cave sediments. Relative to the regional background (soil), all black-colored and brown biogenic cave horizons are consistently enriched in Zn (10–30-fold), Cu (4–20-fold), and Cd (4–10-fold), with a high positive correlation between Zn and Cd (R^2 = 0.83, n = 23) (Fig. 6, *a*). The level of Mo accumulation in these sediments reaches 2–7-fold. However, since other types of cave sediments show a similar level of Mo enrichment, this element was excluded from the list of reliable indicators of guano protohorizons. A similar conclusion was also made regarding other biophile elements, such as Ni and Co, which contents are comparable in different types of cave sediments. Uranium, which generally shows high accumulation levels in organic and bone materials (Tribovillard et al., 2006), in studied cave sediments is mainly connected with siliciclastic matter, and its content in black-colored horizons is lower than in soils (Table 2; Fig. 6, *b*). For these reasons, Ni, Co, and U were also excluded from the list of indicators of biogenic sedimentation in the cave.

The second group of microelements includes Sc, Zr, Nb, and Ga, which are typomorphic for sandy-clayey material. All black-colored and brown horizons show a steady depletion of these elements, and the relevant accumulation coefficients fall up to 0.02–0.3.

The accumulation trends of biophile elements (P, S, Zn, Cu, Cd, Mo) in loamy sediments (contaminated by limestone debris) from the lower part of the Main Chamber section coincide with those in black-colored horizons. However, the accumulation coefficients in the sediments

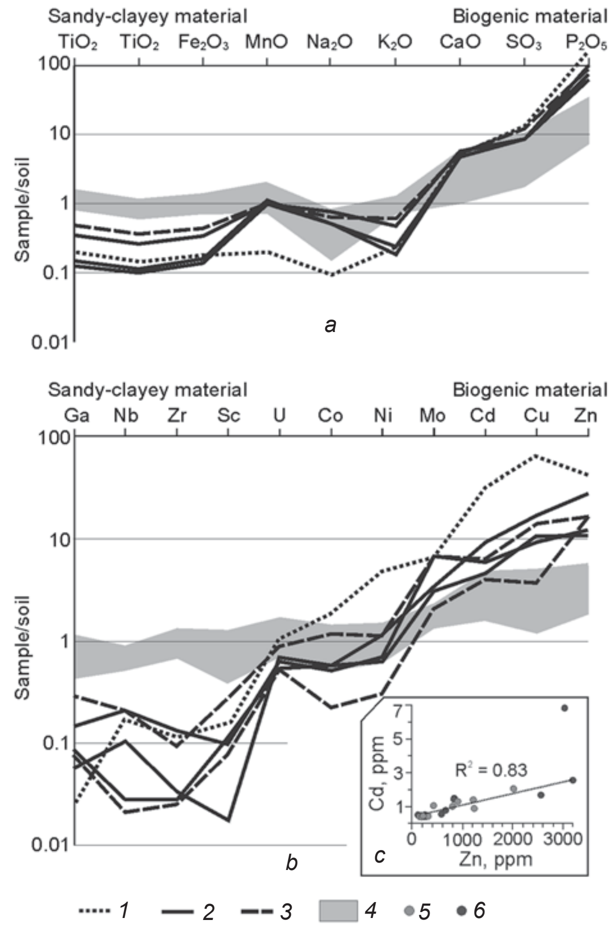


Fig. 6. Graphs of distribution of major (*a*) and some trace elements (*b*) in Pleistocene sediments of the Main Chamber of Denisova Cave (concentrations were normalized to the average composition of soils in the adjacent territory; the absolute elements concentration see in Tables 1 and 2). The inset shows the distribution of Zn and Cd in bulk sediment samples with high content of organic matter.
1 – material from layer 8 (sample 10) of the East Chamber (reference sample); *2* – black-colored lenses in layer 21.2 of the Main Chamber; *3* – brown sediments from layer 21.2; *4* – graph of other sediment types in the section of Main Chamber (layers 22.3–14); *5* – sediments from the section of the Main Chamber; *6* – sediments from the section of the East Chamber.

of the Main Chamber are notably lower (P 7–35-fold, S 2–10-fold, Zn 2–6-fold, Cu and Cd up to 5-fold), as also the content of organic matter (Table 2; Fig. 6, *a*, *b*).

In general, the protohorizons of guano of insectivorous bats in Denisova Cave reveal a common set of mineralogical and geochemical features:

abnormally high accumulation levels of biophile elements (C, N, P, S, Zn, Cu, Cd);

presence of chitin fragments, compressed N-bearing organic matter, and newly formed phosphates Ca (± Ca-Mg); and

predominance of organic and biogenic amorphous matter over the siliciclastic component.

Thus, a set of revealed features makes it possible to reliably identify this type of biogenic sedimentation in the sequence of Denisova Cave.

Discussion

Recently, biogeochemists and archaeologists have been jointly investigating chemical processes that change the composition of sediments, both exposed on the surface and buried at shallow depths (Birkeland, 1999; Bohn, Myer, O'Connor, 2002; Retallack, 2001; Shahack-Gross et al., 2004; Karkanas, 2010; Wurster et al., 2015). These studies are basically important for understanding soil-forming processes, influenced by environmental factors and microbial activity. When studying cave sedimentation, one should also take into account the factors of vital activity of birds and mammals, as well as human activities (Prirodnaya sreda…, 2003; Shahack-Gross et al., 2004; Karkanas et al., 2002; Karkanas, 2010; Wurster et al., 2015).

Biochemical (mainly bacterial) degradation of insectivorous bat guano is one of the principal factors of post-depositional alteration of archaeological caves' sediments. Large colonies of chiropterans use caves as shelters, and breed there only in the periods of human non-occupation (abandonment). Therefore, thick guano horizons are considered as indicators of the periods of absence or rare appearance of people in the caves (Shahack-Gross et al., 2004; Karkanas, 2010; Wurster et al., 2015).

When a colony of bats leaves a cave, the organic component of the guano degrades quickly—during tens of years maximum. The rate of degradation is the highest in warm climates and high humidity in a cave. The initial amount of P_2O_5 in guano horizons is very high (from 12–15 to 34–37.5 wt%) (Wurster et al., 2015). Solutions of organic acids (pH=3–5) that are formed during the biodegradation of guano, gradually wash out phosphorus from the remains of insects and decomposing soft tissues and bone material. Percolating down, these solutions interact with various components of sediments, and dissolve bone material, which is the second important source of phosphorus in cave sediments (Berna, Matthews, Weiner, 2004). As a result, in the sediment column below the degrading guano horizon, two coupled profiles are occurred: geochemical and mineralogical ones (both phosphate). They reflect the gradual neutralization of the initially acidic solutions (Onac et al., 2002; Shahack-Gross et al., 2004; Onac, Forti, 2011; Wurster et al., 2015). The Holocene section of the East Chamber of Denisova Cave is a striking example of a complete chemogenic-sedimentary sequence of this type (Shunkov et al., 2018; Sokol et al., 2022).

Based on new analytical data set (similarity of phase, macro- and trace element compositions, as well as the presence of insect chitin fragments) (see Tables 1, 2; Fig. 2, 6) and on analogy with the horizons earlier studied in the Holocene part of the East Chamber sequence (Ibid.), black-colored lenses from layer 21.2 in the Main Chamber can be identified as the remains of a proto-horizon of insectivorous bat guano. Notably, these biogenic sediments are characterized by a common set of geochemical markers, namely, abnormally high levels of Zn and Cu accumulation, and sharply reduced Sc, Zr, Nb, and Ga contents.

Because layer 21.2 was heavily damaged due to viscoplastic deformations, it impedes reasonable estimations of size of a bat colony or the duration of bat habitation in the Main Chamber. The mineral composition of the black-colored lenses indicates relatively small size of the bat colony populating this part of the cave during the time of accumulation of the layer. Coexistence of carbonate-hydroxyapatite with calcite in layer 21.2 are typical of the phosphate profile, which acid-generating potential was almost exhausted. The relatively good preservation of fine bone detritus also indicates the moderate alkalinity of the contacting solutions (Berna, Matthews, Weiner, 2004; Shahack-Gross et al., 2004). In the considered case, organic acids were gradually neutralized by the limited resource of limestone debris accumulated in layer 21.2. The mentioned facts point to the conclusion that the amount of organic acids, and therefore the guano that produced them, was insignificant.

In the sedimentation history of Denisova Cave, layer 21.1 is of particular importance; it marks the earliest time of regular human habitation of the cave, which affected the composition of the cave taphocenosis (Prirodnaya sreda…, 2003). From this very stratigraphic level, a sharp reduction of both the diversity of bat species and the number of bat remains began (from ~50 to ~15 % of the total amount of small vertebrates) (Ibid.). These data suggest that during the time interval corresponding to the boundary between layers 22 and 21, the habitat of cave-dwelling bats changed to unfavorable. The sharp decrease in the number of Chiroptera remains at this period is in agreement with general changes in the structure of the cave taphocenosis: the number of forest voles and arboreal forms of rodents noticeably decreased, and the proportion of steppe and meadow species increased, which was due to the total effect of climatic factors (Ibid.) and growing anthropogenic impact. Increased human activity in the Main Chamber during the period of the layer 21.1 accumulation is also supported by numerous signs of fire residue (fragments of charcoal and micritic calcite) that are evidences of regular fire use inside the cave.

Conclusions

Each type of sediment is characterized by individual chemical hallmarks, which are controlled by the similarity of matter sources and sedimentation regime (Interpretatsiya…, 2001). However, post-depositional processes (diagenesis, dissolution, and leaching) can modify some chemical features up to their total disappearing. For archaeological sites, reconstruction of the parent sediments, as well as estimation of its preservation degree, help to assess the extent to which different types of organic matter (bones, pollen, spores, plant remains, and charcoal) were preserved in a particular deposition environment. In the case of deep diagenetic transformations of sediment, it is of principal importance to reveal secondary indicators of organic materials survived in modified depositional environment (Karkanas, 2010).

It has been established that in the sedimentary strata of Denisova Cave, a number of ancient black-colored horizons and lenses reveal a common set of geochemical features, and contrast with adjacent layers in phase, macro- and trace element compositions. These biogenic sediments are mainly composed of X-ray amorphous matter dominated by nitrogen-bearing organics and Ca phosphates of low-crystallinity (up to 40 %). Markers of these sediments include: high C, N, P, Zn, and Cu contents; small amount of siliciclastic material (Si, Ti, Al, Mg, K, Na); and the presence of fragments of the chitin exoskeletons of insects. The combination of these features is typical of the insectivorous bat guano protohorizons.

Regardless of the age, this type of cave sediments is characterized by unique and reproducible geochemical marks (high enrichment in $C_{org.}$, P, N, Zn, Cu and strong depletion in Sc, Zr, Nb, and Ga), which survived even in Pleistocene deposits.

In the sedimentation records of the Altai cave sites, these horizons can be identified as markers and used for correlation of different sections in the same cave; in the future, these markers can be used for comparison of different sites. In each Altai intermountain valley, the Quaternary deposits have individual geochemical features; therefore, it is necessary to analyze not only cave sediments, but also open-air soil profiles, in order to compare the sections of different archaeological sites. Identification of trace element composition of cave sediments requires comparison with the local geochemical background (normalization procedure). This procedure allows one to identify local and regional geochemical markers of different cave sediments. A set of characteristics and methodological approaches tested in Denisova Cave can be used to categorize the deposits in other cave sites.

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Newly Discovered Remains of a Late Upper Paleolithic Dwelling in the Northern Baikal Area: Cultural Horizon 3/2 at Kovrizhka IV on the Vitim River

We describe a new complex of remains in cultural horizon 3/2 of the Kovrizhka IV site on the Vitim River in the Baikal-Patom Highlands. This feature is a cluster of archaeological remains near the hearth, enclosed by an oval pavement 4.7 m by 3.2 m, consisting of eight slabs. The feature is interpreted as the remains of a dwelling. The spatial arrangement of finds is described. Rather than taking a central position, the hearth is shifted to the probable entrance in the northeastern part. Under one of the slabs of the pavement, an ocher spot was found. Qualitative and typological characteristics of the artifact assemblage are provided. The feature yielded about 2400 lithic artifacts. On the basis of the use-wear study of selected artifacts, four retouched and unretouched flakes are identified as knives. Other tools include a biface-wedge-shaped core, a bifacial scraper-knife, two fragments of unifacial scraper-like tools, a cutting tool, and retouched flakes (altogether 12 spec.). There are also three wedge-shaped narrow-faced microcores, one of which was knapped from a bifacial preform, and two from flakes. The comparison with two dwellings and a hearth complex previously discovered at Kovrizhka IV, the results of AMS-dating (the age of the complex is estimated at ca 18.9–18.6 ka BP), and the analysis of lithics have shown that the site belongs to the early stage of the Late Upper Paleolithic of the Lower Vitim. Anthracological data indicate a tundra-steppe landscape with islets of shrubs (dwarf or shrubby willow). We conclude that the dwelling evidences a short-term occupation episode. Along with the previously excavated features of Kovrizhka IV, the complex in cultural horizon 3/2 gives an idea of the culture and subsistence strategies of the Late Upper Paleolithic people at the end of the Last Glacial Maximum.

Keywords: *Late Upper Paleolithic, Last Glacial Maximum, dwelling, hearth, microblade knapping, ocher.*

Introduction

Among the most informative Late Upper Paleolithic (LUP) sites are those with remains of dwellings with hearths. These were centers of the key human activities such as manufacture and use of tools, resource processing, preparation of food, eating, symbolic behavior, etc. The study of dwellings, therefore, contributes to the knowledge of various aspects of prehistoric culture.

In the LUP archaeology of the lower Vitim, the first discovered representative site of this sort was the site of Bolshoi Yakor I, referred to the period of ca 11.7–12.7 ka BP / 13.5–15.0 ka cal BP (Ineshin, Tetenkin, 2010). In the 2010s, the study of LUP horizons of Kovrizhka IV was initiated. These are dated to ca 18.5–19.1 ka cal BP and are the earliest well-stratified archaeological complexes in the Vitim River basin. Archaeological remains from horizons 6, 2Б, and 2Г were successively excavated and introduced into scientific circulation (Tetenkin, Henry, Klementiev, 2017; Tetenkin, 2017a, 2019; Tetenkin et al., 2018, 2021). Cultural horizons 6 and 2Г contained remains of dwellings. The totality of data received makes it possible to characterize the early LUP culture of the Vitim area (19–17 ka BP) in terms of building and functioning of dwellings, hunting activities, lithic production, seasonal mobility, exploitation of mineral and plant resources, symbolic behavior, and art. The objective of this paper is to present results of the study of the hearth and dwelling complex discovered in cultural horizon 3/2 at Kovrizhka IV in 2015 and excavated in 2020 and 2022.

Fig. 1. The site of Kovrizhka IV.

Description of the site

The site of Kovrizhka IV is located in the central part of the Baikal-Patom Highlands (Bodaibinsky District of the Irkutsk Region), on the right bank of the Vitim River in its lower reaches, on an 11-meter high erosion terrace (Fig. 1). Archaeological remains were found on an erosion cuesta delimited by gullies.

Cultural horizon 3 was recorded in the upper portion of alluvial deposits, at a depth of approximately 0.45–0.70 m from the ground surface, within deposits of dark gray aleurite. In the northern part of the excavation adjoining a gully, cultural horizon 3 had been flooded out and compressed. Slope solifluction movements of a subareal cycle resulted in the partial compression of the alluvial layer, which remained after the flood erosion event, and influenced the underlying alluvial deposits. This process affected cultural horizon 3. In the southwestern direction, the culture-bearing aleurite deposits separate; two large dark gray sublayers comprise cultural horizons 3/1 and 3/2. The eastern part of the excavation demonstrates traces of the flood erosion event that destroyed the upper portion of the alluvial deposits. After this event, there started the deposition of alluvial flood-plain sediments that incorporated cultural horizons 2А–2Д. According to the radiocarbon dates (ca 15.32–15.36 ka BP / 18.5–18.6 cal BP), this sedimentary unit was formed during a rather short period of time and is chronologically close to the previous one.

In the southwestern portion of the site, the excavation comprises a well-stratified sector of cultural horizon 3/2, where it is not mixed with cultural horizon 3/1, being separated from it by a 5–10 cm thick sterile sand sublayer (Fig. 2, *1*). A test-pit made there revealed a hearth complex. Cultural remains lay in the upper part of the dark gray aleurite approximately 5 cm thick (Fig. 2, *8*), overlain by light gray fine-grained sterile sand. This complex, accumulating cultural remains, was split by a cryogenic crack running from above, followed by the break-off and flexure of the adjoining parts. In

Fig. 2. Photographs of cultural horizon 3/2 of Kovrizhka IV.
1 – stratigraphic section along D-C line; *2* – southern (rear) arc of slabs of the outer contour; *3* – spot of ocher under the slab of the southern arc; *4* – hearth; *5* – bone artifact with a hole in the center; *6* – wedge-shaped core on a biface; *7* – section of the cultural horizon near hearth slab No. 3, with a knife under it; *8* – accumulation of charcoals behind slab No. 8 and a macroblade west of it.

other areas, artifacts were found *in situ*. Bones were recovered in a poor state of preservation.

Archaeological methods

A traditional and basic set of archaeological methods applied in studying the complex included the analysis of spatial distribution, as well as morphological and morpho-techno-typological analyses. Selected specimens were visually examined with regard to use-wear traces (these findings are tentative). The petrography method was used to identify rocks and the composition of the ocher. AMS-dating was applied to determine the age of the complex.

The analysis and attribution of the hearth complex were based on previous studies in LUP archaeology. The earliest of such studies in Eastern Siberia were those at Malta and Buret in the Cis-Baikal region (Gerasimov, 1935; Okladnikov, 1941). After the discovery of dwellings at Sanny Mys, Studeny-1 and -2, Ust-Menza-1 and -2, and Sukhotino in the Trans-Baikal region (Okladnikov, 1958; Kirillov, 2003), studies of such complexes have been extensively developed, and criteria for identification of dwellings have been formulated (Konstantinov M.V., 1994; Konstantinov A.V., 2001; Razgildeeva, 2018). Over the past 50 years, in Eastern Siberia, dwellings have been discovered and attributed in the Angara area, on the Yenisei, upper Lena, and in Kamchatka (Vasiliev, 1996; Paleolit Yeniseya…, 2005; Aksenov, 2009; Dikov, 1993). Some archaeologists attempted to locate dwellings not enclosed by stone pavements around the perimeter (Lezhnenko, 1991; Aksenov, 1974; Ineshin, Tetenkin, 2010). One of the successful attempts was the discovery of a dwelling at Afontova Gora IV (Razgildeeva et al., 2022).

Radiocarbon dating

For the site of Kovrizhka IV, the first radiocarbon date of 14,290 ± 35 BP (UGAMS-27447) was generated on bioapatite of tooth enamel of snow sheep from cultural horizon 3 in the northern part of the terrace adjoining a gully. In that place, owing to compression, the horizon was not separated into upper and lower levels. A date of 15,310 ± 160 BP (Poz-106965) was obtained for the hearth in cultural horizon 3/2. It is close to that of the later horizon 2Д, the lowermost in a sequence of deposits in the eroded part of the terrace: 15,350 ± 150 BP (Poz-106968). One more date of 19,810 ± 220 BP (Poz-131669) was generated on charcoals collected 1.6 m north of the hearth, immediately behind slab No. 8 of the contouring pavement (Fig. 3). In the zone of the charcoal accumulation (2.5 × 1.0 m), neither traces of fire nor concentration of cultural remains were found (see Fig. 2, *8*). This date is much older than the previous ones; it stands out from the series of radiocarbon determinations. Two other dates that “fall outside” of the context were generated on charcoals from cultural horizon 2Б: 31,000 ± 400 BP (Poz-106961) and 31,200 ± 400 BP (Poz-106960) (Tetenkin et al., 2021). At the same time, cultural horizon 2Г yielded two other dates: ca 15,360–15,320 BP / 18,871–18,376 cal BP. Several assumptions can be made about the old age of the charcoals. They could have been transported by the river flood. It is also possible that inhabitants of the dwelling used ancient wood washed out and redeposited by the Vitim. Possibly, the charcoal was washed off the hearth by the flood and deposited nearby. Alternatively, it might have been carried away by people. A date of 15,520 ± 150 BP (Poz-131812) is available for underlying cultural horizon 3Б. Thus, taking into account the results of radiocarbon dating and stratigraphic observations, the age of cultural horizon 3/2 can be estimated to be ca 15.47–15.36 ka BP / 18.9–18.6 ka cal BP.

Results of the anthracological analysis

Two samples of sediments were taken from the hearth and sifted through a dry sieve with meshes of 0.5 and 1.0 mm, which led to the extraction of 23 fragments of wood charcoal. The fragments were observed following three sections of the wood: transversal, longitudinal tangential, and longitudinal radial. They were examined using an optical reflected-light microscope with ×100 to ×500 magnification. Fifteen fragments measuring from 0.5 to 1 mm were identified as willow. Judging by some indicators of the anatomical structure of the wood, willow was represented by shrubs and subshrubs (Benkova, Schweingruber, 2004). Eight fragments remained unidentified because of their small sizes.

Findings

In the complex, the hearth occupies the central place (Fig. 3). It is a washed out coaly spot of irregular

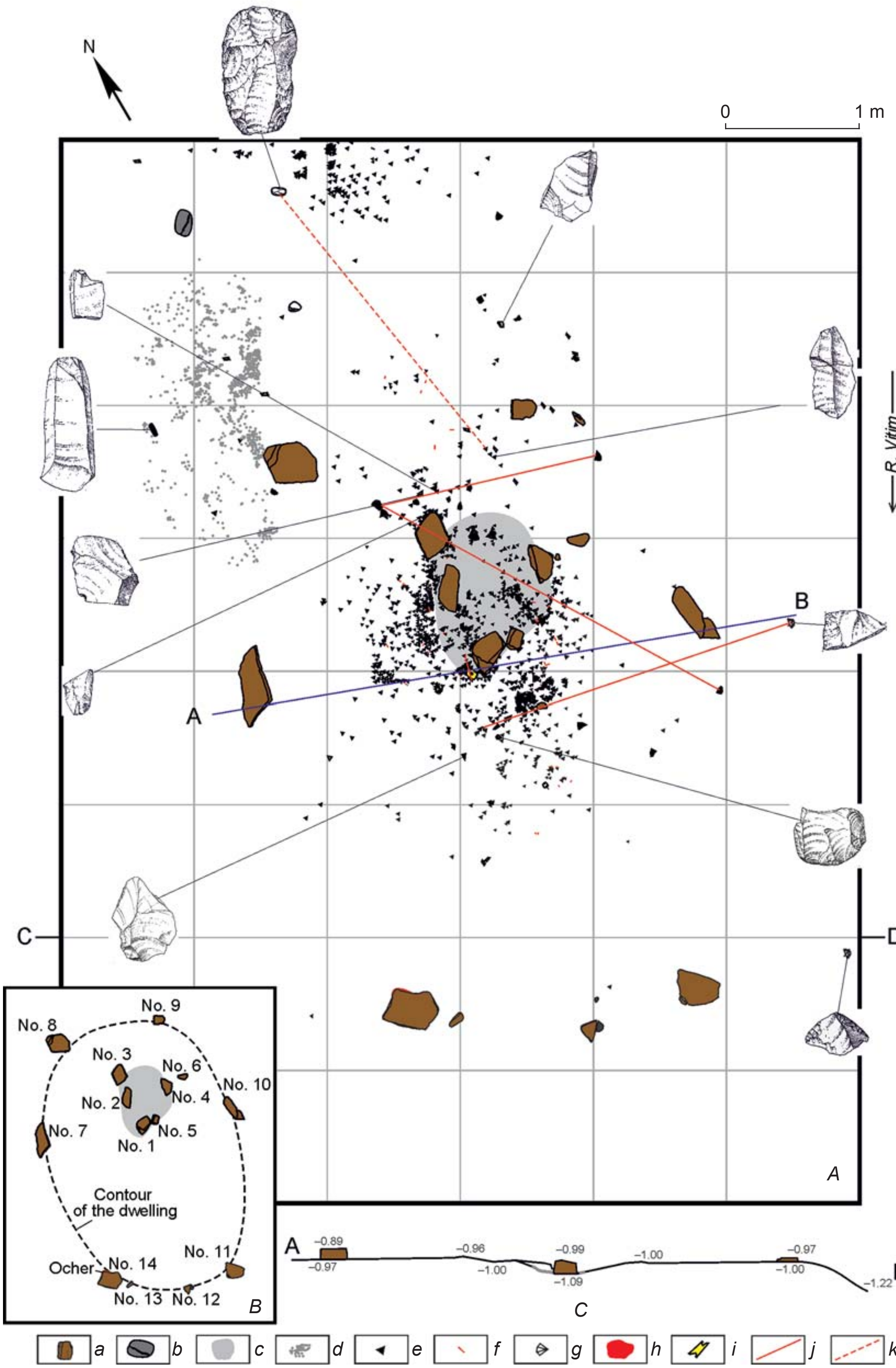

Fig. 3. Plan of location of dwelling remains (*A*), cultural horizon 3/2, scheme of location of slabs in the pavement (*B*), and profile along A–B line (*C*) of Kovrizhka IV.
a – gneiss slab; *b* – boulder; *c* – spot of ash; *d* – charcoals; *e* – flake removed from a stone; *f* – microblade; *g* – core; *h* – spot of ocher; *i* – fragment of bone; *j* – refitting relations; *k* – relationship between the finds, reconstructed from imported raw material.

oval shape, stretching from SW to NE and measuring 1.3 × 0.90 m (see Fig. 2, *4*). Five hearth slabs were placed on the coals. At the western edge of the hearth, along the north-south line, three tubular fragments of amphibolite gneiss up to 35 × 25 cm large were found. The fourth hearth slab (amphibolite gneiss) lay at the eastern edge. The fifth slab (No. 5) was discovered at the western edge, near the first one (No. 1) (see Fig. 3).

Nearly all debitage products, forming a compact agglomerate, were located near the southern, western, and northern edges of the hearth. The density of the artifacts near the southern edge was 230 spec. per 0.25 m^2; near the northern edge, it was up to 108 spec. (including chips found during water screening). Outside this concentration of debitage and slabs, the number of finds drops sharply up to 1–7 spec. per 0.25 m^2.

At the outer contour of the complex, four slabs of amphibolite gneiss (No. 7–10 (see Fig. 3, *B*)) are spaced around the circumference, 0.75–1.3 m west, north, and south-east of the hearth. They are 18 to 60 cm long, and 15 to 30 cm wide. The distances between the slabs are 1.3, 1.5, and 1.9 m. The southern part of this quasi contour is formed by an arc composed of two large gneiss slabs (No. 11, 14), measuring 30–35 × 25 cm and lying at a distance of 2.4 and 2.7 m from the hearth, and small tabular fragments (No. 12, 13) between them. Under the southwestern slab (No. 14), an ocher spot measuring 17 × 10 cm was recorded (see Fig. 2, *2*, *3*; 3, *B*). This is the only spot of ocher in the complex. One flake was found under slab No. 7 of the contouring pavement.

Outside the contour of the dwelling, the periphery of cultural horizon 3/2 was relatively clean, containing only rare artifacts. An increased concentration of debitage was noted 2.3 m north of the hearth. Possibly, it was another cluster of finds, running into the wall of the excavated area. The density of artifact distribution there increased up to 222 spec. per 0.25 m^2. Near the hearth (1.6 m NNW of it), right behind slab No. 8 of the outer enclosure, there was a charcoal accumulation 2.5 m × 1.0 m without traces of fire and with just a few artifacts (see Fig. 2, *8*). According to radiocarbon dates, these charcoals, as noted above, are much older than those from the hearth.

Bones show poor preservation. Only isolated fragments were recorded, and it was impossible to preserve them. However, near the southwestern hearth slab, a bone artifact of subrectangular shape was found, measuring 10.5 × 5.4 cm, with a 2.3 × 2.0 cm hole in the center (see Fig. 2, *5*). Conservation attempts failed at its preservation.

Characteristics of the lithic assemblage

The assemblage collected near the hearth comprises 2384 lithic artifacts: 2282 flakes (including 1937 chips (85 %)), 85 complete and fragmented microblades, 2 macroblades, 3 microblade wedge-shaped narrow-faced cores, 3 morphologically distinct side-scrapers (fragmented and complete), 8 flakes with irregular marginal retouch, and 1 cutting tool. On the basis of the use-wear study, three retouched and unretouched flakes, as well as two scraper-like tools, are identified as knives. This group also includes a formal side-scraper (Fig. 4, *22*) recovered from the northern cluster, not yet completely excavated. Fragmented and complete microblades form 19 % of the debitage (excluding chips). Tools and cores (without chips) amount to only 3 %. Most artifacts (99 %) were made of effusive argillite, or of light green or light gray effusive rocks. Artifacts manufactured of clear or vein quartz form less than 1 %. A side-scraper and two flakes were made of effusive rock represented by brown-colored trachydacite.

The toolkit from the hearth complex is small. It includes flakes with irregular marginal retouch (Fig. 4, *9–12*, *16*, *17*). A fragment of a scraper-like tool with a working edge formed by regular unifacial retouch (Fig. 4, *14*) was found at the southeastern periphery; a fragment of a tool with two retouched working edges converging at a right angle (Fig. 4, *13*) was discovered at the southern periphery. At the northern periphery, an elegant tool was found near a partly unearthed cluster. It is suboval and was manufactured from a brown trachydacite (Fig. 4, *22*). Two flakes of the same rock lay near the northern edge of the hearth. The tool has a convex working element, fashioned on the longitudinal edge of the dorsal face and thoroughly retouched. The narrow ends of the artifact are rounded and thinned on the ventral face. Formally, it can be described as a side-scraper. Its closest analogue is a side-scraper from cultural horizon 6 (Tetenkin, Henry, Klementiev, 2017: Fig. 7, *2*). The resemblance is all the more apparent owing to narrow ends trimmed along the ventral face, rendering the tool bifacial, a convex outline of one of the long edges, and a concave outline of the other. At the northwestern periphery, a 10 cm long macroblade with regular trihedral faceting of the dorsal surface was found (see Fig. 2, *8*; 4, *18*).

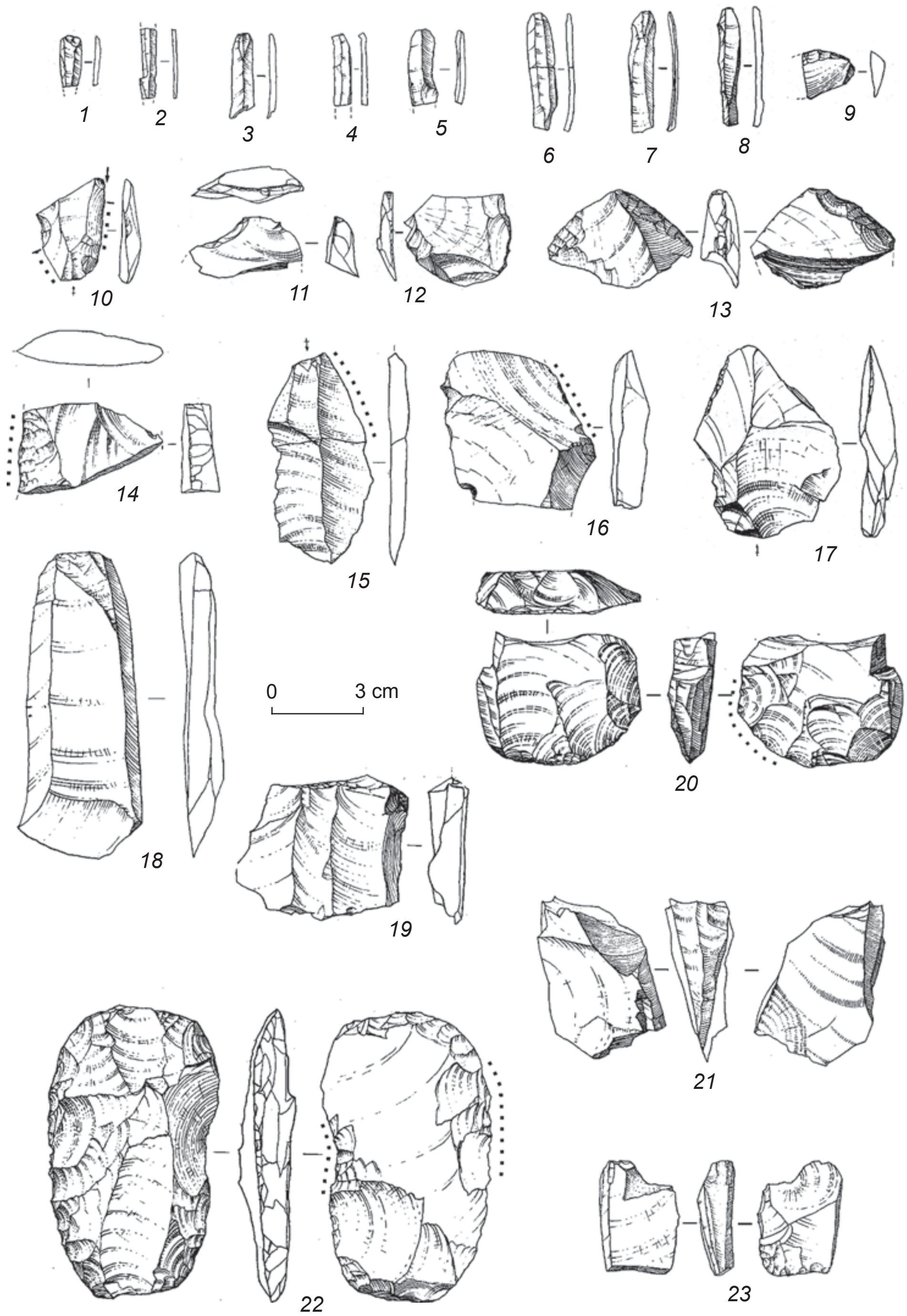

Fig. 4. Artifacts from cultural horizon 3/2 of Kovrizhka IV.
1–8 – microblades; *9*, *11*, *12*, *17* – flakes with marginal retouch; *10* – knife-burin; *13* – fragment of a tool with two converging retouched working edges; *14–16* – knives; *18* – macroblade; *19* – frontal flake removed from a core; *20*, *21*, *23* – microcores; *22* – bifacial scraper-knife. *1–21*, *23* – effusive argillite (?); *22* – trachydacite. Dot lines indicate working edges reconstructed by use-wear analysis.

There are only three specimens of microcores. One of these was fashioned on an oval biface (see Fig. 2, *6*; 4, *20*). Judging by the retrieved fragment of the frontal flake, the fractured flaking-surface was repeatedly rejuvenated. The last time, the platform was shaped by lateral blows; it is slightly concave and, in general, typical of the cores from Kovrizhka IV (Tetenkin, 2017b). Two other cores show no traces of preparation of the keel; they can be defined as narrow-faced cores (see Fig. 4, *21*, *23*).

Given the nature of the rock from which microblades are made, it can be assumed that the complex included one or two more microcores.

Discussion

The paucity of lithics testifies to small amount of tool production and microblade manufacturing (see Fig. 4, *1–8*). It is also indicative of knapping (mostly by facial treatment) of a limited amount of prepared stones. Judging by the distribution of cultural remains, some manufacturing operations were conducted outside the hearth complex. Excavations of level 3/2 suggest that the site was generally large, and the hearth complex was only a part of it. The studied artifact assemblage is smaller than those collected from the previously excavated dwelling (cultural horizon 6) and hearth (cultural horizon 2Б) complexes: 2.4 thousand spec. (including chips) vs. 9.9 thousand spec. in the dwelling complex of cultural horizon 6 and 7.2 thousand spec. in the hearth complex of cultural horizon 2Б; 85 fragments of microblades vs. 392 spec. in cultural horizon 6 and 233 spec. in cultural horizon 2Б. Neither morphologically distinct end-scrapers typical of cultural horizons 3/1 and 6, nor chisel-like tools of *pièce esquilée* kind typical of cultural horizons 2Б and 2Г were found within cultural horizon 3/2.

The use-wear analysis demonstrated that knives were made on flakes with straight thin edges, mostly without trimming: that is, morphologically inexpressive (see Fig. 4, *10*, *15*, *16*; 5). One unifacial tool, represented by a fragment, had a regular retouch (see Fig. 4, *14*). Traces of cutting on the flake (see Fig. 4, *10*) correspond to initial stages of its utilization as a tool, before remodification by a burin-blow. The biface on which the wedge-shaped core was made shows traces of wear on the counter-front, suggesting that it had been used as a tool before the striking platform was formed (see Fig. 4, *20*). The scraper-like implement of trachydacite was used both as a knife and as a scraper (see Fig. 4, *22*). On this tool, one series of notches runs in parallel to the edge and thus indicates the cutting movement, while the other series is perpendicular to the edge, which is typical of the scraping movement. This tool and a macroblade without use-wear traces (see Fig. 4, *18*) were brought to the site in their finished form. Waste by-products resulting from their making are absent.

The presence of two bifaces (see Fig. 4, *20*, *22*) in cultural horizon 3/2 serves as a basis for correlation of this assemblage with the LUP Dyuktai

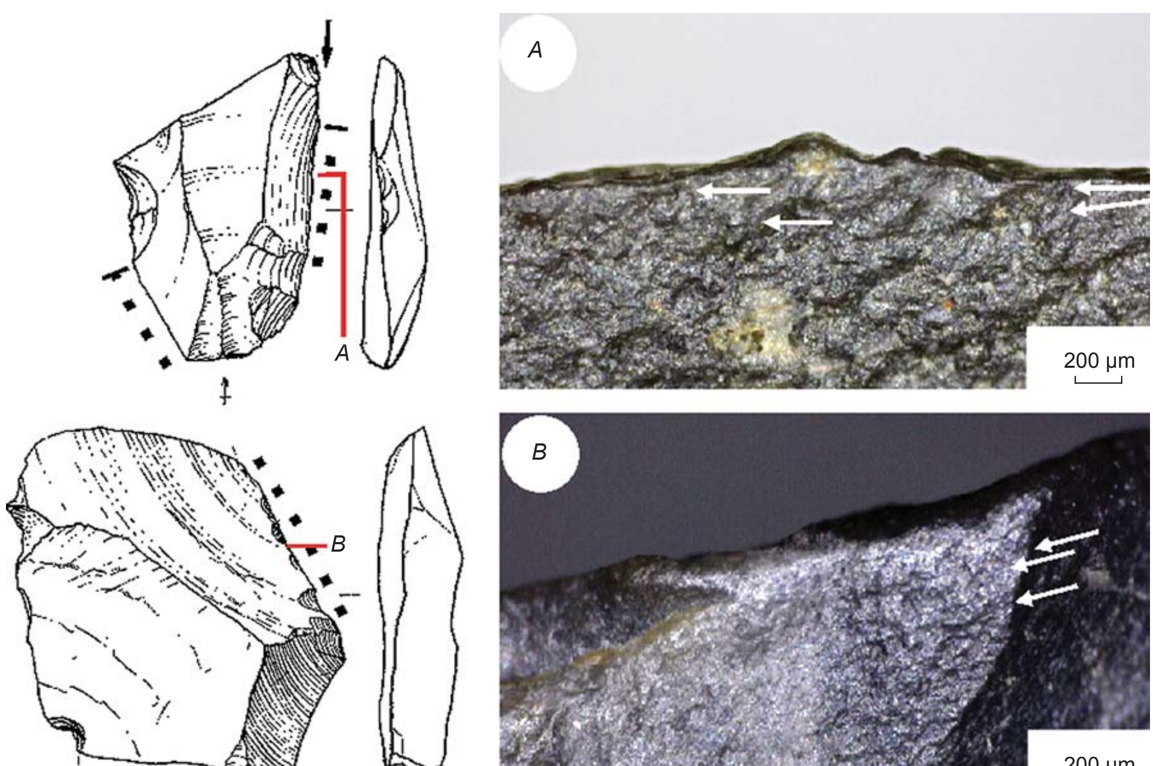

Fig. 5. Microphotographs of working edges of knives made on flakes.

culture of Northeast Asia (Mochanov, 1977). In terms of microblade knapping and the manufacture of macroblades, flakes, unifacial and bifacial scraper-like tools, the industry of cultural horizon 3/2 is typical of the early phase of LUP of the Lower Vitim, as shown by the lower (2Б–6) cultural horizons of Kovrizhka IV. The lack of end-scrapers, chisel-like implements, pebble tools, and cores for flakes and blades probably implies the absence of activities associated with such tools and thus characterizes the functional specificities of the dwelling during the certain episode of habitation.

To assess the function of the dwelling with the hearth, one should pay attention to the surrounding stones (see Fig. 3). The complete enclosure, approximately equal spaces between slabs encircling the hearth from NW to SE, and the absence of artifact clusters near the slabs suggest that the stones were arranged along the perimeter of the dwelling construction, which was approximately 4.7 m long and 3.2 m wide, stretching along the river in the SW to NE direction. Elements of the construction include: 1) hearth, 2) encircling stone pavement, 3) cluster of cultural remains near the hearth, within the outer circle of slabs and out of it—in the area interpreted as an entrance zone (Konstantinov A.V., 2001). Obviously, the stones reinforced the entrance-hearth northern part of the wall and the opposite southern one. The hearth was located not in the center of the dwelling, but rather closer to its entrance. The slabs were placed around the dying fire. This is evidenced by numerous cultural remains, including burnt bones, found under the slabs. At Kovrizhka IV, this is the third accumulation of archaeological remains recorded near the hearth and interpreted as a dwelling, after the recognition of dwelling complexes from cultural horizons 6 and 2Г, identified in the same way. In contrast, archaeological remains from cultural horizon 3/2 were associated with a smaller and, probably, simpler living space for a short-term occupation, i.e. a light dwelling reinforced with stones. The dwellings associated with cultural horizons 6 and 2Г are interpreted as winter houses (Tetenkin, Henry, Klementiev, 2017; Tetenkin et al., 2021). Notably, in cultural horizon 3/2, the spot of ocher was found under only one slab of the outer contour (lining of the dwelling), in distinction from cultural horizons 2Б, 2Г, and 6, rich in ocher. If ocher had been intentionally put under the slab (indeed, none of it was found elsewhere in the complex), then this place had a special status. According to this logic, the absence of artifacts in the southern area outside the hearth would suggest that this was a sleeping area, and the alternation of empty areas around the hearth and those replete with artifacts may have been due to a short-term occupation. Judging from the distribution of cultural remains, the entrance was located in the northeastern part and was oriented toward the Kovrizhka spit, the same as the entrance in the dwelling of cultural horizon 6. In the dwelling considered here, the entrance faced a large utility zone, which was partially washed-out and mixed with archaeological remains of cultural horizon 3/1. From the distribution of the slabs in the outer perimeter and the location of the hearth north of the center, the above-ground construction probably had an asymmetric shape (Razgildeeva, 2018: Fig. 3.6). The fact that the artifacts (macroblade and two fragments of tools) lay at some distance from each other outside the contour lining can suggest that they were either by-products relating to activities at the hearth, or results of activities conducted outside the dwelling, or an outcome of taphonomic processes (natural postdepositional scattering).

Judging by the findings resulted from the study of cultural horizons 2Б, 2Г, and 6, the source of the ocher was a natural mineral (hematite). The ocher was obtained by crushing and friction of the rock that contained up to 94 % of hematite (Tetenkin et al., 2020).

The anthracological analysis of charcoals from the hearth revealed the remains of willow (*Salix*), which generally agrees with the conclusion based on the study of earlier cultural horizon 6 and later horizon 2Б: the late Last Glacial Maximum vegetation was of the shrub and tundra type and the environment was tundra-steppe (Henry et al., 2018). Since only this taxon is present in cultural horizons 2Б and 6, it can be conjectured that willow was the most accessible firewood on the river bank.

Taking into consideration the situation common for all alluvial cultural strata of Kovrizhka IV (location on the beach near the water edge), we can assume that the site was inhabited by people during the non-flood season, i.e. from autumn to late spring.

Conclusions

The accumulation of artifacts found in cultural horizon 3/2 near the hearth, encircled by an oval pavement of eight slabs, 4.7 × 3.2 m in size, is interpreted as a dwelling. This is the third object of this kind discovered at Kovrizhka IV; two other objects were found during previous excavations in cultural horizons 6 and 2Г. The sparse lithic finds indicate small-scale activities, mainly focusing on the manufacture of tools (mostly butchering knives, which were then used at the site) and microblades, and on the splitting of the initially prepared stones. Despite the absence of several tool types, the appearance of the assemblage from horizon 3/2, showing microblade knapping, manufacture of macroblades, flakes, unifacial and bifacial scraper-like tools, is typical of the LUP of the Lower Vitim. The bifaces correlate with the LUP Dyuktai culture of Northeast Asia. The industry of Kovrizhka IV evidences yet another episode of human presence in the tundra-steppe landscape of the late stage of the Last Glacial Maximum, extending our knowledge of the LUP of that area. Also, like other materials from the site, the finds from cultural horizon 3/2 indicate the seasonal mobility of prehistoric hunters and characterize the river-bank settlement as repeatedly visited. The study of dwellings helps to reconstruct their layout, heating, and functioning as the key adaptive cultural tradition.

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Sanctuary with "Kalguty" Style Images in Northwestern Mongolia (Preliminary Data)

This article presents the first results of a detailed study of a key rock art site with the earliest petroglyphs in the Mongolian Altai—Baga-Oigur-5 (Right Bank). Basic data on its location, the surrounding environment, etc. are provided. The main groups of petroglyphs are characterized and attributed. The most numerous group, that of the "Kalguty" style, is examined in detail. This style was previously attributed by the current authors to the Final Upper Paleolithic. Bronze Age and medieval petroglyphs are also present at the site. The most informative panels show single horses, bulls, sheep, and deer rendered in the "Kalguty" style, as well as compositions including these animals. Among the earliest local rock art, for the first time, a nonfigurative sign has been found, resembling a grid, connected with the figure of a horse in a manner that is typical of prehistoric art. The analysis of a multilayered composition—one of the most important—confirms the hypothesis that "Kalguty" style petroglyphs predate the Bronze Age. The unusual natural context of Baga-Oigur-5 (Right Bank) is addressed in detail: a restricted area with available flat rock surfaces standing out against a background landscape with convex boulders. The arrangement of rock carvings within the site is unusual: animal figures on various surfaces combine in a nearly compositional manner. A tentative conclusion is made that the site was a sanctuary.

Keywords: *Rock art, petroglyphs, palimpsest, "Kalguty" style, Baga-Oigur-5 (Right Bank), Mongolian Altai.*

Introduction

In the summer of 2023, a joint expedition from the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences and the Institute of Archaeology of the Mongolian Academy of Sciences continued the research begun in 2019 in order to search for and document rock art downstream the right bank of the Baga-Oigur River (Molodin, Cheremisin, Batbold et al., 2019; Batbold et al., 2019) (Fig. 1). The site named Baga-Oigur-5 (Right Bank) is especially notable among the discovered rock art sites of various periods. It stands out from among numerous rock art location not only on the left and right banks of the Baga-Oigur River, but also in the northwestern regions of the Mongolian Altai.

The site was discovered by a group of Mongolian archaeologists (T. Turbat (team leader), N. Batbold, B. Umirbek), who photographed multilayered composition. In 2021, the palimpsest was published (Umirbek, Batbold, Tserendagva, 2021) and presented at an international conference in Mongolia in 2022, along with other palimpsests with "Kalguty" figures (Molodin et al., 2022). In 2023, the composition was published again (Turbat, Batbold, Umirbek, 2023)*. Detailed examination of the Baga-Oigur-5 (Right Bank) site during field works of 2023 showed its particularly rich content as compared to previously discovered rock art sites, which meant that it ought to be studied using the latest recording methods.

At the foot of the mountain range stretching along the river, a secluded area with slate outcrops was discovered, consisting of a slightly inclined surface polished by the movement of a glacier to a mirror-like finish (Fig. 2). Such surfaces extend for 17 m up the slope and for about 18.5 m along the bank. This site was located on a small hill, separated from large surrounding boulders by small ravines (Fig. 2, *1*; 3). The coordinates of Baga-Oigur-5 (Right Bank) are 49°18′45.2″ N 088°27′41.4″ E. The height above sea level is 2345 m.

As opposed to other slate outcrops in the area, which have the shape of rounded boulders, these surfaces look almost perfectly smooth, creating a pronounced reflective effect. A separate mirror-like flattened area stands out in the lowest part of the slope among numerous smoothed *roches moutonnées* shining in the sun (see Fig. 2).

When examining neighboring rock outcrops 45 m east of Baga-Oigur-5 (Right Bank), in addition to late petroglyphs, a deer figure made in the "Kalguty" style was discovered. Two more figures of deer

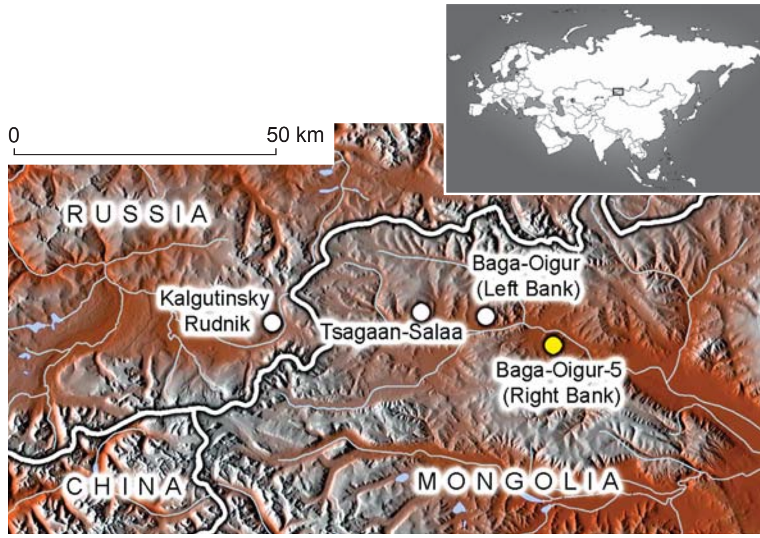

Fig. 1. The Baga-Oigur-5 (Right Bank) rock art site, the Mongolian Altai.

Fig. 2. Part of the Baga-Oigur River valley, with Baga-Oigur-5 (Right Bank) (*1*); general view of Baga-Oigur-5 (Right Bank) from the northwest (*2*).

*Since the name of the site Baga-Oigur with Roman numerals and without indicating the bank (Jacobson, Kubarev, Tseveendorj, 2001) can be used in the future to designate new sites on the left bank, in this paper we use the name Baga-Oigur-5 (Right Bank), in accordance with the numbering adopted by our joint expedition of 2019.

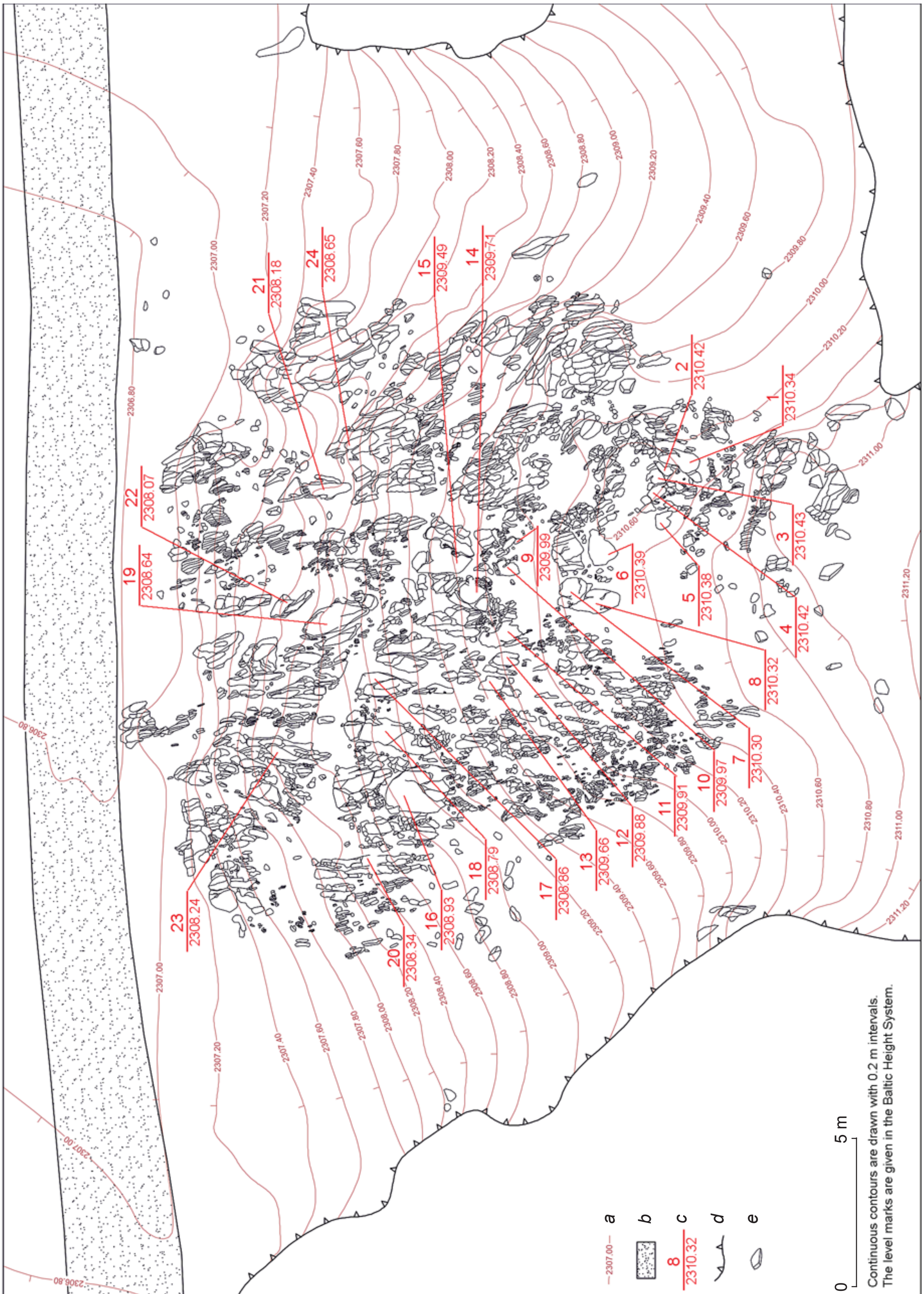

Fig. 3. Topographic plan of Baga-Oigur-5 (Right Bank). Prepared by R.V. Davydov.
a – continuous contours; *b* – country road; *c* – numbers and leveling data of panels; *d* – boundaries of rock masses; *e* – stones.

and argali were found at the nearby Baga-Oigur-6 (Right Bank) site of the Bronze Age (Molodin, Cheremisin, Nenakhova, Batbold, Zotkina, 2023). A series of four partial images of deer and three argali, made in the archaic manner, appeared on the much worse-preserved surfaces of boulders 25 m west of Baga-Oigur-5 (Right Bank).

In the upper part of Baga-Oigur-5 (Right Bank), panels are horizontal. These contain compositions of the Bronze Age. Several images from the Late Middle Ages were discovered in the lower part of the slope (Fig. 4). Interestingly, the earlier petroglyphs were not damaged during their creation. The main part of the site contains single, less often grouped, images in the archaic manner, mainly in the "Kalguty" style (Fig. 4–9). Noteworthy is a multilayered composition with Bronze Age images and zoomorphic figures in the "Kalguty" manner (see Fig. 7, 8), which gave rise to the study of this site.

In terms of position, type of panels, and specific features of figurative style, the carvings from Baga-Oigur-5 (Right Bank) resemble those from the Kalgutinsky Rudnik site on the neighboring Ukok Plateau (the Russian Altai). A series of petroglyphs, distinguished by their archaic figurative style, was first identified on glacier-polished rhyolite surfaces on the bank of the Kalguty River (Molodin, Cheremisin, 1999). Later, together with rock images of Baga-Oigur-2 and -3 (Left Bank) and Tsagaan-Salaa, they were united into a special group representing the "Kalguty" style and were attributed to the earliest petroglyphs in the Russian and Mongolian Altai (Cheremisin et al., 2018; Molodin, Geneste, Zotkina et al., 2019).

Notably, the images made in the "Kalguty" style differ from the rock paintings of Mongolia studied by A.P. Okladnikov in Hoyt-Tsenker Agui Cave (Okladnikov, 1972) and from the images of Arshan-Khad, which were tentatively dated by Okladnikov to the Mesolithic (1981: 79). The relation between these images and the "Kalguty" style petroglyphs still needs to be clarified.

At present, the Baga-Oigur-5 (Right Bank) site is undoubtedly the richest and best preserved location containing the earliest rock art in the Mongolian and the adjacent Russian Altai Mountains. Considering that it was suggested dating the sites with "Kalguty" petroglyphs in this region to the Final Paleolithic (Molodin, Geneste, Zotkina et al., 2019; Molodin et al., 2020; Zotkina et al.,

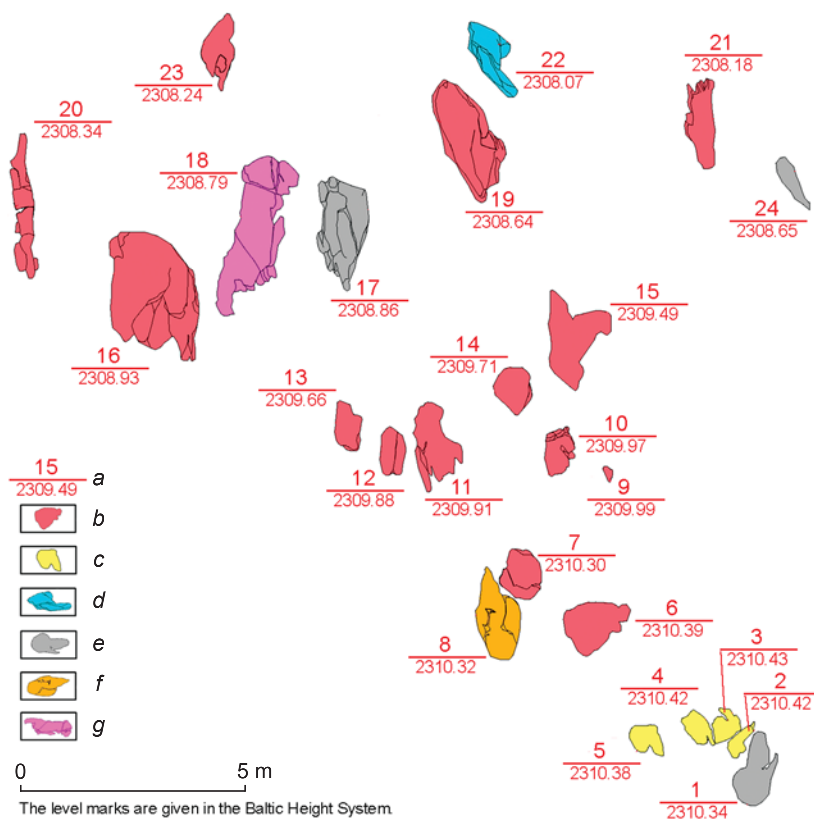

Fig. 4. Relative position of panels at Baga-Oigur-5 (Right Bank).
a – numbers and leveling data of the panels; *b* – panels with the earliest images; *c* – panels with images of the Bronze Age; *d* – panels with images of the Middle Ages; *e* – panels with indeterminate images; *f* – panels with images of the earliest period and the Bronze Age; *g* – panels with images of the earliest period and Middle Ages.
Prepared by R.V. Davydov.

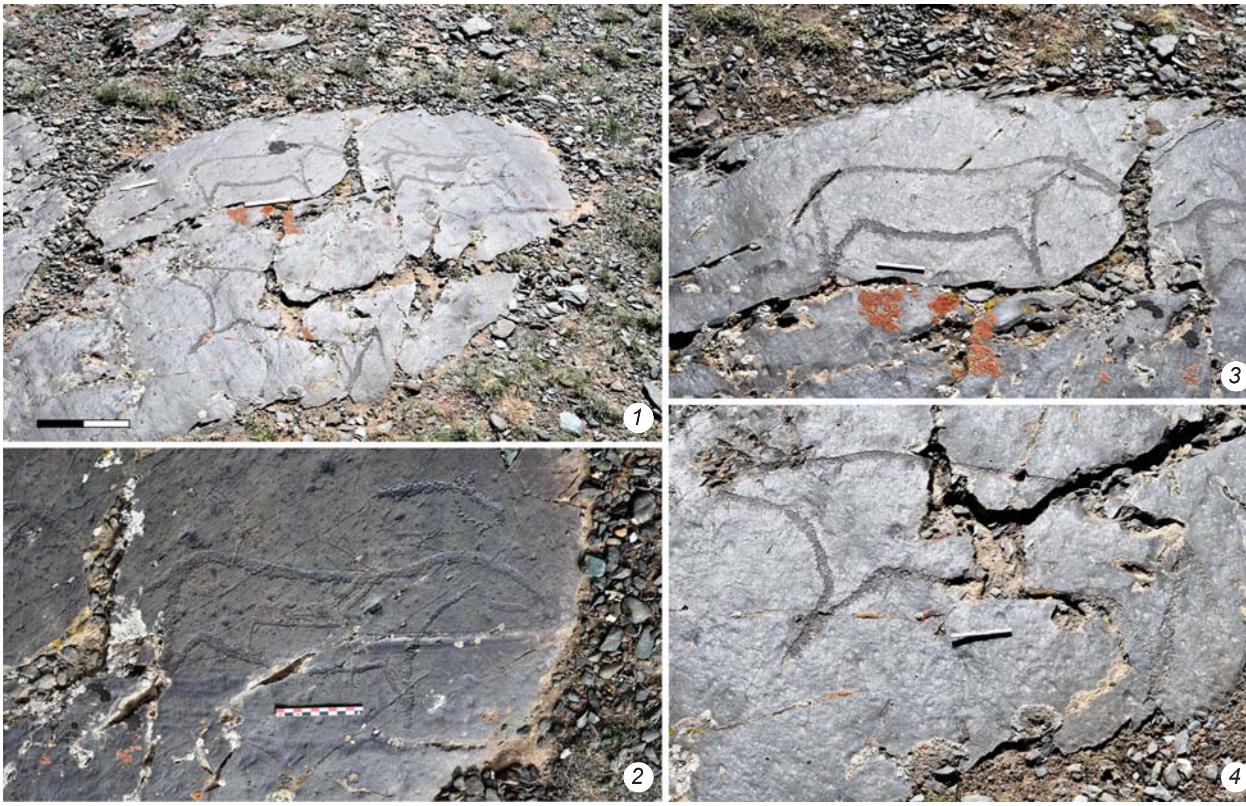

Fig. 5. Panel 8.
1 – general view of the panel; *2* – multilayered composition; *3* – horse image; *4* – bull image.

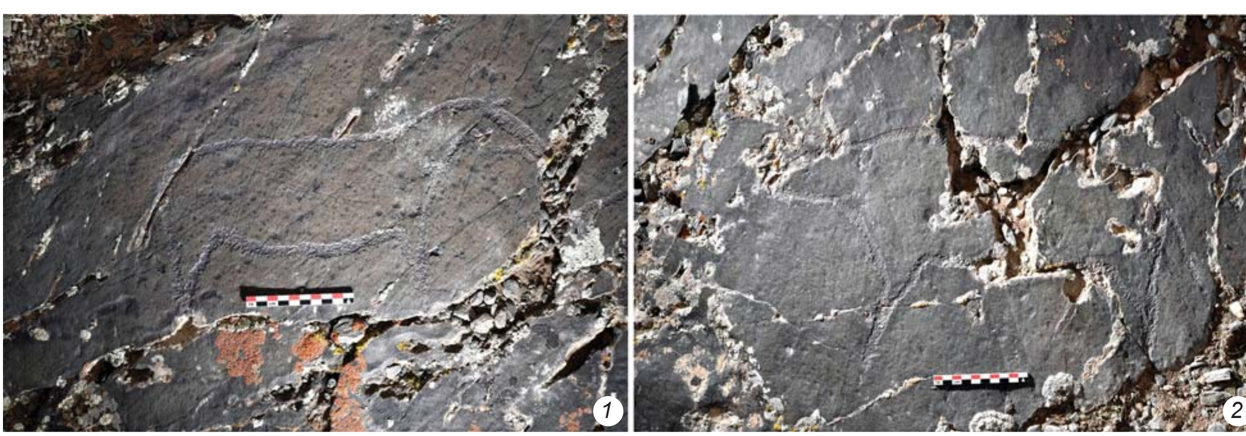

Fig. 6. Images of the horse (*1*) and bull (*2*) on panel 8. Photo with artificial light.

2020), the scholarly importance of Baga-Oigur-5 (Right Bank) can hardly be overestimated.

This article provides only some of the most important information about Baga-Oigur-5 (Right Bank). The purpose of this study is to introduce the first results of conceptualizing the site as a special location with a series of the most significant earliest rock images in the "Kalguty" style. The site certainly deserves a separate monographic study, which will be prepared by this team in the near future.

Research methods

The study of the Baga-Oigur-5 (Right Bank) site required a comprehensive approach to the documenting of rock images and their context. After a thorough examination of the site, all identified surfaces with depictions were indexed; in full, 24 panels with petroglyphs of different periods were recorded. The numbering was made from the upper southern part of the slope to the lower northern part, from left to

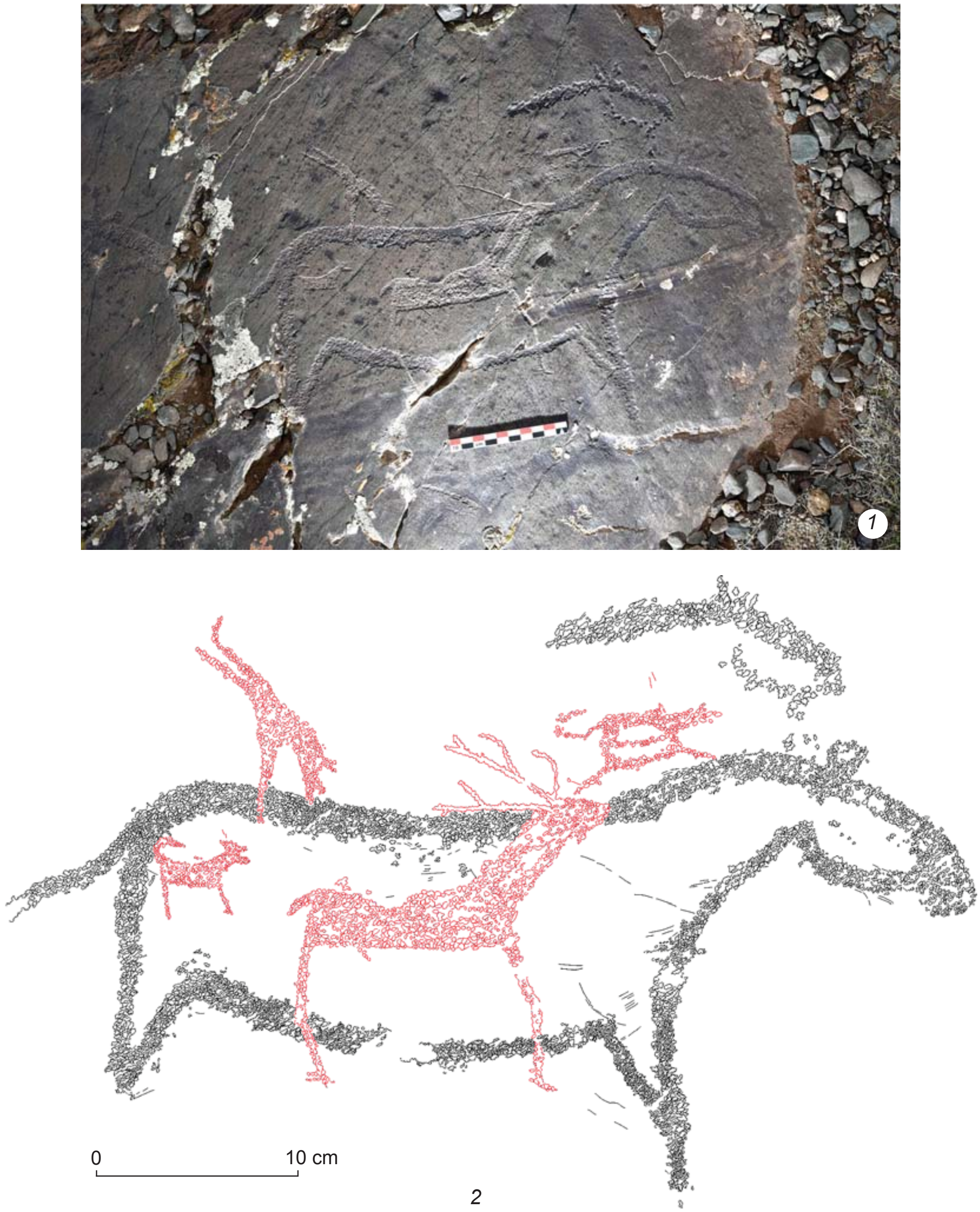

Fig. 7. Multilayered composition on panel 8.
1 – photo with additional artificial light; *2* – tracing.

right (see Fig. 3, 4). The natural features of the terrain determined the borders and sizes of the site.

Preparing the panels for recording involved clearing loose sediments and rubble resulting from natural rock destruction from the main part and periphery of each surface. Many of the images were partially covered with lichen, which was removed using wooden sticks and a large amount of water.

Photographs of the site and its context in the Baga-Oigur River valley were taken using a Nikon D750 camera with a wide-angle AF-S Nikkor 14-24 mm lens and using a DJI Phantom 4 Pro drone (see Fig. 2). Photogrammetry was used for documenting in order to obtain a three-dimensional model of the site. It involved two stages. First, photographs of each panel were taken without labels, and then with labels containing numbers. This made it possible to easily recognize the location of each figurative surface on 3D models. Using these models, a diagram of the site was made in laboratory, providing a complete idea of the spatial position of each

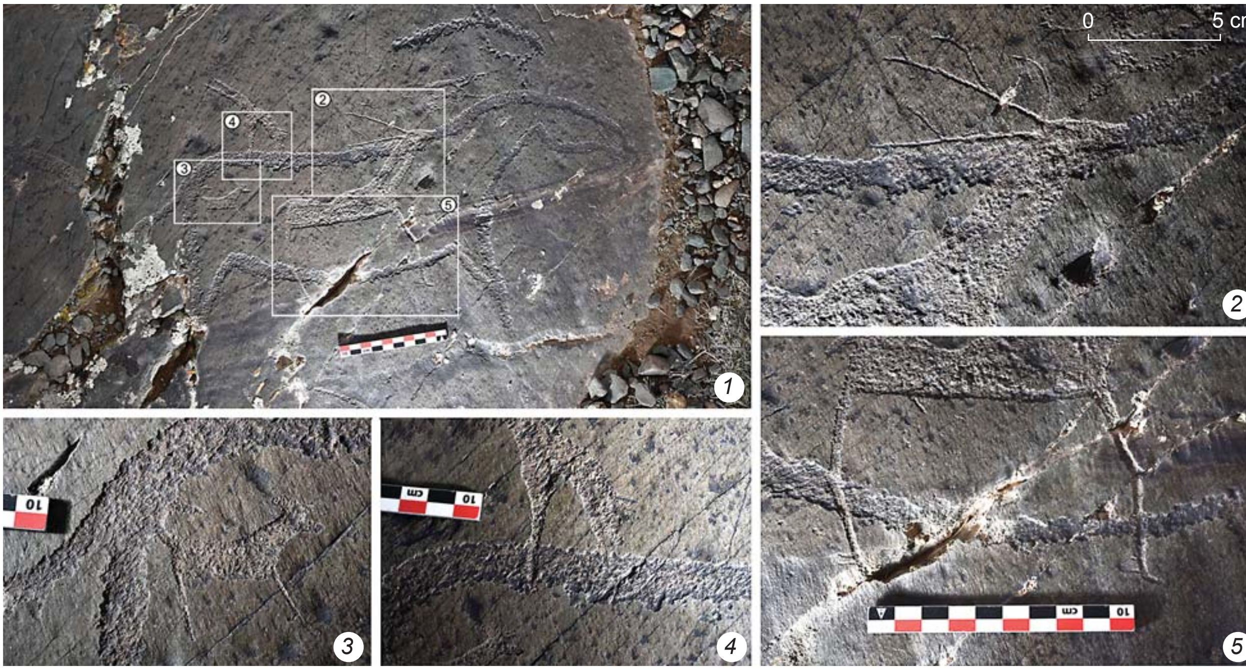

Fig. 8. Intersection of the "Kalguty" horse image with Bronze Age petroglyphs on panel 8.
1 – general view of the multilayered composition; *2*, *5* – intersection with the deer figure; *3* – intersection with the dog figure; *4* – intersection with the predator figure.

image, which was especially important for the subsequent interpretation of the site (see Fig. 3, 4).

Each panel with petroglyphs was carefully and uniformly described. The size, nature of the surface, and its orientation relative to other panels were taken into account. Information about the content of each image, technique used, and general stylistic features was provided.

Each identified panel was documented in accordance with a unified standard. Photographs of the surfaces and of each image were taken under different lighting. In addition to documenting the panels with natural side-light, a large series of photographs was taken with artificial lighting, using an external flash in various positions to the surface. If necessary, macro photography of individual significant details of the images was implemented. Three-dimensional visualization using the photogrammetry technique was applied to each identified petroglyph and individual significant details. Photographs were taken using a Nikon D750 full-matrix camera with Nikon 105 mm f 2.8G IF-ED AF-S VR Micro-Nikkor and Nikon 60 mm f/2.8 Nikkor Micro lenses. At the final stage of documenting, analytical tracings of each rock image and composition were made on transparent film, using magnifying glasses (from ×3 to ×15) and a portable microscope Nikon NS 111470 (×20). Laboratory processing of the completed tracings was carried out using CorelDraw 2020. Agisoft Metashape Professional was used to build 3D models, and AutoCAD was used to create a location diagram based on the model.

The formal typological approach (Molodin, Geneste, Zotkina et al., 2019) was used to analyze the figurative manner of the petroglyphs. Traceological analysis based on 3D visualization (Zotkina et al., 2014; Zotkina, 2019) was used to study the multilayered composition on panel 8.

Study results

Petroglyphs of various periods were discovered at the Baga-Oigur-5 (Right Bank) site. Preliminary analysis attributes the images on 16 panels (6–16, 18–21, 23) to the earliest period (see Fig. 3, 4). Petroglyphs on four surfaces (2–5) represent the Bronze Age. Panels 8 and 18 include images of different periods—of the earliest period and the Bronze Age. Panel 8 contains intersected figures, which is extremely important for clarifying the relative chronology of the rock art. On panel 23, a "Kalguty" petroglyph was found close to an image probably of the Middle Ages. Medieval images were also present on panel 22. Carvings or their preforms on panels 1, 24, 17 cannot be definitely dated.

Images of chariots, as well as zoomorphic figures of a deer, predator, and dog, belong to the Bronze Age (see Fig. 7, 8). All of them are small as compared to the "Kalguty" petroglyphs, and were made by very fine

Fig. 9. Panel 15.
1 – general view in natural light; *2* – image of the horse and grid (photo with additional artificial light); *3* – macro photograph of the grid (photo with additional artificial light).

percussion, with sharply defined contours (without surrounding random dents), and were concentrated in the upper part of the slope. The execution of carvings of this group was typical of the Bronze Age rock art in this region (Molodin, Cheremisin, Nenakhova, Batbold, 2023: Fig. 2, *22–27*). Medieval petroglyphs include stylized geometrized images, mainly of goats, also typical of the region.

This article focuses on the earliest images. The most significant "Kalguty" petroglyphs were found on panels 6–8, and 15 (see Fig. 5–9). These figurative surfaces were located quite densely, on an elevation in the southern and central parts of the site. Almost every image occupied either the entire panel or an area limited by natural fractures. Petroglyphs were clearly inscribed into a separate figurative space (see, e.g., Fig. 5, *1*; 9, *1*).

Six out of ten images of the earliest period, including partial images, on the four mentioned panels, contain the image of a horse in the "Kalguty" style (see Fig. 5, *2*, *3*; 6, *1*; 9, *2*). Panel 8 contains the image of a bull (see Fig. 5, *4*; 6, *2*), while panel 15 depicts two deer figures (see Fig. 9). Previously unknown in the "Kalguty" style, images of snakes and compositions consisting of the earliest petroglyphs were discovered on other panels.

Almost all "Kalguty" images discovered at the site are large in size (ca 0.5 m long), which sets them apart from later, smaller petroglyphs. All the "Kalguty" figures are depicted in the same figurative manner: they are silhouetted, and there is no filling or any decoration inside the body contours, as opposed to the decoration inside early images in the adjacent territories, for example, in the rock art of the "Minusinsk" style (Zotkina et al., 2023: Fig. 5, *23–26*; 6, *1–30*; 9, *11–20*). Only two legs are shown using two connecting contour lines. The belly is conveyed by an arched line emphasizing the heavy outline of the torso. The thigh is slightly emphasized; the croup is rounded, and the tail most often extends from it.

Noteworthy are the methods of depicting the back and head of animals, since the species of zoomorphic figures can be identified precisely from these parts of the image. For example, a small sub-triangular head, bend in the neck, small hump, and short tail correspond to the image of a deer, even if it has no branched antlers (see Fig. 9, *1*). A large trapezoidal head, massive hump, horns, neck, and shoulder, as well as back with almost no bend and long tail, are indicative of a bull-aurochs (see Fig. 5, *4*; 6, *2*). A figure with pronounced arch of the back, curved neck, long tail, and muzzle rendered in detail with the rounded contour of the lips, emphasized cheek, and distinctively depicted ears, can be defined as the image of a horse (see Fig. 5, *2*, *3*; 6, *1*). Notably, in the lower part (legs, stomach), the outlines of the animals are almost identical. This suggests the uniformity of the laconic and naturalistic manner of depiction.

These petroglyphs are also notable in their execution. They were made by superficial percussion, which creates fairly clear (not very wide) lines. The power of close-range strikes decreases, but their control improves. The artisan had to make many strikes to obtain a line of relatively deep, dense percussion marks, but this technique minimized the number of individual random dents protruding beyond the contours of the image. A paucity of such dents distinguishes most of the earliest petroglyphs at Baga-Oigur-5 (Right Bank). Many of them also show additional contours made using the fine engraving technique. For example, engraved lines that usually run parallel to the pecked contours are clearly visible in the images of horses on panels 6–8. They can be interpreted as sketch elements. Some pecked partial images show engraved lines that continue the torso and legs. Traces of the abrasion technique are also present. For instance, a horse's ear on panel 7 was depicted using this technique. The combination of all these methods was typical of other rock images created in the "Kalguty" style (Zotkina et al., 2020).

An identical set of techniques is observed in the petroglyphs at Kalgutinsky Rudnik (Molodin et al., 2019; Zotkina et al., 2020), which suggests a consistent and distinctive manner of execution typical of the "Kalguty" style. It may be recalled that the combined techniques of percussion, engraving, and abrasion was typical of Foz Côa—one of the most famous Paleolithic open-air sites in Western Europe (see, e.g., (Baptista, 1999: 63, 67, 76, 77, 82, etc.)).

One of the unusual motifs that previously was unknown in the earliest rock art in the region is a grid sign made using a combined technique of fine engraving and sawing. This abstract motif was found on panel 15, next to the image of a horse in the "Kalguty" style (see Fig. 9, *2*, *3*). There is reason to believe that this sign and the horse image were simultaneous, since identical thin engraved lines appear outside the grid, in the area of the animal's head and neck, although the engravings are oriented at a slightly different angle. There are engraved lines covered with percussion marks, as well as incisions passing over densely pecked area that forms the contours of the animal's head and neck (see Fig. 9, *3*). Some engraved lines connect the grid and the horse figure, thus precluding clear distinction between the images. Therefore, the "Kalguty" horse and nonfigurative motif of a grid can be considered interconnected elements of a simultaneously created composition.

Especially noteworthy are the images of two reptiles on panels 9 and 10, which are probably typical figures of the site. In his work on the petroglyphs of Central Asia, A.P. Okladnikov wrote that the images of snakes constituted "the most ancient corpus of Gobi rock images, probably of the Stone Age" (1980: 5).

On the right side of panel 8, there is a palimpsest that includes an image of a horse in the "Kalguty" style, and figures of a red deer, dog, and predator, made in the classic Bronze Age manner (see Fig. 8, *1*). This composition has been published several times. The style of percussion in the image of the horse and figures of the three other animals is essentially different. Bronze Age petroglyphs have the most defined and even boundaries of pecked lines. Individual percussion marks are almost unreadable due to very dense filling. The lines that make up the image of the "Kalguty" horse are wider. Relatively large dents appear along the edges of the pecked contour. Therefore, the boundaries of the lines seem less smooth, and generally, despite the high density of trace concentrations, the pecked lines of the horse image have a cellular relief (see Fig. 8, *2*–*5*).

Differences in the manner of percussion are visible even to the naked eye. Typical features of Bronze Age pecked images are observed in all the areas of intersections of the figures (head and legs of the deer, front paw of the predator) (see Fig. 8, *2*, *4*, *5*) and even in close proximity to the images' contours (tail of the dog and face of the predator) (see Fig. 8, *3*, *4*). This indicates that the image of the "Kalguty" horse was created earlier than the figures of the other animals in the composition. This conclusion confirms the earliest age of not only the palimpsest figure of the horse on panel 8, but also of all the animal images in the "Kalguty" style.

Discussion

Features of the figurative style and technological aspects of the small set of "Kalguty" images at Baga-Oigur-5 (Right Bank), described above, find the closest parallels among the petroglyphs from the neighboring sites of

Baga-Oigur-2 and -3 (Left Bank), Tsagaan-Salaa-4, and Kalgutinsky Rudnik on the Ukok Plateau (Molodin, Geneste, Zotkina et al., 2019; Molodin et al., 2020) (see Fig. 1). The images discussed above and other images at Baga-Oigur-5 (Right Bank) have significantly expanded the series of "Kalguty" petroglyphs attributed to the Final Paleolithic (Ibid.), and supplemented the already known figures with the new images of snake and compositionally organized petroglyphs (see, e.g., Fig. 5, *9*).

One of the main arguments in favor of the Paleolithic age of this group of petroglyphs is their stylistic consistency with the images of the Pleistocene fauna (mammoths) from the sites of Baga-Oigur and Tsagaan-Salaa (Molodin, Geneste, Zotkina et al., 2019: 22–23). Additional indirect evidence of the Paleolithic age of these petroglyphs is their similarity, in terms of archaic figurative style, with classic examples of the Paleolithic art of Western Europe (Ibid.: 19–20).

A specific motif of Paleolithic cave art in Western Europe and other regions is nonfigurative signs. Most often they are located next to the images of animals or are compositionally related to them (see, e.g., (Ajoulat, 2004: Fig. 68, 70, 78, 82; La Grotte Chauvet…, 2010: Fig. 73, 75, 157; Sauvet et al., 2014: 407; Gaussen, 2019: Pl. 2, 5, 30, 34; Plassard, 2018: Fig. 8)). These abstract motifs have been most frequently interpreted as designations of identity among the groups of Paleolithic populations (Sauvet et al., 2018). We may find similar manifestations (nonfigurative signs) at other sites of Paleolithic art of Eurasia, such as, for example, Shulgan-Tash (Kapova) Cave (Zhitenev, 2017: Fig. 270–276).

The geometric motif in the form of a grid, appearing on panel 15 at Baga-Oigur-5 (Right Bank)* and linked to the image of the horse in the "Kalguty" style (see Fig. 9, *2*, *3*), requires a fresh look at the earliest rock art of that region. This abstract symbol can be considered additional evidence that the "Kalguty" style belonged to the Paleolithic.

The relative chronology of images in palimpsests is an additional indirect argument in favor of the Paleolithic age of the "Kalguty" style. Previously, images of the "Kalguty" horses were known only from one multilayered composition at Tsagaan-Salaa-4 (Molodin et al., 2020). The palimpsest on panel 8 at Baga-Oigur-5 (Right Bank) (see Fig. 7, *8*) confirms the conclusions about the chronological position of the "Kalguty" style prior to the Bronze Age (Molodin et al., 2022).

Another important feature of the Baga-Oigur-5 (Right Bank) site is its specific geomorphological context. As mentioned above, the site is located in a small isolated area of almost horizontal surfaces smoothed by a glacier, on a small elevation separated from other outcrops by shallow ravines (see Fig. 2). In contrast to the rest of the massif, the panels of this localized area have a bright mirror-like finish and stand out among other, more convex, outcrops.

The site is framed on the west and east by boulders bearing partial images in the same manner as the petroglyphs on the convex boulders. In addition to this cluster of petroglyphs created in the "Kalguty" style, no other images of the earliest period have been discovered so far on the right bank of the Baga-Oigur River (Molodin, Cheremisin, Nenakhova, Batbold, Zotkina, 2023).

It was observed that the images belonging to the "Kalguty" style were arranged in a special way relative to each other. Petroglyphs usually form compositions within a single figurative surface; however, at Baga-Oigur-5 (Right Bank), several panels with images in the "Kalguty" style appear to be compositionally connected (see Fig. 4). This observation made in the field requires further comprehension and more detailed analysis of the spatial structure of the entire site.

The site was probably chosen by ancient humans not by chance. First of all, it was attractive due to its isolation, and second of all, due to the smooth, horizontal panels, which were convenient for creating images. The concentration of the earliest images in such a limited area, set of depicted animals, and relative compositional arrangement of petroglyphs observed at the stage of field research (see Fig. 4) suggest that the site was a special sacred place—a sanctuary.

It should also be mentioned that a wonderful view of the wide, glacial-shaped valley of the Baga-Oigur River opens up from Baga-Oigur-5 (Right Bank), showing the sites of Baga-Oigur-2 and -3 on the left bank with images of mammoths and other animals in the "Kalguty" style (see (Jacobson, Kubarev, Tseveendorj, 2001: 366, fig. 907)). This "neighborhood" could not have been accidental, since in the Late Pleistocene herds of animals probably moved along the river in the zone of the high floodplain with abundant grass, both up and down the Baga-Oigur River.

Conclusions

The group of rock images discovered at Baga-Oigur-5 (Right Bank), which were made in an archaic naturalistic manner, can confidently be attributed to the "Kalguty" style, based on the parallels with petroglyphs known from the left bank of the Baga-Oigur River, Tsagaan-Salaa River, and the Kalgutinsky Rudnik site.

The rock art site of Baga-Oigur-5 (Right Bank) is an isolated location with densely grouped images of the earliest period located in a specific context, which

*According to the classification of signs and symbols in mythology and art, this sign can be interpreted as a net—a symbol of catching and collecting (O'Connell, Airey, 2009: 236).

makes it possible to view this site as a special sacred place—a sanctuary, where religious rituals might have been performed.

The analysis of the multilayered composition on panel 8 indirectly confirms the earliest age of the rock images of the "Kalguty" style. Together with the palimpsest from Tsagaan-Salaa-4, the "Kalguty" petroglyphs occupy the same position of being before the Bronze Age in the relative chronology of rock art in the region.

The combination of the horse image in the "Kalguty" style and the "grid" on panel 15 may probably be considered as a fundamentally new theme, which has not been previously found in the "Kalguty" rock art. Such nonfigurative motifs, together with zoomorphic images, form a sophisticated semantic structure based on mythological content, typical of the classic art of the Paleolithic.

The new data provided in this article elucidate more fully the "Kalguty" style in the earliest rock art of the Russian and Mongolian Altai, as well as adjacent areas.

A targeted study of the site as a sanctuary will provide fundamentally new information on the symbolic behavior of the ancient populations who inhabited at least the northern part of the Altai Mountains.

Acknowledgment

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Pottery Traditions Among the Carriers of the Novosibirsk Variant of the Kulaika Culture: A Multidiscuplinary Study

This article presents the findings of a multidisciplinary analysis of pottery belonging to the Novosibirsk variant of the Kulaika culture. Technological (traceological), petrographic, X-ray phase, and thermal analyses were carried out, providing a basis for an objective reconstruction of the pottery technology. Raw material used at two sites, Kamenny Mys and Dubrovinsky Borok-3, originated from a single region, but from different mines. Three types of clay were used at the former site, and two at the latter, evidencing several groups of potters using various types of clay. Correlation between the types of clay and composition of the paste supports this idea. The clays used at Kamenny Mys are quite different from those used at Dubrovinsky Borok-3 in terms of mineral composition, as shown by petrographic and X-ray phase analyses. According to the thermo-gravimetric analysis, the samples fall into groups differing in the quality of firing. Certain vessels were subjected to more intense firing than others.

Keywords: *Archaeology, Early Iron Age, Novosibirsk Ob region, Kulaika culture, pottery, interdisciplinary approach.*

Introduction

The Kulaika cultural and historical community existed in Western Siberia in the Early Iron Age. Scholars have identified several of its variants in different areas. Currently, over 25 archaeological sites attributed to the Kulaika culture are located in the Novosibirsk Ob region. Extensive research at the sites belonging to this culture by the Novosibirsk Archaeological Expedition headed by T.N. Troitskaya have identified a special Novosibirsk variant (Troitskaya, 1979).

Pottery is the most common category of finds at the Kulaika sites. The study of the pottery technology makes it possible to analyze the manufacture of ceramic dishware and to reconstruct some historical and cultural processes that took place among specific populations in different ancient periods (see, e.g., (Bobrinsky, 1978, 1999; Tsetlin, 2012; Zhushchikhovskaya, Mylnikova, 2020; Molodin et al., 2020)). Modern archaeology has widely used scientific methods of research. When studying ancient pottery, these methods have been used to identify the mineral composition of the original raw materials, natural and artificial impurities, ceramic coating (glazes, engobes, etc.), isotopic composition of deposits, and the firing regime of dishware (see, e.g., (Fiziko-khimicheskoye issledovaniye…, 2006; Drebushchak V.A., Mylnikova, Drebushchak T.N., 2018; Molodin et al., 2019; Zhushchikhovskaya, 2022)). Digital technologies, in particular 3D modeling, have also been actively used in the study of stone and pottery (Karasik, Harush, Smilansky, 2020; Chistyakov, Bocharova, Kolobova, 2021). However, less than all scholars clearly delineate the potential for various scientific methods and their use in solving individual focused problems. In our opinion, the integrated use of technical/technological, scientific, and digital methods of studying ancient pottery makes it possible to produce results that do not contradict each other, but rather complement each other, because each method has its own boundaries. This may be achieved by setting a clearly defined research problem and correctly interpreting formal physical, technological, and metric parameters of pottery. This article is intended to reconstruct and compare individual pottery traditions at various sites of the Novosibirsk variant of the Kulaika culture.

Material and methods

The sources used in the research were pottery assemblages of the Novosibirsk variant of the Kulaika culture from the cemetery of Kamenny Mys, the fortified settlements of Dubrovinsky Borok-3 and -4, and the settlement of Ordynskoye-9. It was particularly interesting to compare the technological features of pottery-making from Kamenny Mys and from Dubrovinsky Borok-3 located 1 km southeast of it. Troitskaya observed some similarities in the ornamentation and shapes of vessels from these sites (1979: 29–30) which, according to her, belonged to different periods. The cemetery of Kamenny Mys was dated to the late 3rd century BC, while the fortified settlement to the 1st century BC (Ibid.: 48–49).

This study was based on the interdisciplinary synthesis. The technical/technological analysis followed the methodology proposed by A.A. Bobrinsky in accordance with the natural structure of production (1978, 1999). Techniques of pottery manufacturing were identified by binocular microscopy (Leica M51) of the surfaces of items and fractures of shards, followed by comparison of the technological traces with the collection of experimental samples. Vessels from Kamenny Mys (n=49), Dubrovinsky Borok-3 (n=25) and -4 (n=12), and Ordynskoe-9 (n=10) were examined.

Mineralogical and petrographic analysis of thin sections involved polarization microscopy (Zeiss Axio Scope A1) to determine the composition of initial raw materials and artificial additives. The mineral phases of the initial raw material were determined by X-ray phase analysis using a Stadi MP (Stoe) X-ray powder diffractometer*. Thermogravimetric analysis, using a Netzsch TG-209 thermal weighing unit in the temperature range from 20 to 850 °C, was carried out to establish specific features of pottery firing and to compare its quality. Samples were analyzed in a 546 mg gold crucible with a heating rate of 20 °C/min, in pure argon. The sample mass was measured after each heating, using an electronic weighing unit with a scale of 1 g and division value of 0.001 mg. Petrographic and X-ray phase analysis was used for the pottery from Kamenny Mys (n=30) and Dubrovinsky Borok-3 (n=10). Thermal analysis was used for the same vessels and for the pottery from Dubrovinsky Borok-4 (n=4) and Ordynskoye-9 (n=6).

Notably, the results of technical/technological analysis of the pottery from the Kamenny Mys cemetery and settlements have been published (Selin, 2021). This article focuses on the data obtained using scientific methods and their correlation with the results of technical/ technological analysis of the pottery.

Geological structure of the sites' area

Geologically, the sites under discussion are located in the area confined to the Kolyvan-Tomsk fold system, which includes the Novosibirsk fold zone. The latter comprises the Yeltsovka-Basandaika synclinorium composed mainly of aleurolite, argillite, shale, and sandstone. Its deposits are intensely foliated, with formation of clayey and silty-clayey shale rocks intruded by Late Paleozoic-Early Mesozoic granitoids of the Ob P_3–T_1 and Barlak $T_{1–2}$ complexes. They are associated with the occurrence of mafic dikes of the Tashara gabbro-dolerite complex $T_{1–2}$ (Gosudarstvennaya geologicheskaya karta…, 2015). The areas of Dubrovinsky Borok-3 and Kamenny Mys are associated with outcrops of the Ob complex of granitoids (Fig. 1), more precisely

*The measurements were carried out by Y.V. Seretkin.

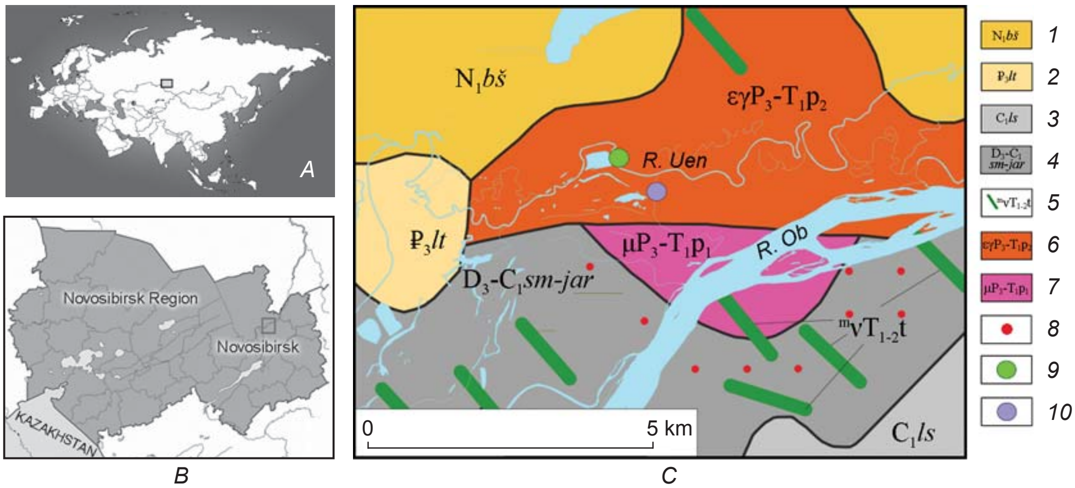


Fig. 1. Location of the sites on the maps of Eurasia (*A*) and Novosibirsk Region (*B*), and geological map of the area of the Kamenny Mys and Dubrovinsky Borok-3 sites (*C*).
1 – Beshcheulskaya formation ($N_1 b\check{s}$); *2* – Lagernotovskaya formation (₽$_3$*lt*); *3* – Lagernosadskaya formation ($C_1 ls$); *4* – Salamatovskaya and Yarskaya poorly defined formations (D_3-$C_1 sm$-jar); *5* – gabbro-dolerite dikes; *6* – the second phase: monzogranites, granosyenites, granites, and amphibole-biotite and biotite medium-grained granodiorites ($\varepsilon\gamma P_3$-$T_1 p_2$); *7* – the first phase: monzodiorites, diorites, quartz monodiorites and quartz diorites (μP_3-$T_1 p_1$); *8* – contact metamorphism, hornfels; *9* – Kamenny Mys; *10* – Dubrovinsky Borok-3.

with the second phase of its injection. Monzogranites, granosyenites, granites, as well as amphibole-biotites and biotite medium-grained granodiorites, occur in the area under study.

Results and discussion

Petrographic and X-ray phase analysis (Fig. 2–4). For pottery production, an initial plastic clay-like raw material (hereafter IPRM) was selected. In almost all the samples from Kamenny Mys, either the predominance of cement (60–70 %) over clastic material (30–40 %), or their equal ratio has been observed. The clastic material includes mainly potassium feldspar, plagioclase, biotite, and amphibole. Pyroxenes and fragments of what is presumed to be granite have also been observed. The cement is predominantly micaceous, with fragments of plagioclase, potassium feldspar, and grains of muscovite, biotite, and pyroxene. The grog contains fragments of plagioclase, potassium feldspar, and muscovite. The obtained data, which were also confirmed by X-ray phase analysis (see Fig. 4, *1*), make it possible to distinguish three types of IPRM, which differ in mineral composition in the pottery assemblage from Kamenny Mys.

IPRM 1 (see Fig. 2, *1*) shows increased content of natural biotite inclusions (11–14 wt%). The clastic material includes quartz (47–65 wt%), potassium feldspar (7–22 wt%), and plagioclase (13–17 wt%).

IPRM 2 (see Fig. 2, *2*) consists mainly of salic minerals, such as quartz (41–90 wt%), potassium feldspar (2–20 wt%), and plagioclase (3–46 wt%).

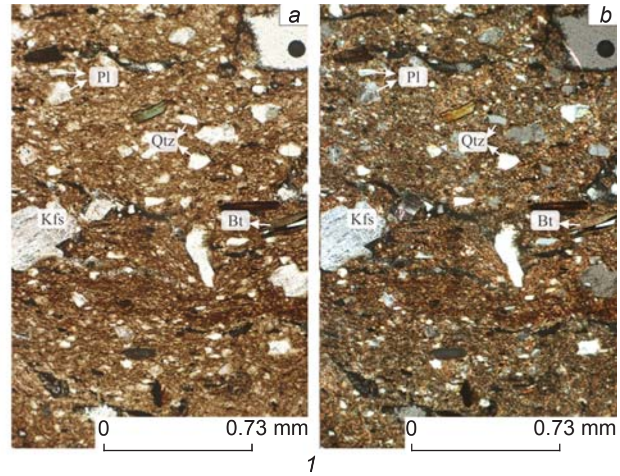
IPRM 3 (see Fig. 2, *3*) is distinguished by a relatively large amount of natural dark-colored minerals: pyroxenes (1–20 wt%) and amphiboles (2–6 wt%). The clastic material includes quartz (37–90 wt%), potassium feldspar (1–41 wt%), and plagioclase (1–32 wt%).

Nevertheless, all of the raw materials were procured from one granitoid massif in the same area. The diversity of their composition is probably associated with different stages of crystallization of the massif, during which monzogranites, granosyenites, granites, as well as amphibole-biotite and biotite medium-grained granodiorites, were formed. When granitoids were weathered, terrigenous deposits of the same composition emerged in their place.

Technical/technological analysis of pottery from Kamenny Mys has revealed six recipes of paste: 1) clay + + grus (68 %); 2) clay + grus + grog (14 %); 3) clay + + grog (10 %); 4) clay + grog + organic solution (2 %); 5) clay + grus + grog + organic solution (4 %), and 6) clay + organic solution (2 %). When comparing the identified types of clay with the paste, it was possible to determine that IPRM 2 had a larger quantity of mixed paste with the addition of grus and grog, and IPRM 3 had a two-component paste with grog. This indicates the coexistence of at least three groups of potters with different skills in selecting raw materials.

An interesting fact is that vessels made of different clays were found together in the same burial mounds and graves. This may imply that a mixed population left behind the Kamenny Mys cemetery, and that the funeral practice of offering ceramic vessels to the deceased came from different groups of potters.

In all samples from the Dubrovinsky Borok-3 fortified settlement, the predominance of cement (60–70 %) over clastic material (25–35 %, mostly potassium feldspar, plagioclase, muscovite and biotite) was detected. The cement was predominantly micaceous, with fragments of plagioclase, potassium feldspar, muscovite, and biotite. According to the



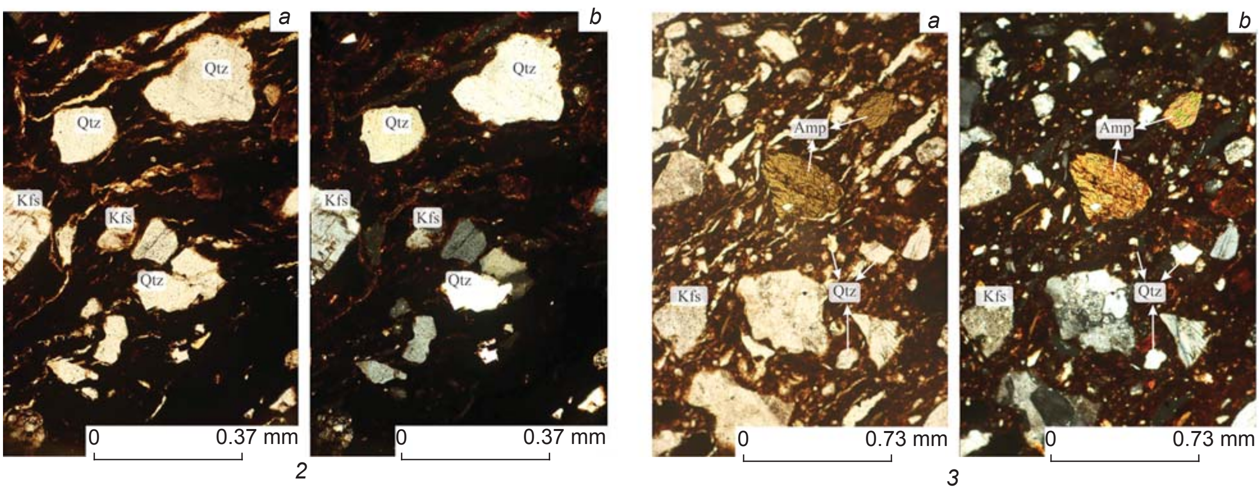


Fig. 2. Thin sections of pottery from the Kamenny Mys cemetery.
1 – IPRM 1; *2* – IPRM 2; *3* – IPRM 3.
a – in polarized light; *b* – in transmitted light.
Qtz – quartz; Pl – plagioclase; Kfs – potassium feldspar; Bt – biotite; Amp – amphibole.

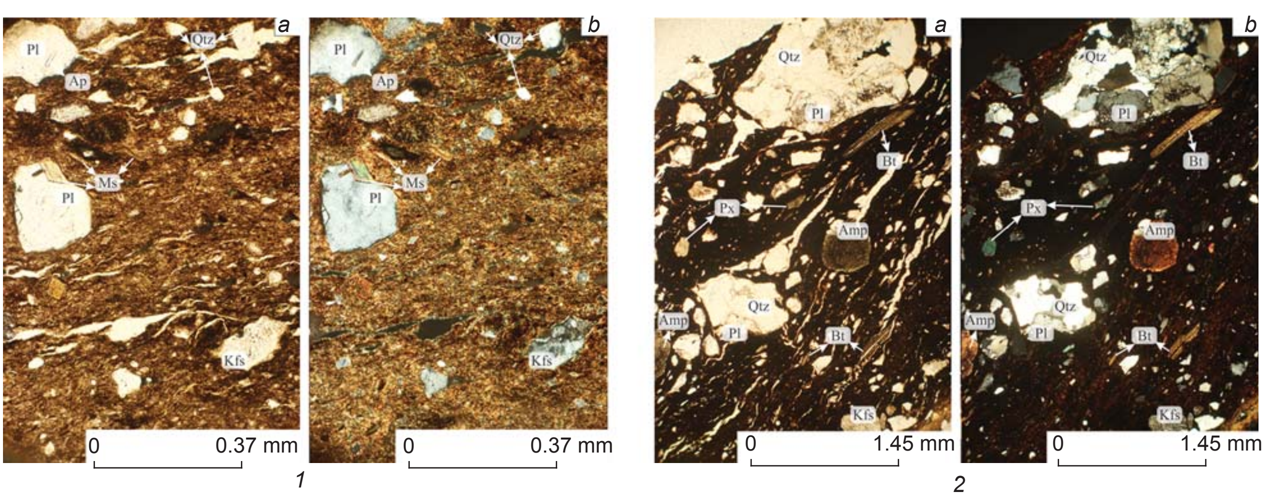


Fig. 3. Thin sections of pottery from the Dubrovinsky Borok-3 site.
1 – IPRM 1; *2* – IPRM 2.
a – in polarized light; *b* – in transmitted light.
Qtz – quartz; Pl – plagioclase; Kfs – potassium feldspar; Ms – muscovite; Ap – apatite; Bt – biotite; Px – pyroxene; Amp – amphibole.

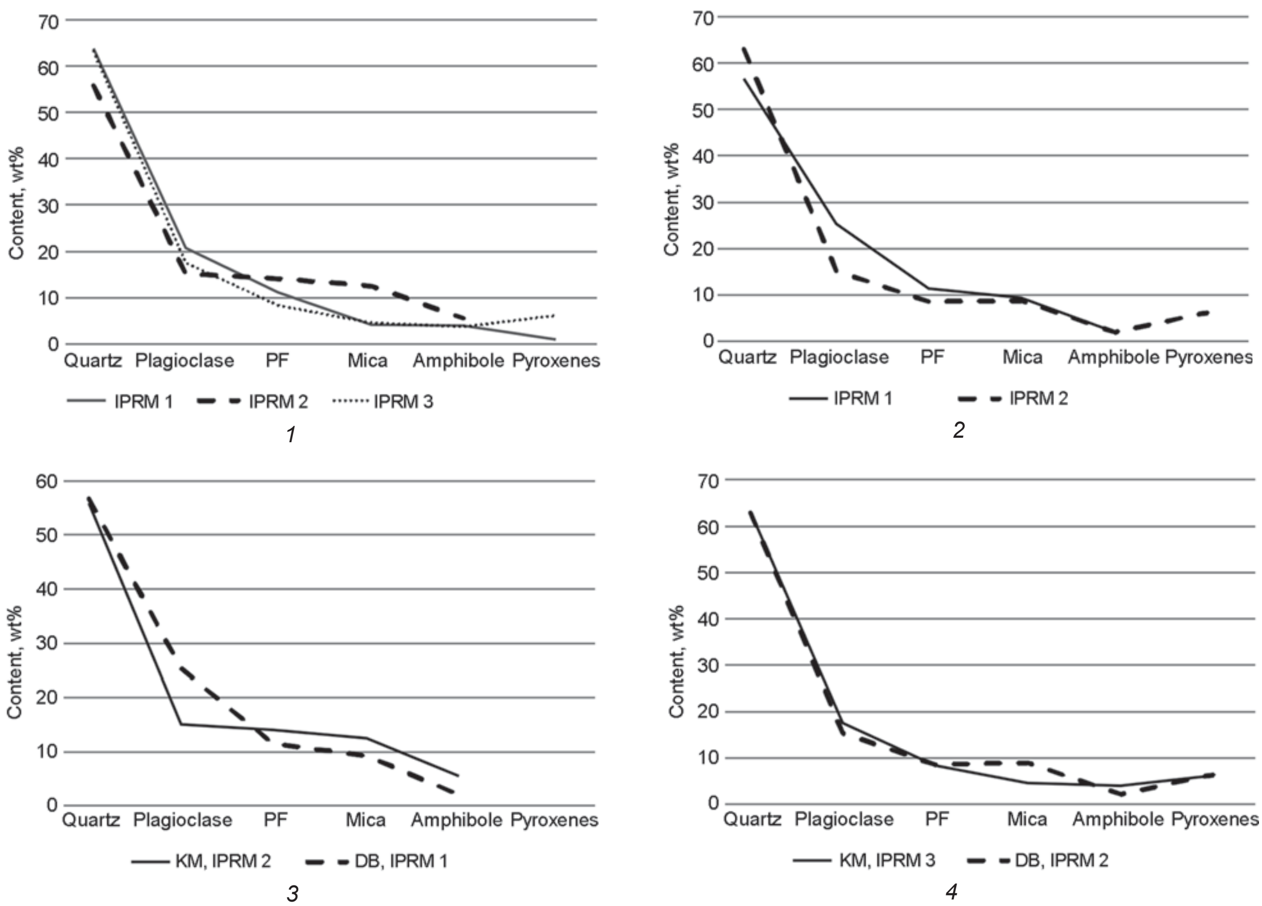


Fig. 4. Results of X-ray phase analysis.
1, *2* – average composition of IPRM mineral phases for pottery from Kamenny Mys (*1*) and from Dubrovinsky Borok-3 (*2*); *3*, *4* – comparison of the average compositions of mineral phases in different types of IPRM for pottery from these sites. PF – potassium feldspar, KM – Kamenny Mys, DB – Dubrovinsky Borok-3.

petrographic and X-ray phase analysis (see Fig. 3; *4*, *2*), two types of IPRM can be distinguished.

IPRM 1 (see Fig. 3, *1*) shows an increased content of natural mica inclusions (3–14 wt%). It consists mainly of quartz (47–74 wt%), potassium feldspar (9–16 wt%), and plagioclase (7–14 wt%).

IPRM 2 (see Fig. 3, *2*) contains a relatively large amount of natural pyroxenes (3–11 wt%).

Six pastes were identified after technical/technological analysis of the pottery: 1) clay + grus (40 %); 2) clay + grus + organic solution (32 %); 3) clay + organic solution (4 %); 4) clay + grog + organic solution (4 %); 5) clay + grus + manure of ruminants (8 %); 6) clay + grus + grog + manure of ruminants (12 %). The correlation of the identified types of clays with pastes has shown that manure was more often introduced into IPRM 2, which suggests two groups of potters who used different clays and were carriers of different traditions of paste composition.

The comparison of IPRM in the pottery from two sites (Table 1) demonstrates that clays differing in mineral composition were used for making vessels from Dubrovinsky Borok-3 and Kamenny Mys. Clastic material in the pottery from Dubrovinsky Borok-3 contains mostly feldspars, muscovite, and biotite; cement in the pottery mainly consists of micas with grains of these minerals, but of a smaller fraction. Samples from Kamenny Mys are distinguished by a more famic composition (the IPRM contains more dark-colored minerals) of fragments and cement, as well as the presence of grog and granite fragments, which is not typical for the pottery from Dubrovinsky Borok-3. Two possible explanations can be suggested: 1) the population of Dubrovinsky Borok-3 did not leave behind the Kamenny Mys cemetery, which was the necropolis of another group; 2) when one site functioned, the other already ceased to exist.

X-ray phase analysis has shown that clay composition in the samples from both sites includes mineral phases that appear in granite rocks occurring in the area confined to the Kolyvan-Tom fold system. Their content, which is two or more times larger in the pottery from the burials of Kamenny Mys, indicates a smaller proportion of cement than clastic material in the IPRM, as compared to the samples from Dubrovinsky Borok-3. The X-ray phase analysis has confirmed the types of IPRM identified. They show clear differences in the content of mineral phases (see Fig. 4, *1*, *2*). The clay in pottery from Kamenny Mys and Dubrovinsky Borok-3 also differs (see Fig. 4, *3*, *4*).

Thermal analysis. According to technical/technological and petrographic analysis, most of the pottery samples analyzed had approximately the same concentration of artificially added tempers (grus, grog), which is 1:4–5. Instances when the concentration deviates from the average values are described below. All study samples were taken from the same part of the vessel (the outer part of the rim), which ensured validity of comparative analysis of thermal transformations in pottery obtained from different sites. The quality of pottery firing can be assessed from the ratio of weight loss in a sample at the stages of dehydration and dehydroxylation (Fiziko-khimicheskoye issledovaniye…, 2006: 24–29; Drebushchak V.A., Mylnikova, Drebushchak T.N., 2018; Molodin et al., 2019), which occur in different temperature ranges of 30–350 °C and 350–600 °C, respectively.

Samples of pottery from Dubrovinsky Borok-4 (DBR) can be divided into two series: 1) DBR1 and DBR11, and 2) DBR2 and DBR6. They differ significantly in the total weight loss upon heating up to 900 °C (Table 2), most of which occur at the dehydration stage (in the range of 30–350 °C). This indicates different degrees of porosity of pottery in these series. In the range of 350–600 °C, mass loss varies between 1.28 and 1.98 %. It can be concluded that samples from series 1 were subjected to more intense exposure to high temperatures or longer firing than those from series 2.

Samples of pottery from the Ordynskoye-9 (OR) settlement can also be conventionally divided into two series, which differ significantly in weight loss upon heating up to 900 °C: 1) OR6, OR7, and OR9; 2) OR2, OR4, and OR5 (Table 3). In the latter series, weight loss was significant during both dehydration and dehydroxylation. The difference in the amount of hydroxyls in ceramics, all other things being equal, results from different quality of firing. Hence, samples from series 1 were subjected to more intense thermal impact than samples from series 2, which may indirectly indicate differences in the firing skills of potters at this settlement.

The minimal weight loss of sample OR7 was most likely caused by a longer time of its firing as compared to other samples, or firing at a higher temperature. Noteworthy is also the presence of grog in the paste in a proportion of 1:3 as opposed to the rest of the vessels, which show a lower concentration of 1:4–5 (according to technical/technological analysis).

Table 1. **Correlation of mineral composition of IPRM in pottery from Kamenny Mys and Dubrovinsky Borok-3**

IPRM components	Dubrovinsky Borok-3	Kamenny Mys
Clastic material	KFSp, Pl, Ms, Bt	KFSp, Pl, Bt and Amp; some Px and fragments of supposedly granite
Cement	Micaceous; fragments: Pl, KFSp, Ms, Bt	Micaceous; fragments: Pl, KFSp, grains of Ms, Bt and Px
Accessories	Apatite	Apatite, monazite

Notes: KFSp – potassium feldspar, Pl – plagioclase, Ms – muscovite, Bt – biotite, Amp – amphibole, Px – pyroxenes.

Table 2. **Weight loss in pottery samples from Dubrovinsky Borok-4 in different temperature ranges, %**

Sample code	30–350 °C	350–600 °C	600–850 °C	30–850 °C
DBR1	2.40	1.98	1.02	5.39
DBR2	6.70	1.85	0.74	9.29
DBR6	7.38	1.50	0.21	9.09
DBR11	3.04	1.28	0.99	5.31

Table 3. **Weight loss in pottery samples from Ordynskoye-9 in different temperature ranges, %**

Sample code	30–350 °C	350–600 °C	600–850 °C	30–850 °C
OR2	4.20	2.76	1.65	8.61
OR4	6.31	1.76	0.50	8.58
OR5	6.39	2.47	1.05	9.9
OR6	3.67	1.34	0.38	5.35
OR7	2.39	1.16	0.32	3.87
OR9	3.26	1.32	0.18	4.76

Table 4. **Weight loss in pottery samples from Dubrovinsky Borok-3 in different temperature ranges, %**

Sample code	30–350 °C	350–600 °C	600–850 °C	30–850 °C
DB2	2.85	1.82	0.91	5.59
DB3	5.82	1.95	0.74	8.52
DB4	5.63	2.21	1.44	9.27
DB5	3.25	1.03	0.66	4.94
DB6	4.34	1.70	0.88	6.92
DB8	1.34	2.48	1.70	5.52
DB10	5.36	1.56	0.81	7.73
DB11	2.4	0.70	0.43	3.53
DB13	5.39	1.58	0.66	7.64
DB19	4.70	2.18	1.02	7.90

Table 5. **Weight loss in pottery samples from Kamenny Mys in different temperature ranges, %**

Sample code	30–350 °C	350–600 °C	600–850 °C	30–850 °C
1	2	3	4	5
		IPRM 1		
KM6	4.95	1.70	0.54	7.18
KM7	4.5	3.41	0.96	8.86
KM8	3.28	1.56	0.68	5.52
KM10	2.89	1.56	0.69	5.15
KM12	6.33	2.47	0.78	9.58
KM4	3.35	2.06	0.98	6.39
KM29	5.23	3.19	1.01	9.44
KM33	4.12	1.73	0.73	6.58
KM34	5.1	3.06	1.51	9.67
KM35	3.83	1.41	0.67	5.91
KM38	6.07	2.30	0.85	9.22
		IPRM 2		
KM1	1.69	1.01	0.76	3.46
KM2	3.57	2.08	0.69	6.34
KM4	4.81	2.26	0.87	7.94
KM9	4.10	1.42	0.48	6.10
KM18	5.35	1.57	0.82	7.74
KM19	4.87	1.71	0.89	7.47
KM23	5.47	2.00	0.72	8.19

Table 5 (end)

1	2	3	4	5
KM29	5.23	3.19	1.01	9.44
KM36	2.42	1.11	0.22	3.75
KM37	5.23	4.28	0.85	10.35
		IPRM 3		
KM13	2.44	1.33	0.64	4.41
KM17	4.71	1.47	0.32	6.50
KM20	4.32	2.84	1.63	8.79
KM25	5.03	1.95	1.00	7.98
KM26	1.15	0.59	0.31	2.05
KM27	3.78	1.22	0.93	5.94
KM28	3.45	1.78	1.09	6.33
KM30	3.87	1.72	1.02	6.61
KM47	3.96	2.22	1.06	7.24

Sample OR2 differs from all the other samples in its relatively large loss of mass in the high-temperature range (600–850 °C). This could have resulted from release of carbon-containing compounds, which could have formed during firing of a product made of a paste with organic additives. Technical/technological analysis has shown that out of the entire collection from the settlement only that vessel was made with the addition of an organic solution.

Samples of pottery from Dubrovinsky Borok-3 (DB) were also conventionally divided into two series: 1) DB3, DB4, DB6, DB10, DB13, and DB19; 2) DB2, DB5, DB8, and DB11. They have revealed significant differences in weight loss upon heating up to 900 °C both at the dehydration and dehydroxylation stages (Table 4). In series 2, this indicator is lower, which suggests that these samples were subjected to a more intense thermal impact than those from series 1. This circumstance may indirectly point to the differences in potters' firing skills.

Significant weight loss in samples DB8, DB4, and DB19 at the high-temperature stage (600–850 °C) can be explained by the release of carbon-containing compounds: according to technical/technological analysis, these three vessels differ from the rest of the pottery in that they have paste with organic additives.

Samples of pottery from Kamenny Mys (KM) were divided into three series depending on the type of IPRM. Most samples are distinguished by significant weight loss, especially at the dehydration stage, and some at the dehydroxylation stage (Table 5). Release of a large amount of water indicates a fairly high porosity of pottery and weak thermal impact. The exceptions are samples KM1, KM26, and KM36 with relatively small total weight

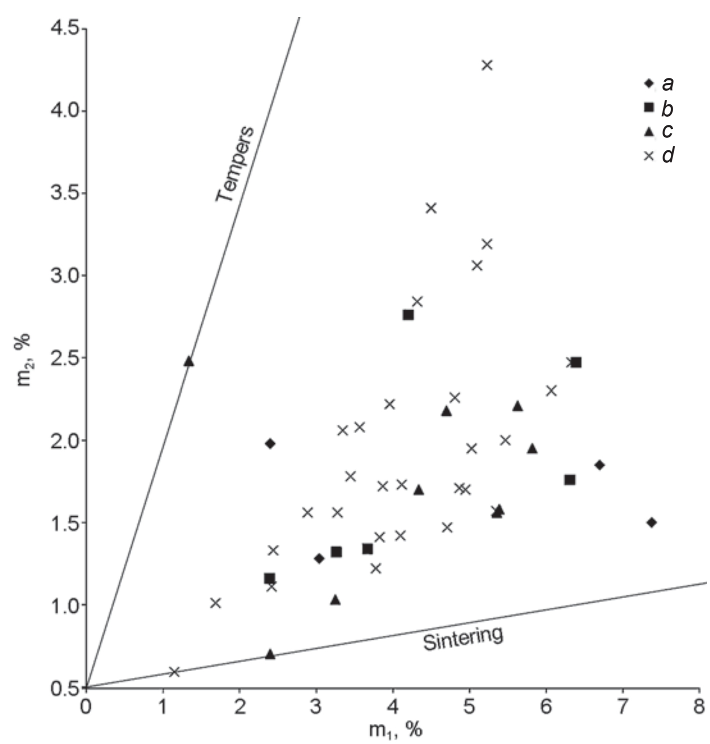


Fig. 5. Diagram of weight loss by pottery samples in the temperature ranges of 20–350 °C (m_1) and 350–600 °C (m_2).
a – Dubrovinsky Borok-4; *b* – Ordynskoye-9; *c* – Dubrovinsky Borok-3; *d* – Kamenny Mys.

loss (2.05–3.75 %). It can be assumed that they were subjected to more intense firing.

Four samples (KM20, KM34, KM30, KM47) demonstrate a fairly large mass loss (1.02–1.63 %) in the high temperature range (600–860 °C), associated with release of carbon-containing compounds, since these items were made of pastes containing organic additives.

Differences between pottery samples from all the sites can be more clearly observed in the diagram showing the preservation of the clay component (Fig. 5). The ratio of mass loss during dehydration and decomposition of hydroxyls (m_1/m_2) for clay of a specific composition is known to be constant. If temper (sand, grus, or grog) is added to the paste, both m_1 and m_2 decrease, but the ratio remains the same. Since, with rare exceptions, the pottery under study was made of pastes with approximately the same concentration of artificially added tempers, we can compare specific features of thermal transformations of pottery from different sites. The points characterizing the samples from Kamenny Mys are distributed relatively evenly on the diagram and are located far from the sintering line, which indicates a relatively weak thermal impact. Vessels from Dubrovinsky Borok-3 were apparently fired at a lower temperature or for a shorter period of time as compared to those from Kamenny Mys. As far as the samples from Ordynskoye-9 are concerned, the figure clearly shows the existence of two series differing in intensity of firing.

Conclusions

A comprehensive multidisciplinary analysis of the pottery has revealed that the vessels from Kamenny Mys and Dubrovinsky Borok-3 were made of clays procured from the same granitoid massif. Different types of initial plastic raw materials (IPRM), including three for the pottery from Kamenny Mys and two from Dubrovinsky Borok-3, have been distinguished according to their mineral composition, which implies several groups of potters who used different clay pits. The difference was also evident in the skills of paste making. Comparison of IPRM in the pottery from Kamenny Mys and Dubrovinsky Borok-3 has revealed significant differences in the mineral composition. This may indicate that the population of Dubrovinsky Borok-3 did not leave the Kamenny Mys burial ground (it belonged to another population group), or that these sites were populated in different periods. The latter assumption is consistent with the hypothesis of Troitskaya that the sites belonged to different chronological periods of the Novosibirsk variant of the Kulaika culture (1979: 48–50). Thermal analysis of pottery samples from all the sites has shown that some of the vessels had a more intense firing than others, which may indirectly manifest the differences in the skills of potters at different settlements.

Continuing integrated multidisciplinary studies of the Kulaika pottery will expand our knowledge of the Early Iron Age in Western Siberia and will make it possible to reconstruct intercultural contacts, as well as historical and cultural processes in ancient times.

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Origin and Date of Cast-Iron Moldboards from Southern Siberia

The study addresses the dating and provenance of cast-iron moldboards found in Southern Siberia (the Altai Mountains, Khakassia, and Tuva). For the first time, a similar artifact from the Katanda valley, Ust-Koksinsky District, Republic of Altai, is described. The traditional idea that such artifacts date to the Tang epoch (618–907) is unwarranted. New interpretations of inscriptions on moldboards are proposed, indicating ties with the metallurgic center in Qiyang, Shahe County, Hebei Province, China. Certain specimens could have been manufactured in Qiyang, while others may be local replicas of Chinese prototypes. The closest parallels are those from Northern China, dating to 900–1400 (Song, Liao, Western Xia, Jin, and Yuan states). Those from Southern Siberia likely date to th e 13th–mid-14th century, when that territory was part of the Mongol and Yuan empires. The appearance of Chinese moldboards and their replicas in Southern Siberia was caused by the establishment of military-agricultural settlements, and progress in agriculture and metallurgy under the auspices of Yuan governors, who needed food to supply the army.

Keywords: *Southern Siberia, China, Middle Ages, moldboards, agricultural development, cast-iron production.*

Introduction

In 2021, during the work of the Southern Altai team from the Institute of Archaeology and Ethnography of SB RAS at archaeological sites in the Katanda valley, Ust-Koksinsky District of the Altai Republic, a cast-iron moldboard broken into two parts was found on a plowed field (Polosmak, Dyadkov, 2021: 605). This was a massive object of irregular lenticular shape, with jagged protrusion in the upper part. Its maximum size was 29.5 × 29.5 cm; thickness 7–8 mm. A protrusion-lug and four eyelets for fastening were on its back. Between the eyelets, there was an inscription consisting of two Chinese characters (Fig. 1). The upper character 張could be read as *zhang*—one of the most common Chinese family signs. The inscription could have indicated the name of the craftsman who made the tool or name of the workshop. This new find compels us to revisit the issue of dating and establishing the origin of this category of artifacts, which will provide new information about the development of agriculture in the Altai Mountains and the entirety of Southern Siberia.

Materials

At present, over thirty similar items are known in Russia. These are mainly accidental finds from the Minusinsk Basin and Tuva. About twenty specimens*

*The State Catalogue of the Museum Fund of the Russian Federation (https://goskatalog.ru/portal/#/) contains photographs

Fig. 1. Plow moldboard from the Katanda valley, Ust-Koksinsky District of the Altai Republic (*photo by the author*).

are kept in the collection of the Minusinsk Museum of Local History. Some of these were described by Y.I. Sunchugashev (1990: 34–35). Several more items are in the collections of the National Museum of the Republic of Tuva*. One cast-iron moldboard is on display at the Krasnoyarsk Regional Museum of Local History (Fig. 2, *1*). Apparently, it was brought from Tuva by A.P. Ermolaev (1919: 36). Two specimens (presumably from the Manchu period, second half of the 17th to early 20th centuries) are in the collections of the State Hermitage. One plow moldboard from the Khakass-Minusinsk Basin is kept in the State Historical Museum (Evtyukhova, 1948: 82–83; Kiselev, 1951: 570–571). Another one is in the Khakass National Museum of Local History (Kyzlasov, 2002: 73–74). The only specimen obtained during scholarly archaeological excavations is a lenticular moldboard (27.5 × 23.5 cm) discovered during the study of the 3rd Shagonar fortified settlement in Tuva (Fig. 2, *2*). Kyzlasov mentioned that this was a local product and not an imported item, since, unlike Chinese products, it was riveted from forged iron plates and not cast from cast-iron (1969: 63–64, pl. II, fig. 12; 1979: 155–156). In addition, another moldboard, similar to the specimens from Tuva and Khakass-Minusinsk Basin, was found in the Zakamensky District of the Republic of Buryatia, and is currently kept in the Buryatia History Museum.

In June 2012, a cast-iron moldboard was found on the right bank of the Bely Iyus River, 7 km south of the village of Maly Syutik, Ordzhonikidzevsky District of Khakassia. The subsequent destiny of the find is unknown. This was a massive lenticular item (31 × 27 cm), with four eyelets for fastening on the back. Between the eyelets, there were two Chinese characters張宜, which can be read as *zhang yi*. The authors of the publication offered the following translation of the inscription: “to establish in the proper order” (Botvich, Oborin, 2013: 216). However, these characters can also be interpreted as a proper name, since the first one designates one of the most common Chinese surnames (Zhang), while the second may be a personal name. Indication of the surname of the artisan, name or location of the workshop on the back of the item was typical of Chinese goods.

Only one similar item has been found so far in the Altai Mountains. This was a lenticular moldboard (28.5 × 25 cm), with four eyelets for fastening on the back and two Chinese characters in between. It was discovered in 1977 in the mound of a large kurgan on the bank of the Yustyd River (Kubarev, 1997: 220–221), and is currently kept in the collection of the Museum for the History

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of 18 plow moldboards from the collection of the Minusinsk Museum of Local History. S.V. Kiselev mentioned twenty items (1951: 570), but provided accession numbers for only 19 of them (Ibid.: Nt. 1).

*The State Catalogue of the Museum Fund of the Russian Federation contains photographs of three plow moldboards kept in the National Museum of the Republic of Tuva. Information about two more items (with their accession numbers) is provided in the article by L.R. Kyzlasov (2002). Thus, there are at least five such items in the collection of this museum.

Fig. 2. Plow moldboards.
1 – collection of the Krasnoyarsk Regional Museum of Local History (*photo by the author, not to scale*); *2* – 3rd Shagonar fortified settlement, Tuva (after (Kyzlasov, 1979: 156)); *3* – Khara-Khoto fortified settlement, Inner Mongolia (after (Guo Zhizhong, Li Yiyou, 1987: 11)); *4* – Museum of Inner Mongolia (after (Zhonghua nongqi tupu, 2001: 158)); *5* – Daguxiancun site, Beijing (after (Su Tianjun, 1963: Col. pl. 4)); *6* – Tuchenzi site, Inner Mongolia (after (Zhonghua nongqi tupu, 2001: 159)); *7* – Wuhai Museum (after (Xi Xia wenwu…, 2014: 893)); *8* – Hohhot, Inner Mongolia (after (Ibid.: 911)).

and Culture of Peoples of Siberia and the Far East IAET SB RAS. The state of preservation of this item precludes an unambiguous decipherment of the inscription. However, it can be assumed that it should be read in the same way as the inscription on the moldboard from the Ordzhonikidzevsky District of Khakassia. Furthermore, another item with a similar inscription is kept in the Minusinsk Museum of Local History (Inv. No. AJ-1197). This is a lenticular plow moldboard (30.5 × 27.5 cm), with four eyelets for fastening on the back side and two Chinese characters in between, the first of which is 張 *zhang**. Thus, it can be assumed that four tools—two from the Altai Mountains, one found in Khakassia in 2012, and the moldboard from the Minusinsk Museum of Local History—were made in the same production center.

Problems of attribution

Chinese cast-iron moldboards that were discovered in Southern Siberia have been traditionally dated to the Tang period (618–907) in Russian archaeological literature. When scholars bring up this dating, they refer to the work of L.A. Evtyukhova from 1948. However, according to the original source, this dating was based on oral communication by some unnamed Chinese experts who participated in preparing an exhibition of Chinese art in Moscow and examined the only item from the collection of the State Historical Museum (Evtyukhova, 1948: 82). This version is described in more detail in the book by S.V. Kiselev. In 1940, the item was examined by the curators of the Beijing Museum of the Former Imperial Palace (Gugong)—art historian Fu Zhenlun and paleographer-calligrapher Li Naizhi. On the basis of epigraphic evidence, they unanimously attributed the creation of that tool to the pre-Tang period, most likely to the 5th century AD. In addition, Kiselev mentioned that on the back of the moldboard, "there is a relief inscription 'man-made'" (1951: 570), but he did not indicate when or who translated it. However, the published drawing (Evtyukhova, 1948: 83, fig. 165) and photograph (Kiselev, 1951: 571, pl. LIII, fig. 2) of that item exclude the possibility of such translation of the inscription. The characters should be read as 綦陽 *Qiyang*, which is the name of a place famous for its ironworks. The modern village of Qiyangcun is a part of the town of Qicun in Shahe County of the Xingtai Prefecture-level city, in Hebei Province of Northern China. Information about production of cast iron in this area has survived in local gazetteers (地方志 *difangzhi*) from various periods.

*For a photo and description of the item, see the State Catalogue of the Museum Fund of the Russian Federation. URL: https://goskatalog.ru/portal/#/collections?id=14363371 (Accessed September 11, 2022).

Extraction of iron ore, production of cast iron, and organization of state-owned workshops in Shahe County in the Han and Wei periods* was first mentioned in the 15th juan “Hedong Circuit. Part 4” (“Hedong dao. Si”) of the geographical work “Illustrated Description of Districts and Counties During the Reign of Yuanhe” (“Yuanhe junxian tuzhi”), written in 813 by the scholar and dignitary Li Jifu (758–814) (1983: 428). The “Description of Shahe County”, compiled in 1609 by the local official Gu Shiyan, states: “The administration of cast iron production is located in the Qiyang settlement; <when> under Han and Wei, officials were appointed to <manage> the production of cast iron, an inspector was sent here” (铁冶司在綦阳镇，汉魏立铁冶官，分守于此*Tieyesi zai Qiyang zhen, Han-Wei li tieye guan, fenshou yuci*) (cited after (Zhao Mengkui, 2017: 59)). More detailed information is contained in the “Description of Shahe County”, compiled in 1940 by a team of authors led by Wang Yansheng: “Shunde is located in the lands north of the Yellow River. It was an important place for the imperial court. There are many high mountains and beautiful hills in this area. Since a long time ago, ore mining and metal smelting have been profitable in this area. Qicun is located there. In the 5th year of the reign of Huangyou (1053), officials began to be appointed. There used to be a temple near the foundries. It existed for a very long time and almost collapsed, but the inspector of the foundry Mr. Zhang, restored it in its original place” (顺德在河朔，为朝廷一襟要。其地多隆岗秀阜，坑冶之利，自昔有之。綦村者即其所也。皇祐五年，始置官吏，冶之旁旧有神祠，历载既久，将就倾圮，冶吏监侯张即故址而新之。*Shunde zai Heshuo, wei chaoting yi jinyao. Qidi duo long gang xiu fu, kengye zhi li, zixi youzhi. Qicun zhe ji qisuo ye. Huangyou wu nian, shi zhi guanli, ye zhi pang jiu you shenci, lizai jijiu, jiangjiu qingpi, yelijian hou Zhang ji guzhi er xin zhi*) (cited after (Ibid.)).

Information from historical sources is confirmed by archaeological and epigraphic evidence. In 1957, archaeological works in the Qicun township (transformed into a town in 1985) revealed traces of the developed metallurgical production, which existed here in the past. Fragments of iron ore and slag were found on the ground surface to the west of the entrance to the village of Qiyangcun. The remains of 17–18 blast furnaces, concentrated inside the ditch that the locals called “Iron Ditch” (铁沟 *Tiegou*), also survived in the area. Nearby, pieces of iron were found in a pile. Fragments of tiles and gray pottery were discovered near the ditch, at a distance up to 1.5 km from the village, which may indicate the existence of buildings there. In addition, traces of mining survived in the southern part of the township, and local folklore preserved stories related to iron mining at that mine. A stone stele half buried in the ground was found in the southern part of the village of Qiyangcun, behind the temple of the Bodhisattva Guanyin. The stele had the inscription: “The General Administration for iron foundry of Shunde District [in the territory of the modern prefecture-level city Xingtai in Hebei Province. – *M.K.*], the stele was set up in [the character has not survived. – *M.K.*] day of the 9th month of the 2nd year of the reign of Dade (1298)” (順德等處鐵冶都提舉司，大德二年九月□日立石*Shunde dengchu tieye dutijusi, Dade er nian jiuyue ... ri li shi*). The stele could have stood in front of the entrance to the administration office mentioned in the inscription. Another stone stele was discovered in the northern part of the village, on the eastern side of the temple of Xuan-di*. That stele had an inscription entitled “Record of the restoration of the temple of the patron deity of iron-smelting under the Great Song [the Chinese state, existed in 960–1279. – *M.K.*]” (大宋重修冶神廟記*Da Song chongxiu yeshen miao ji*). It was set up in the 8th month of the 4th year of the reign of Xuanhe (1122). Only a fragment of the inscription has survived: “…an important place for the imperial court. There are many high mountains without vegetation in this area. Since a long time ago, ore mining and metal smelting have been profitable here. Qicun is located here… since the 5th year of the reign of Huangyou (1053), officials began to be appointed. At first, annual income was still insignificant…” (…年始 置官吏，岁入之数初也甚微… *...chaoting yi jinyao, qidi duo long gang tu, kengye zhi li zixi youzhi, Qicun zhe ji qisuo ye... Huangyou wu nian shi zhi guanli, suiru zhi shu chu ye shenwei...*). Ren Zhiyuan (1957) assumed that the monument belonged to the pre-Song period; Tang Yunming (1959) tentatively dated it to the Song period.

Unfortunately, historical and cultural monuments in the village of Qiyangcun were seriously damaged in the subsequent years. In 1966–1970, during the “cultural revolution”, stone steles with inscriptions about the development of metallurgy in Qiyangcun in

*That is, during the reign of the Chinese Han Empire (206 BC to 220 AD) and Kingdom of Wei during the Three Kingdoms period (220–266).

*One of the mythical five emperors, also known as Zhuan-xu and Gao-yang.

the Middle Ages were destroyed. Only two epigraphic evidences—tablets on a brick arch in the western part of the village—have survived until today. On the eastern wall, facing the village street, above the vault, there is the inscription "Pavilion for the Prosperity of Culture" (文昌閣*Wenchang ge*). Apparently, a small pavilion used to be built over the arch. On the western wall, facing the ruins of the metallurgical production complex, the inscription "Reflection of iron smelting" (映鐵冶*Ying tieye*) has survived. Archaeological complexes were also significantly damaged. When examining the site west of the village in 1977, the remains of only one semicircular blast furnace were found. The furnace was about 2.5 m high (the diameter of the surviving part was approximately 1.4 m), cut into the steep slope of a loess terrace. On the inside, the walls of the structure were reinforced with pebble stonework. Inside the furnace, pieces of burnt soil and fragments of iron and slag were found. In the 1980–1990s, the above-ground part of the archaeological site was completely destroyed by plowing, and remains of the blast furnace were covered with debris from the local mining and processing plant (Zhao Mengkui, 2017: 59).

Thus, the entire set of evidence indicates that in the village of Qiyang, there was a developed metallurgical complex, which emerged no later than the Song period, and possibly existed as early as the Han period. Production appears to have flourished during the Song and Yuan periods (1279–1368). However, to this day, metallurgy is one of the most important industries in the economy of this region.

It is known that plow moldboards were manufactured in Qiyang along with other products. In 2005, east of the village of Shamingcun, in the Hejin township of Wu'an County, Handan Prefecture of Hebei Province (at a distance of about 30 km south of the village of Qiyangcun), a cast-iron moldboard was found, with the inscription: "Cast <in the village> of Conghu in the west of Jiyang by <a craftsman from> the Chang clan" (綦陽西叢鵠冶常氏*Jiyang xi Conghu ye Chang shi*). Apparently, Jiyang is a village of Qiyang. Conghu is the former name of the village of Quanhucun in the Cejing township of Shahe County, which is located approximately 15 km southwest of the modern village of Qiyangcun. The village of Quanhucun received its current name at the end of the Ming period, in the first half of the 17th century; therefore, the moldboard was made no later than that time (Wang Ronggeng, 2018: 113–114). In 2015, in the Pinglu District of Shuozhou Prefecture-level city, in Shanxi Province, a local peasant, while cultivating land, found a hoard of cast-iron agricultural tools, including two plow moldboards*. The items were severely damaged by corrosion, but traces of ornamental decoration were still visible on their surfaces. The inscription on one of them can be read as "Produced by the state-owned <workshops> of Jiyang" (綦陽官造*Jiyang guanzao*). Local experts dated the tools to the Song Dynasty**.

Another moldboard with similar inscription was found during excavations at the fortified settlement of Khara-Khoto (Chinese: Heicheng, Heishuicheng)—the ruins of the Tangut town of Edzina. This was an important administrative center of the Western Xia (Xi Xia), known since 1032, which retained its significance even under the Mongols, and was destroyed by the troops of the Ming dynasty in 1372. This fortified settlement is located 25 km southeast of the village of Dalaihubu, in Ejin Banner of Alxa League, in the Inner Mongolia Autonomous Region. Two layers were identified at the site: one from the time of the Western Xia (1032–1226), and the other of Yuan Empire and Northern Yuan State*** (1286–1372). The lower boundary of the second period resulted from the fact that in 1286 the town became an administrative center of Yijinai District, and its reconstruction began. A cast-iron plow moldboard was discovered during the excavations in 1983–1984 in the layer of the Yuan period. This is a lenticular item (26 × 25 cm). A protrusion and four eyelets for fastening are on the back. An inscription of four characters, enclosed in rectangular frame, is between the eyelets. The first character is unreadable, but the next three (□陽官造 *…yang guanzao*) suggest that this item was also "manufactured by the Jiyang state-owned <workshops>". To the right of the frame, there is a mark in the form of *huaya* ('flower seal')—stylized monogram of Chinese characters, possibly the "signature" of the artisan who made the tool. On the left side of the moldboard, a fish is represented, and on the right side, a lotus flower (Guo Zhizhong, Li Yiyuo,

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*In the news article, they were mistakenly called ploughshares, but the published photograph indicates that these actually were moldboards.

**"Shanxi Shuozhou cunmin gengzuo shi faxian songdai nongju, yi yanzhong xiushi (tu)" – "While cultivating land, a peasant from Shozhou, Shanxi, discovered agricultural tools of the Song period, which were seriously damaged by corrosion (photo)". October 12, 2015. (Official website of the state news agency "Zhongguo xinwenshe" (China News Service). URL: https://www.chinanews.com.cn/cul/2015/10-12/7564271.shtml (Accessed September 5, 2022)).

***This state existed in 1368–1388 in Mongolia after expulsion of the emperors of the Yuan dynasty from China.

1987: 11) (Fig. 2, *3*). In its shape, some decorative details, and content of the inscription, this moldboard is most similar to the specimen from the collection of the State Historical Museum, which is decorated with a pair of fish images. These two items could have been made at approximately the same time.

In addition, the collection of the Inner Mongolia Museum (Hohhot, China) contains a plow moldboard with an inscription in Chinese characters "Produced by the Jiyang state-owned <workshops>". Although its exact origin is unknown, it has also been dated to the Yuan period. This item is lenticular in shape (30 × 25.5 cm). On its back, there is a protrusion and four eyelets for fastening. Four characters in a frame are between the eyelets. A fish is to the left of the eyelets, and flower on a long curved stem is to the right (Fig. 2, *4*). Thus, its design is almost identical to that on the moldboard from Khara-Khoto (Fig. 2, *3*). However, unlike the items discussed above, this one was made of bronze and not cast-iron. Another remarkable detail is that the inscription was incorrectly applied to the casting mold, and therefore appeared on the moldboard in mirror image (Zhonghua nongqi tupu, 2001: 158). Judging by this feature and by the material, it may be assumed that this item was not produced in Qiyang workshops, but was a local imitation.

A specimen that is extremely similar to the moldboards from Khara-Khoto and Museum of Inner Mongolia is kept in the National Museum of the Republic of Tuva. It was cast of iron and has a lenticular shape (28.4 × 25.0 cm). A protrusion and four eyelets for fastening are on the back. An inscription of four characters enclosed in a frame is between the eyelets. A fish is depicted to the left of them, and lotus flower to the right*. The first two characters are unreadable, and only a part of the inscription can be reconstructed as □□官造 *…guanzao,* "produced by state-owned <workshops>…". A similar item was found in 2020 together with a cast-iron share in the Untakhan locality, near Salaga Ulus, Zakamensky District of the Republic of Buryatia, and is currently on display at the Buryatia History Museum. An inscription of four vertically placed characters in a rectangular frame was on the back of the item under the protrusion, between four eyelets for fastening. Two upper characters have not survived. The lower characters can be read as □□官造*…guanzao,* "produced by state-owned <workshops>…". A lotus flower is represented on the right of the frame.

An inscription containing a reference to Jiyang workshops also appears on a plow moldboard found in 1947 in a hoard of agricultural tools (four cast-iron moldboards, a bronze share, and the upper lid of a bronze mold for casting the share) in the village of Sosnovka in Tuva. The inscription consists of two characters (綦易*Qiyi*) carved into the surface, and was made during casting of the item (Kyzlasov, 2002: 77, fig. 5). In 1957, the characters were read correctly by B.I. Pankratov and V.S. Kolokolov. Pankratov proposed two translation options: the literal "very convenient", and more expanded, but in no way substantiated "make every effort to cultivate the fields" (Kyzlasov, 1969: 139, 143, 155–156; 2002). However, in our opinion, it would be correct to interpret these characters as a proper name—a modified name of the village of Jiyang. All the tools from the hoard were made by local artisans, which is also confirmed by the discovery of the mold lid along with the tools (Kyzlasov, 2002: 73–74). The foundry workers could have tried to copy the mark that was placed on high-quality products of Jiyang workshops, which came to Tuva, but made a mistake in writing the second character, having cast 易*yi* instead of 陽*yang*. The same hoard also contained a plow moldboard with the inscription "23rd year of <the reign of> Zhiyuan [1286]" (至元二十三年 *zhiyuan ershisan nian*), which makes it possible to date the entire complex to the late 13th century. These characters were applied to the casting mold in such a way that on the finished product they appeared in mirror image (Ibid.: 73–77, fig. 4).

Incorrect interpretation of the inscription on the moldboard from the State Historical Museum might have been caused by "translation difficulties". The translator could have assumed that the inscription named the manufacturer of the tool (a specific person or workshop), and this was taken as a literal meaning of the characters. Archaeological and epigraphic evidence of metallurgical production in Jiyang, at the time when inscriptions on plow moldboards from the collection of the State Historical Museum (before 1940) and from the Sosnovka hoard (in 1957) were translated, was still unknown.

Parallels from China

Dating of the plow moldboards under consideration can be clarified by considering a wider circle of

*For a photograph and description of the item, see the State Catalogue of the Museum Fund of the Russian Federation. URL: https://goskatalog.ru/portal/#/collections?id=33076531 (Accessed September 11, 2022).

archaeological evidence from China, where dozens of similar items have been discovered—from the Han period to the ethnographically modern period. These are items of various shapes and sizes, usually made of cast-iron, less often of bronze; tools made of different metals existed at the same time (Zhonghua nongqi tupu, 2001: 155–159; Chen Wenhua, 1994: 218–224, 237, 240, 244, 246–247, 249). The greatest similarity to plow moldboards from Southern Siberia is manifested by some types of moldboards common in the northern regions of China in the 10th–14th centuries. This was the time when the Chinese Empire of the Northern Song (960–1127), Khitan Liao (916–1125), Tangut State of the Western Xia (1038–1227), Jurchen Jin Empire (1115–1234), and Mongol Yuan (1279–1368) existed in this region. Only some of the tools were discovered during archaeological excavations; others were accidental finds, and the exact dates of their manufacture cannot always be established.

In addition to the above-described plow moldboard from Inner Mongolia, three more items were found during scholarly research of archaeological sites. One of these was discovered in 1958 at a site from the Liao and Jin periods, near the village of Daguxiancun in Shunyi District of Beijing. This was a cast-iron moldboard of lenticular shape (35.5 × 32.0 cm). Four eyelets for fastening were on the back. A swastika 卐 *wan* was between the eyelets (Su Tianjun, 1963: 140) (see Fig. 2, *5*). Another cast-iron moldboard was found during the excavations of one of the fortresses belonging to the defensive system of the Great Wall in the Jurchen Jin Empire. The site is located in the northern part of Tongliao Prefecture-level city, in Inner Mongolia. The moldboard was discovered in a pile of ash and household waste next to one of dwellings in the southeastern part of the fortress, surrounded by an internal wall. This was a lenticular item (34.0 × 23.5 cm), but its outline was more rounded than that on the other examined items. On its back, there were four eyelets for fastening. In the upper part, a character 火 *huo* was carved, the literal meaning of which is “fire”; however, it can also mean “ten soldiers” or be a family name (Shao Qinglong, 1984: 163, 168, 170–171). Another moldboard was discovered during the excavations at the Tuchengzi site of the Yuan period in Horinger County of Hohhot Prefecture-level city, in Inner Mongolia (it is now kept in the Inner Mongolia Museum). This is a massive cast-iron item of lenticular shape (29.5 × 25.0 cm), with protrusion and four eyelets for fastening on its back (Zhonghua nungqi tupu, 2001: 159) (Fig. 2, *6*).

Among accidental finds, noteworthy are two lenticular moldboards of cast-iron found in Inner Mongolia. These are believed to have been produced in the Tangut state of Western Xia. The first item (28.7 × 23.8 cm) was transferred to the Wuhai Museum (Wuhai Municipal District, Inner Mongolia) in 1989 (Fig. 2, *7*). The second item (30.6 × 25.5 cm), found in 2010 by a resident of Hohhot, is in the Alashan Museum (Bayan-Hot town, Alxa Left Banner, Alxa League, Inner Mongolia) (Fig. 2, *8*) (Li Yufeng, Du Jianlu, 2018: 345; Xi Xia wenu…, 2014: 892–893, 910–911). Another item of similar shape, measuring 26.5 × 19.5 cm, was found in Fengning Manchu Autonomous County of Chengde Prefecture-level city in Hebei Province, and was tentatively dated to the time of the Jurchen State of Jin (Bai Guang, Zhang Hanying, 1990: 88, 90).

Conclusions

Thus, at present, there are no grounds for dating all the plow moldboards discovered in Southern Siberia to the Tang period. Most likely, these items appeared in Siberia in the 13th–14th centuries, when Southern Siberian lands came under the rule of the Mongol Empire and then of the Yuan Empire as a part of Lingbei Province. First information about Chinese artisanal and agricultural colonies in Tuva in the Mongol period is contained in the “Description of the Journey to the West of the Real Man Changchun” (“Changchun zhenren xi you ji”), written by the Taoist monk Changchun (1148–1227), who traveled from China to Central Asia in 1221–1224 (see (Plotnikov, 2019: 338)). As L.P. Potapov pointed out, juans 7, 11, 12, and 15 of the “Basic Records” (“Ben ji”) of the “History of Yuan” (“Yuan shi”), compiled in 1369–1370 under the leadership of Song Lian, testify to creation of military-agricultural settlements in the Qianzhou region, in the upper reaches of the Yenisei River, in order to supply the Mongolian troops with food. These settlements were provided with seeds, draft animals (oxen), and agricultural tools. Both local residents (the Kyrgyz people) and forcibly resettled Chinese and Jurchens could live in these settlements (Potapov, 1953: 106). The presented data correlate with the evidence from the settlement complexes of the Mongolian period, studied on the territory of the Tandinsky and Ulug-Khemsky Districts of the Republic of Tuva. Residential, administrative, and religious buildings in these settlements were built according to Chinese models. Traces of ancient irrigation canals were found around the sites. Judging by the discovered plant remains, the colonists grew wheat, barley, millet, and other crops. Metallurgical production was also well developed (Plotnikov, 2019: 338–343). All this information encourages us to correct the current idea that the "agriculture in the Khakass-Minusinsk Basin lost its former development as a result of the Mongol domination in the 13th–16th centuries" (Sunchugashev, 1990: 84).

The second chapter "The Rebellion of the Northern Princes" of the historical work "Complete Records of Events in the History of the Yuan" ("Yuan shi jishi benmo"), composed by Chen Bangzhan in 1606, says that in 1309, the governor of Lingbei Province, in his report to the Emperor, proposed to establish military-agricultural settlements on the northern slopes of the Altai Mountains in order to keep in subjection the Chagatai princes who lived on the southern slopes (Potapov, 1953: 106). Similar settlements existed among the Jurchens in the early 13th century, which is known from the written sources and confirmed by archaeological evidence from the Russian Primorye (see (Artemieva, Sorokin, 2021: 67)).

The appearance of Chinese agricultural tools and the manufacture of replicas thereof in Southern Siberia could have been associated with the establishment of military-agricultural settlements and the development of agriculture and iron casting under the patronage of the Yuan governors, who needed food to supply the army. This is consistent with the results of paleogeographic studies in Tuva, which showed that the maximum development of irrigated agriculture in the region happened in the Uyghur-Mongol period (mid 8th–14th centuries), when sophisticated systems of irrigation canals were built (Prudnikova, 2005, 2018). These conclusions can also be extended to the Altai Mountains. Additional information about the time and place of manufacture of medieval agricultural tools discovered in the Altai, Khakassia, and Tuva can be provided by inscriptions in Chinese characters on their surface, whose reading and interpretation has not yet received sufficient attention.

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The Wanyan Digunai (Wanyan Zhong, Esikui) Funerary Complex in Primorye

The article outlines the findings of studies of a funerary complex beside the stone sculpture of a bixi turtle, discovered in 1893 on the territory of the mill of O.V. Lindholm in Primorye. The present research is based on unpublished diaries (from 1893 and 1894) of F.F. Busse, who carried out rescue excavations of the hill under the sculpture and unearthed a stone coffin buried nearby. A rounded stele top with 20 Chinese characters was found at the same place. The translation demonstrates that the burial was that of a prominent Jurchen military leader belonging to a noble Wanyan clan—Wanyan Digunai (Chinese name Wanyan Zhong, 完颜忠, known as Esikui/Asukui, 阿思魁). The burial was largely neglected, because scholars focused on translating and interpreting the inscription. The burial was believed to have been looted long ago, and Busse's diaries remained unpublished. The focus of the present study, therefore, is to describe all available sources relating to Wanyan Digunai's funerary complex. Based on the analysis of the excavation findings, features of the funerary rite are reconstructed. The architectural design and layout of the complex are shown to have followed the local East Asian tradition.

Keywords: *Jurchens, Wanyan Zhong, funerary complex, stone turtle, Jin Dynasty, Far East.*

Introduction

The medieval antiquities of the city of Ussuriysk represent the highlights of the history of the Russian Far East. Archaeological sites discovered there are of striking importance and highly informative with relation to issues concerning the history of East Asia. This territory includes the city of Kaiyuancheng (开元城, Krasnoyarovskoye fortified settlement)—the Upper capital of the Jurchen state of Eastern Xia (东夏国, Dongxiaguo); the city of Xupinlu (恤品路, South Ussuriysk fortified settlement)—a district center of the Jin Empire; as well as two funerary complexes with stone sculptures of turtles, which have provoked the interest of scholars since the 19th century. They are referred to as the Ussuriysk and Khabarovsk turtles according to the current locations of the statues. The former is presently associated with the founder of the Eastern Xia state, Puxian Wannu (蒲鲜万奴) (Artemieva, 2019), while the latter is associated with the outstanding military leader from the famous Wanyan family, Wanyan Digunai (完颜迪古乃, Chinese name Wanyan Zhong (完颜忠), nickname Esikui/Asikui (阿思魁)) (Larichev, 1966a: 235–237; 1966b, 1974). Scholars have usually paid more attention to the grave stone structures than to the burials. The objective of this study is to present evidence from the unpublished diaries of F.F. Busse who excavated the burial mound with the Khabarovsk turtle in 1893 and 1894, reconstruct the funerary rite using sources related to the burial of Wanyan Digunai, and identify specific features of spatial distribution and architecture at the Jin family cemeteries.

The Khabarovsk stone turtle (Fig. 1, *1*) is located in front of the entrance to the Grodekov Khabarovsk

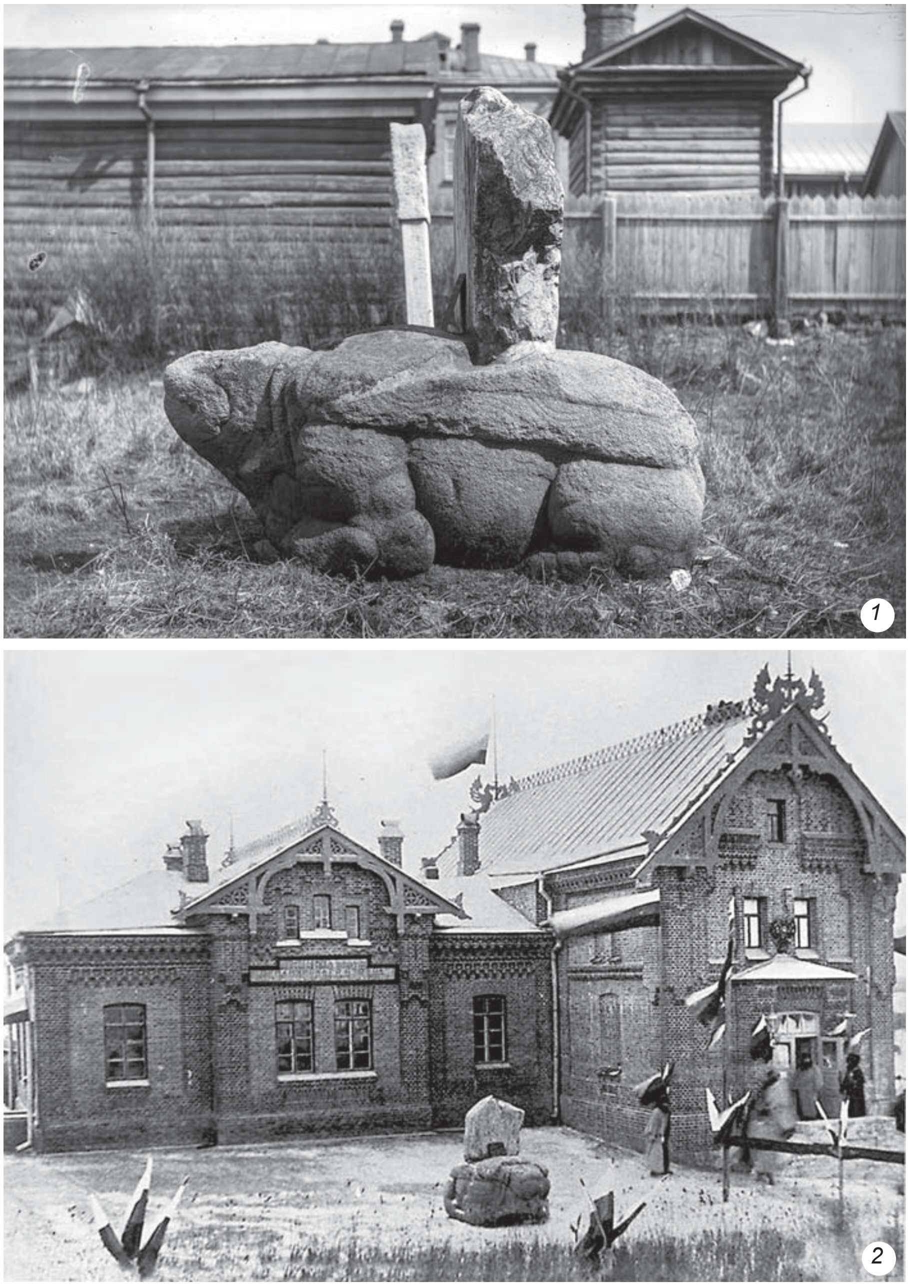

Fig. 1. Turtle at O.V. Lindholm's mill in 1893 (*1*) and in front of the building of the Amur Department of the Imperial Russian Geographical Society (Khabarovsk) in 1894 (*2*). *Photo from the collection of the Grodekov Khabarovsk Regional Museum*.

Museum of Local History (Fig. 1, *2*). This gravestone was first discovered by F.F. Busse, who visited the village of Nikolskoye in 1866: "…I saw two statues of turtles, a grave decorated with three pairs of statues of rams, people, and columns" (1893a: fol. 48). Initially, its discovery was attributed to P. Kafarov, who visited Nikolskoye in 1871 (Kafarov, 1871; Khokhlov, 1979). He made a drawing of the burial ground with the Khabarovsk turtle and placed it on the main drawing of the "Plan of Dvugradye and its environs". The funerary complex was depicted schematically as an embankment line, marked by six burial mounds. Dots indicated four more burial mounds inside this approximate geometric figure (Fig. 2, *4*)*. Kafarov was the first to describe a rounded stone top with an inscription written in Chinese characters and associated this text with a person "from the most noble Jurchen families", who lived in the early 13th century (1871: 94).

*Describing this drawing later, V.E. Larichev mentioned only two burial mounds surrounded by an embankment (1966a: 73).

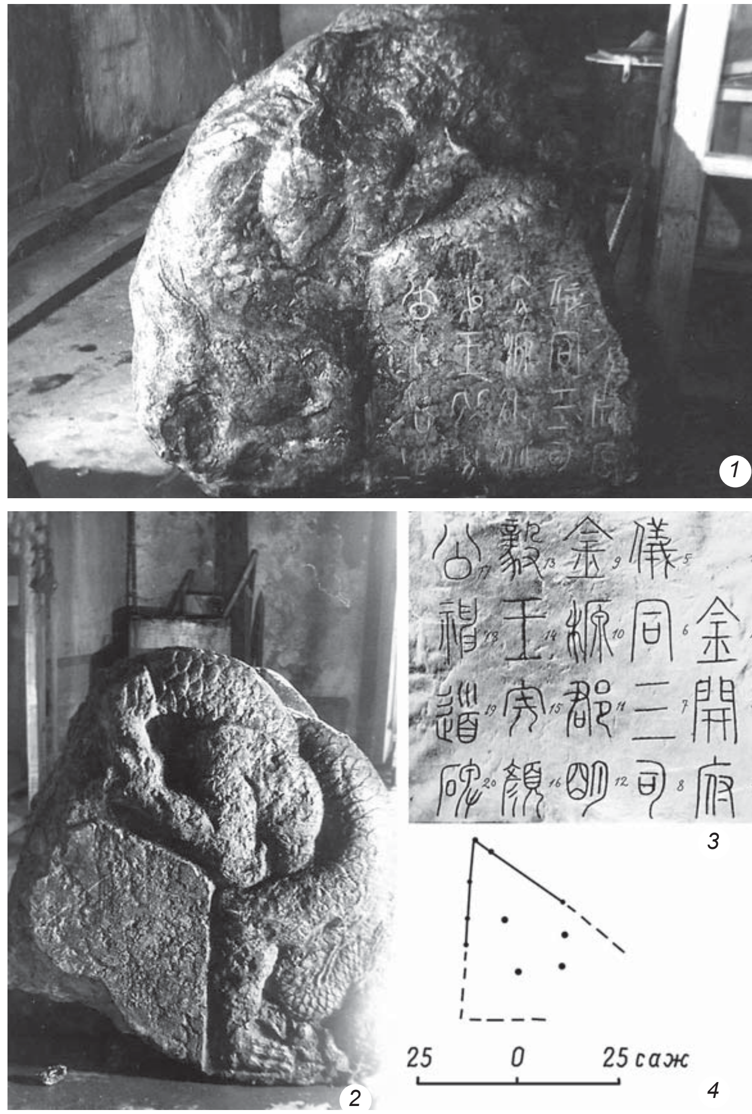

Fig. 2. Top of the stele with a dragon image. *1* – front side; *2* – reverse side; *3* – trace drawing of the inscription on the top (Busse, 1893a: fol. 53); *4* – diagram of the funerary complex made by P. Kafarov (Busse, Kropotkin, 1908).

The top, which formed the upper part of a funeral stone, was subsequently lost. It was rediscovered in 1885 by V.S. Mikhailovsky in the yard of the peasant Spiridon Nazarenko. A part of the stone on the right side was chipped, but the front side retained twenty Chinese characters, four lines of five characters each. One sign was lacking (Fig. 2, *1–3*). Presumably, it was the character 大 (da, 'big, great'), which was part of the name of the Jin state 大金 (Da Jin, 'Great Jin'). The surviving (complete) text was as follows: 大金开府仪同三司金源郡明毅王完颜公神道碑 (Da Jin kaifu yitongsansi jinyuan jun ming yi wang Wanyan Gong shendao bei, 'a stele on the way to the grave of the enlightened and resolute Jin revered prince of the Golden Empire [with the title of] kaifu yitongsansi Wanyan Gong'*).

Busse traced this inscription and ordered photographic copies from the Schulz workshop. These photographs were sent for interpretation to the Academician V.P. Vasiliev, to the Beijing Mission, the Chinese commissioner from the border commission, and to the archaeologist Wu Dacheng. Busse also gave many copies to sinologists in China and Russia. M.G. Shevelev was the first to translate the inscription: "The monument… to the Prince of Wanyan Ming of the Great Jin Dynasty, the founder of the local government identical to the three chambers of the city of Jinyuan" (Busse, 1893a: fol. 53). Mikhailovsky, who was working on his translation at the same time, using a large number of sources, commented in detail on his interpretation of each character ("The monument of glorious merits, the Most Serene Prince of Jinyuanjun of Wanyan Gong of the Great Jin Kingdom") and came to the conclusion that "everything occurred under Emperor Shizong, whose reign lasted from 1168 to 1190 AD" (Pismo…, 1890). V.K. Arseniev gave another interpretation: "A funerary monument of the 12th century was erected to the Commander-in-Chief of the Jin Army, the Jinyuan Prince of Wanyan" (1947: 303).

Orientalists of the 19th–20th centuries did significant work on the translation, but the final point in resolving this issue was made by Larichev, who proved that this burial belonged to Wanyan Digunai, the prominent Jurchen military leader from the Wanyan clan (1964, 1966a: 228–229, 1966b, 1974). He was an important historical figure contributing to consolidation of state power in the Suifen River valley. Much later, without disputing the identity of the buried, Chinese scholars clarified the translation of the passage from the *Jin Shi* ("The History of Jin") made by Larichev (Lin Yun, 1992: 37). According to the *Jin Shi*, Wanyan Digunai (Esikui) governed on the Suifen River for 13 years and died in the 14th year after the beginning of the reign of Xizong (Wanyan Hela, Chinese name Wanyan Dan, temple name Xizon; 1135), that is, the year of his death was 1148, as indicated by Larichev. The same chronicle also reported that in the 2nd year of Tiande (1150), people began to perform the ritual of sacrifice to Wanyan Digunai in the Taizong Temple, and in the 2nd year of the Dading era (1191), he received the posthumous title of "Jinyuan junwang" ('Jin Revered

*Translation by P.A. Artemieva.

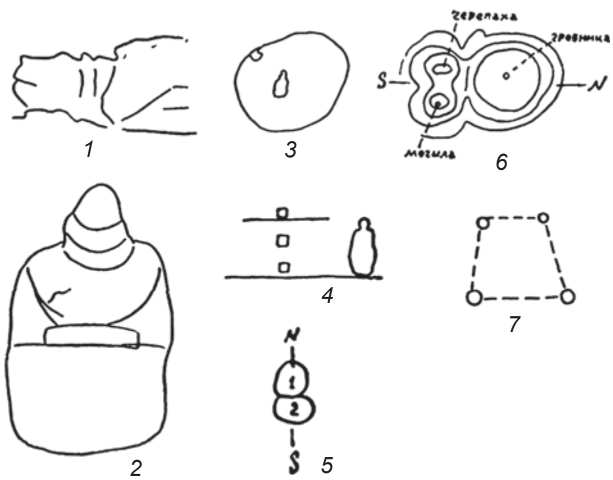

Fig. 3. Drawings by Busse, from his excavation diary.
1–3 – stone turtle: side view, top view, and location on the hill; *4* – stone bases of columns located next to the statue of the turtle; *5* – diagram of the hills (1 – location of the stone coffin, 2 – location of the turtle statue); *6* – diagram of the hills after excavations; *7* – plan view of the pillars discovered in the burial mound adjacent to the stone turtle.

Prince') (Jin Shi, 1970: 547)*. Based on this information, Wanyan Digunai (Esikui) died in 1148, and the funerary complex was built after 1191, because the inscription on the top of the stele contained his posthumous title.

According to the chronicles, Wanyan Digunai (Esikui) was one of the three sons of Wanyan Zhilihai, the leader of the Yelan tribe. The section of biographies of the *Jin Shi* preserved a brief biography of the commander, from which it follows that in 1118, after the death of Shitumen, the leader of the Wanyan tribe in the Yelan Province, he was replaced by his brother Wanyan Diguai (Esikui). The latter was a prominent commander and advisor to Aguda. At a meeting concerning war with Liao, Wanyan Digunai persuaded the Emperor to take military action in which he also took part. The death of Shitumen compelled him to return to Yelan. Wanyan Digunai organized resettlement of his tribe to the Suifen (Razdolnaya) River, since their old lands had become infertile, and lived there for thirty years, diligently engaged in arable farming (Larichev, 1964).

Lin Yun studied the biography of Wanyan Digunai and noted two important events related to him. From the first half of the 11th to the early 12th century, Aguda's ancestors paid great attention to the Suifen River basin. The Jurchens had to use military force several times, because local tribes still possessed some independence—sometimes they served and sometimes they rebelled. The Jin dynasty firmly established its dominance over the region after the troops under the leadership of Wanyan Digunai settled on the Suifen River in 1124, and there were no more military clashes in the entire Lindong region (literally, 'east of the ridge'). Another event involved a report that Wanyan Digunai, together with Wanyan Loushi, submitted to the Emperor after the capture of Xianzhou in 1117, proposing "to resettle the poor to the interior lands" (meaning the conquered people). During implementation of this initiative, additional measures were taken to "provide material assistance to starving and poor people by the officials", which contributed to independent influx of population from the Liao state. Then in the 7th year of Tianfu (1123), "people of all tribes moved to Lindong", and in the 2nd year of Tianhui (1124), they were also given material assistance. This played an important role in further development of the Primorye region east of the Laoyeli Ridge. Regarding the time when the burial stele of Wanyan Digunai (Esikui) was set up, Lin Yun believed that this occurred in the 8th year of Dading (1168) (Lin Yun, 1992: 37).

Excavations of the Khabarovsk stone turtle by F.F. Busse in 1893–1894

Busse began excavating the hill under the stone turtle in October 1893. This was caused by the need of the owner of the mill, O.V. Lindholm, to use the part of the yard where the mounds were located for expanding his farm. It was decided to transport the statue to the public garden in the village of Nikolskoye and initiate excavations. Busse already had experience in that kind of work (Artemieva, 2019). It was planned to put the monument on a sleigh and transport it in the winter.

Lindholdm's mill was located on the edge of a natural terrace on the left bank of the Krestyanka River, 1 km downstream from the Western Ussuriysk fortified settlement. According to the description by Busse, the statue of the turtle was located on an ellipsoidal mound, not in its center, but to the west of the highest point (Fig. 3, *3*) (1893a: fol. 48). Another partially destroyed burial mound was adjacent to that mound (Fig. 3, *5*).

Busse kept a detailed diary of the excavations, which is now the only source of information about this burial (1893a). An excavation ditch, approximately 2.15 m long and 1.5 m deep on its eastern side, was made under the turtle statue along east-west line. A continuous layer of gray tiles of two types was under the sod (3–4 cm). Three stone bases of columns were found at a distance of 4.2 m on the eastern side of the turtle statue (Fig. 3, *4*). Next to them, an iron chisel and a carnelian ornament with images of berries were discovered. A layer of clay with significant accumulations of large pebbles (15 cm) was under the tiles.

Another trench was needed for placing the sleigh under the statue. It was made along the meridian through the

*The translation from the *Jin Shi* was made by P.A. Artemieva.

center of the adjacent burial mound. Many pig (?) bones were discovered under a layer of black soil (30–60 cm) at a depth of about 1 m northeast of the center of the hill, and bones of a large animal were found 30 cm lower. Both groups of finds were located in compact accumulations continuing into the eastern and western sides of the ditch, so Busse decided to begin excavations of the entire central part of the burial mound. The works were carried out in two sections. Two accumulations of bird bones were discovered at a depth of 1.2 m in the western part of the well. Blue bricks and fragments of tiles of various colors and sizes, which could not be correlated with any structure, occurred in the filling throughout the entire layer. Most likely, they ended up in the layer by accident.

An iron pipe 10.5 cm long with thick walls and a cap, and the fragment of a screw, attributed to the modern period, was found at a depth of about 1 m, which led scholars to the conclusion that earlier robbers tried to plunder the burial mound by digging a well in the center, which was later filled in. The robbers' pit did not touch the full skeleton of a horse no more than 6 years of age, as was determined by the doctor F.F. Sushinsky on the basis of its teeth (Ibid.: fol. 50). A board located obliquely along the northwest-southeast line was below this skeleton at a depth of 30 cm. It was inserted into the robbers' pit, and its lower edge rested against the stone that turned out to be the lid of the coffin. There was the skeleton of a dog in the middle part of the burial mound.

A stone tomb 2.3 m long and 1.5 m high, oriented with its long axis to the NW-SE, was unearthed at a depth of about 2.5 m from the top of the burial mound. The lid was broken in the center. A subtriangular hole measured ca 60 × 15 cm (Fig. 4, *1*). Through this hole, soil collapsed into the coffin, and its upper part was filled with a mixed layer containing fragments of tiles, bones, and pieces of charcoal. Below, there were fragments of bones with traces of fire, a part of a human jaw with molars, iron arrowheads, a fragment of a lid decoration with a dragon's head, and grains of a plant (Ibid.: fol. 51). A part of a human jaw was found above the lid, and another molar was discovered separately. These human remains might have ended up there when robbers tried to pull out the contents of the coffin through the hole. After seeing the cremated remains, they probably lost interest in the tomb.

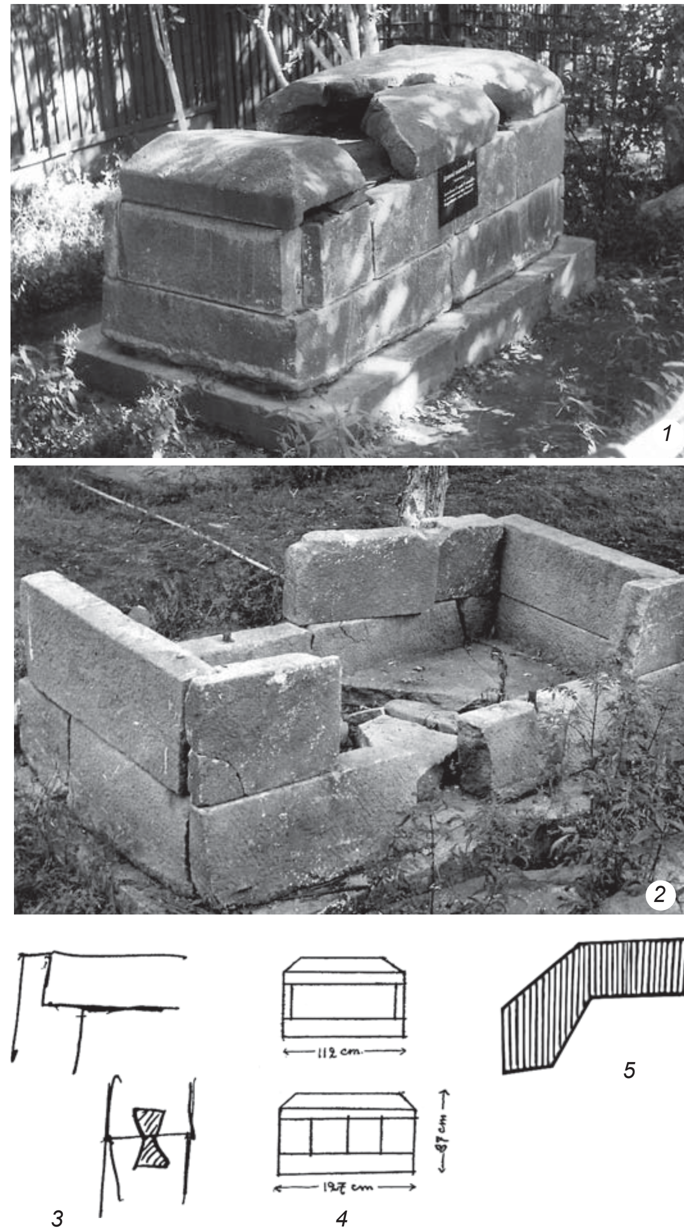

Fig. 4. Stone tomb.
1 – the tomb assembled, when it was exhibited near the Arseniev Museum of Local History (Vladivostok); *2* – the tomb without its lid (iron pins visible in the side slabs); *3* – diagrams of the fastening of the slabs, from the diary of Busse; *4* – drawing of the tomb (Busse, Kropotkin, 1908); *5* – profile of the tomb lid, from the diary of Busse.

Busse described the stone coffin in detail: "After clearing the tomb cavity, it turned out that the internal cavity was somewhat expanded to the west-southwest, and the width was 2 ft 9 inches (83.5 cm – **N.G.A.**) there. I measured the ends to the east-northeast; it was 2 ft 6 inches long (61.1 cm). The length of the grave inside the walls was 6 ft 8 in (183 cm). The thickness of the vertical walls was 5 in (10.25 cm). The grave depth was 23 in (57.5 cm). The walls were made of properly hewn and well-preserved slabs laid on lime, which also connected the walls with the covering stones. Each of the two walls to the west-southwest and east-northeast consisted of one slab, while the long walls consisted of two layers: one full-length stone on the bottom and four stones on top. The bottom of each wall was made of one slab along its entire length" (Ibid.: fol. 51). After unearthing the layer located below the second layer of stones, it turned out that the corners were secured by soil pressure from the outside (Fig. 4, *2*). At the top, all the slabs were fastened with iron brackets. Each of them was placed on an iron pin as a "butterfly" (Fig. 4, *3*) fixed in the slab of the lower layer. Busse observed that "this fastening holds excellently, and it took considerable effort to knock out the brackets and remove the slabs. Pure lime is visible along the seams" (Ibid.: fol. 52). The bottom of the tomb was a monolithic slab with vertical side edges (Fig. 4, *4*). The tomb was placed on four flat stones. There was empty space under the middle part, which was the reason for the tomb's breakage under the pressure of the mass of soil of the mound. Large stones were tightly placed around the lower stone layer of the tomb, and were also located underneath the tomb.

To transport the stone turtle, an additional wide trench was dug, where charcoal, pig bones, and fragments of tiles were discovered approximately 3 m from the statue, indicating another grave. It was located in a burial mound to the east of the stone turtle (Fig. 3, *6*). Excavations of that burial mound were planned for the next year.

A year later it turned out that Lindholm had organized the mill yard and leveled all the mounds (Busse, 1894: fol. 44). Therefore, before starting to excavate the new grave, it was necessary to establish the exact location where the stone turtle had stood. The location of the grave pit was determined by a layer of clay with charcoal, and fragments of tiles and bones. Yellow clay, found in the ditch, indicated the grave boundaries. After expanding the ditch to the north, Busse dug a pit 2 × 2 m in size and ca 70 cm deep. There were bones, tiles, and charcoal in the soil. At the bottom of the pit, there were six round black spots, consisting of decomposed wood remains (holes from posts). These formed a subtrapezoidal figure in plan view (2.1 m on the western side, 1.2 m on the northern side, 2.2 m on the eastern side, and 1.8 m on the southern side) (Ibid.) (see Fig. 3, *7*). A pile of pebbles with an admixture of yellow clay was lower, and a layer of bones, charcoal, and soot (1.3 m thick) was under the pebbles. Widening the pit and the space near the other walls of the pit did not bring any new results. Busse concluded that "a small shrine (*miao*), covered with tiles and decorated with patterned clay shields, stood on the burial mound to the east of the turtle in ancient times. This is confirmed both by the objects discovered in 1893 and by the traces of posts in the clay, which were found now. The ground was disturbed under this *miao*, as can be seen from the charcoal and bones discovered during the current excavation, but all these traces of human activities are so unclear, so uncertain that now there is no way to guess as to the purpose which the ancient inhabitants had when building the burial mound under discussion" (Ibid.: fol. 46).

Upon reconstructing the remains of the second burial from the description by Busse, it can be inferred that the platform where the stone turtle stood was located at the place of an earlier grave. A number of column bases were discovered 4 m to the east of the statue, under a layer of tiles. The grave spot recorded on the sterile soil was located at a distance of 3.2 m from the stone turtle (under the bases of the columns). Its area was 4.5 m^2. Most likely, a burial pit filled with cremated remains had previously existed under the platform on which the gazebo (*miao*) was built. This pit was covered with stones, and some kind of structure was built on top of it.

Busse mentions that the turtle sculpture was made of coarse-grained pink granite. A note to the report of 1893 provides an explanation: such granite, according to the mining engineer D.L. Ivanov can be found near the village of Nikolskoye in two locations: the cliffy bank of the Tudagou (Rakovka) River slightly above the railway station, and Mount Saltnikovaya on the Olenevka River near the village of Krasnoyarovskaya, on the southern side parallel to the mountain spur (the right bank of the Suifen River), where an ancient Chinese town (Krasnoyarovskoye fortified settlement) was located. The measurements of the stone turtle are also given: the width along the middle of the body – 4 ft 8 in (146.3 cm), the width along the same line from the vertical slab to the edge on the eastern side where the slab was broken off – 1 ft (30.4 cm), the width from the western side – 1 ft 2 in (36.5 cm), the length from the vertical slab to the rear end of the turtle – 2 ft 8 ½ in (85.3 cm), and the length to the beginning of the first neck fold – 1 ft 8 in (54.9 cm), the width of this fold – 6 in (15 cm), the width of the second fold – 5 ½ in (13.7 cm), the length of the head to the nose – 1 ft 9 in (57.9 cm), and the length of the entire turtle – 7 ft 9 in (240.8 cm) (Busse, 1893a: fol. 53).

The vertical slab that was placed upon the stone turtle was made of slate. It suffered greatly over time. Its outer layer disintegrated over the entire surface; therefore, the characters, except for two located in the upper right corner, were not preserved.

After the excavations, the turtle statue was installed in the public garden. In 1895, it was moved to the railway station of the village of Nikolskoye, and then it was taken to the Iman River. At the end of August 1896, the statue was transported along the Ussuri River to Khabarovsk on the motor boat "Kazak Ussuriysky" and placed in front of the museum. The stone coffin discovered in the large burial mound was first kept by the mill manager and later was delivered to the garden of the Museum of the Society for the Study of the Amur Region in Vladivostok.

Note that when Busse invited the Chinese to participate in the excavations, they refused, because, as he explained "the entire foreign world honored the person who was buried near the turtle. When the tomb was unearthed, several of the Chinese made full prostrations and chanted

prayers, reverently bowing to the monument and the discovered tomb. Each ethnic group was convinced that some legendary popular hero was buried here" (Busse, 1894: fol. 45).

Reconstruction of the funerary complex

In the process of rescuing the turtle statue from destruction, Busse discovered the funerary complex of a Prince from the Jurchen family clan of Wanyan. The stone coffin with the cremated remains of the deceased, set on a platform made of clay and densely packed stones, was located in an earthen mound measuring 14 × 13 m and 3 m high. Four flat stones were placed at its corners. The tomb had the following size: a length of 227 cm, width of 112, and height of 150 cm. The bottom of the tomb was a monolith 20 cm thick, with vertical side edges. Its walls were hewn stone slabs 57.5 cm high, fastened to the base with iron pins 2.5 cm in diameter, and attached together with iron brackets in the form of "butterflies" embedded in the stone. In the corners, the slabs were attached to each other using special rectangular cutouts on one of the sides where the slab without a cutout was inserted (see Fig. 4, *3*). The tomb had a trapezoidal shape in plan view. Based on this, Busse suggested that it was oriented to the southwest with its "head" part. The coffin lid was a monolith in the shape of a truncated pyramid (see Fig. 4, *5*). The inner walls of the tomb had no traces of fire, which means that the deceased was cremated outside.

The funerary rite, which involved the burial of animals, birds, and fish with the deceased, was performed during construction of the burial mound. A dog was buried above the coffin lid, and a horse with its head facing south was buried above the dog. The Jurchens always had the custom of burying the deceased of high rank with a horse (Vorobiev, 1983: 129). Bird and fish bones, as well as fragments of clay fishing sinkers, were discovered at the same level as the horse's skeleton, but slightly to the west. Bone fragments and pig tusks were found slightly higher. No traces of fire were observed on the animal remains.

Fig. 5. Stone statues.
1 – official; *2* – warrior; *3* – lion; *4* – official and rams.

The stone *bixi* (贔屓) turtle, with its head facing south, together with the stele "on the path of the spirit" of Wanyan Zhong (Esikui) was set south of the main burial. A shrine 2.5 × 2.5 m with a tiled roof, with its base supported by six wooden columns, was located to the east of the turtle.

One of the controversial issues associated with the funerary complex of Wanyan Zhong is the presence or absence of stone statues, which were traditionally set in pairs "on the path of the spirit" of the deceased. Their number had to correspond to the rank of the deceased. The *History of the Song Dynasty* (Juan 124, "Descriptions" 77, ceremonies 27 (funerary rites), "Foreign funerary rites and ceremonies for honoring the memory of the dead; funerals of dignitaries, etc.") reads: "In front of the graves, there are stone statues of rams and tigers, as well as stone posts, two of each type; when higher than the third rank, two statues of people should be added" (cited after (Lin Yun, 1992: 41)). It was assumed that there used to be at least paired statues of civil officials, warriors, tigers, and rams (Fig. 5), and two stone pillars (Ibid) in front of the grave of Esikui (Wanyan Zhong).

None of the Russian scholars of the funerary complex mentioned that there were stone statues near the statues of the turtles. Most likely, they were no longer there by the time the burial was discovered. According to Busse, when he visited the village of Nikolskoye for the first time in 1866, he saw "two statues of turtles, a grave decorated with three pairs of statues of rams, people, and columns" (1893b). Later, this was erroneously interpreted as Busse having seen a stone turtle with sculptures as part of a single funerary complex, although he was writing about three different burials: two with stone turtles and one with the paired statues of rams, people, and columns. Two years later, one of these turtles (the Ussuriysk turtle) and another burial with stone sculptures of people and sheep were described and sketched by I.A. Lopatin (1869). In 1874, the remains of the statues were photographed by V. Lanin (Fig. 5, *2*, *4*). Later, the following was written about them: "From the cemetery church heading west, there is an ancient road about 150 sazhens long; from the point of its intersection with the road heading to the village of Mikhailovskoye, there are two burial mounds about 100 sazhens to the south. The southern burial mound is much smaller than the northern one. On the northern burial mound a pit, which is not very deep, can be seen. According to the testimony of old dwellers, there were originally stone figures on this mound: two rams, two dogs, two people, and a bear. Reported by Lanin in 1897" (Busse, Kropotkin, 1908: 19) (Fig. 6, *2*). Considering all the available data about these stone sculptures, the conclusion can be made that the statues were not discovered on the grave of Wanyan Zhong; although, judging by the funerary complex of Wanyan Xiyin (?–1140, Jin dignitary, cousin of Wanyan Aguda), created in the late 12th century in the Upper capital of the Jurchen state of Jin (Huiningfu, currently a part of the Acheng District of Harbin) under the order of Emperor Shizong (1161–1189) (Wu Jin, 2012), they should have been there (Fig. 6, *1*).

As mentioned earlier, the stele commemorating Esikui (Wanyan Zhong) was erected after 1191, when he was

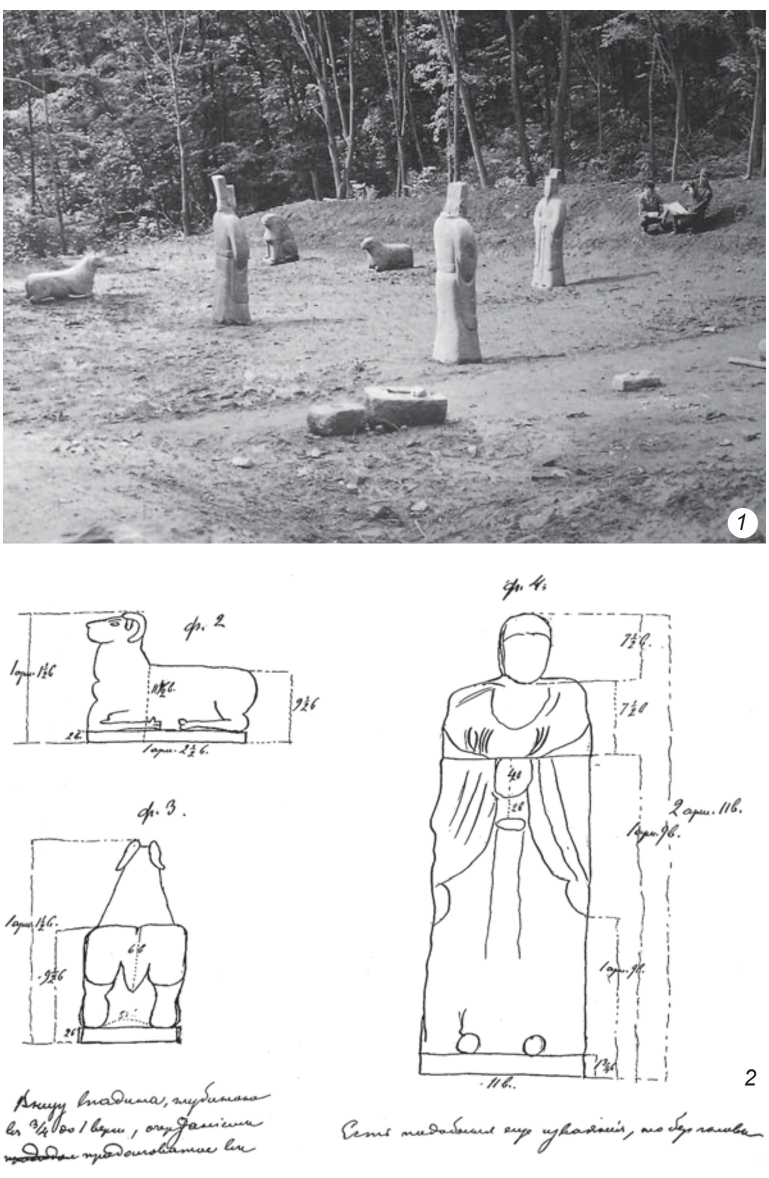

Fig. 6. Grave sculptures.
1 – Wanyan Xiyin's grave (*photo from the Jilin Provincial Museum*); *2* – drawings by I.A. Lopatin (1869).

given his last title of "kaifu yitongsansi jinyuan jun ming yi wang Wanyan Zhong". Construction of new grave monuments to major statesmen of the Jin Empire (such as Wanyan Aguda, Wingyan Xiyin, etc.) was associated with the policy of exalting the historical past of the Jurchens (Larichev, 1974: 223; Golovachev, 2006). Old burial sites were reconstructed along with building new funerary complexes. The remains of an earlier burial located inside the platform under the statue of the turtle might have been associated with that process. The ashes of the deceased were placed in a stone coffin, and a reburial ceremony was performed.

Conclusions

Relatively few Jurchen burials, such as the Novitskoye (Artemieva, 2018) and Kraskino (Boldin, Ivliev, 1994) burial grounds, have been discovered in Primorye. These burial grounds did not belong to high-ranking Jurchens as opposed to the funerary complex of Wanyan Zhong, which was a unique structure built in honor of a famous representative of the Imperial family clan.

Reconstruction of the architecture in this complex, revealing funerary traditions typical of Jin family cemeteries of the 12th century, was possible only owing to the diaries of F.F. Busse. It has been established that the stone coffin was not lowered into the grave pit. Weapons (arrowheads), food (cereal grains), and roof decorations (a fragment of the sculptural image of a dragon and an end tile) were placed with the cremated remains of the deceased. Funerals of clan chiefs and members of rich, influential families have been known to be especially ceremonial. Their favorite servants, maidservants, and saddled horses were burned, and their remains were placed in the grave as a sacrifice to them. The funerary rite also included burials of pigs, dogs, and birds in the mound. Vessels with beverages were placed in the grave. The entire memorial ceremony was called "cooking porridge for the deceased". Later, human sacrifices were abandoned. The custom of burying a horse with the deceased existed among the Jurchens even before the creation of their state. A distinctive part of the commemorative ceremony was the ritual of burning food, which was most likely intended to release the spirit of food, since the spirit of the deceased could only use the spiritual essence of a thing (Vorobiev, 1966: 63–64). Judging by the burial of Wanyan Zhong, these customs continued to exist during the state period, but new rituals were added to them. A stone turtle with a stele on its back started being set next to the grave. According to the chronicles, it was called a *bixi* (赑屃) in China, and was considered one of the nine mythological children of the dragon, symbolizing happiness and longevity. When people wanted to glorify rulers or outstanding figures, and perpetuate their memory, a stele listing the achievements of the deceased was set on the back of the stone turtle so that the magical power of the *bixi* would contribute to preservation of his great deeds for centuries (Zhang Ruifeng, 2018: 43).

This design of burial places emerged during the Han Dynasty. Six more burial mounds constituting a family cemetery surrounded the burial of Wanyan Zhong. A symbiosis of the borrowed and native Jurchen customs can be seen in the funerary rite, internal layout, and architectural features of the examined funerary complex, confirming the fact that centuries-old Chinese traditions had a significant effect on the development of cultures of various peoples living in the Asia-Pacific region.

It was believed that after the death of Wanyan Digunai (Esikui) in 1148, the Yelan Province began to gradually lose its primary importance and turned into a peripheral region (Larichev, 1964: 634). Currently, there is convincing evidence that the territory where Wanyan Digunai brought the Yelan Wanyan tribe became the district center of the Jin Empire, and later, the city of Kaiyuan—the capital of the Jurchen state of Eastern Xia—was founded there.

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Cultural Horizons at the Uyelgi Cemetery Mound 11, Southeastern Urals

The article outlines the findings from excavations at Uyelgi mound 11, the most informative one at the cemetery. Its lower horizon revealed a burial demonstrating features highly indicative of the nomadic culture of the Southern Urals. The upper horizon contained two burials belonging to the Srostki culture, characterized by certain artifacts of the "Hungarian" (Carpathian) type, evidencing the return of some South Uralic groups from the west at the time when the Srostki people migrated in the opposite direction from Eastern Kazakhstan and the Altai. This conclusion is supported by findings from the Aktobe cemetery, where typically "Hungarian" ornaments of horse harness co-occur with a belt set with floral decoration following the Srostki tradition of the Altai. Inside the mound and on the platform under it, fragments of five clay vessels were found, most of which are decorated with comb-and-cord patterns of the post-Bakal, Nevolino, and Petrogrom-Yudina type, associated with the East Uralic and West Siberian Ugrians. In terms of spatial structure, stratigraphy, and typology, then, the Uyelgi mound 11 demonstrates at least four cultural horizons: South Uralic, "Hungarian" (Carpathian), Altaic (Srostki), and Ugric (East Uralic and West Siberian), jointly mirroring complex ethnic processes in the region between 800–1000 AD.

Keywords: *Middle Ages, Southeastern Urals, cultural horizons, burials, belt set, Hungarian-style items.*

Introduction

The Uyelgi cemetery was found in 2009 thanks to timely information from prospecting workers, on the interlake terrace of the Uyelgi and Saigyrly lakes, 7 km north of the village of Kunashak, Chelyabinsk Region (Fig. 1). The site is located on the high slopes of the hills formed by the uplift of the Ural peneplain. Initially, up to 30 mounds were visually recorded over its main area (120 × 130 m), although some mounds were noted 30–250 m away from it (Fig. 2, I).

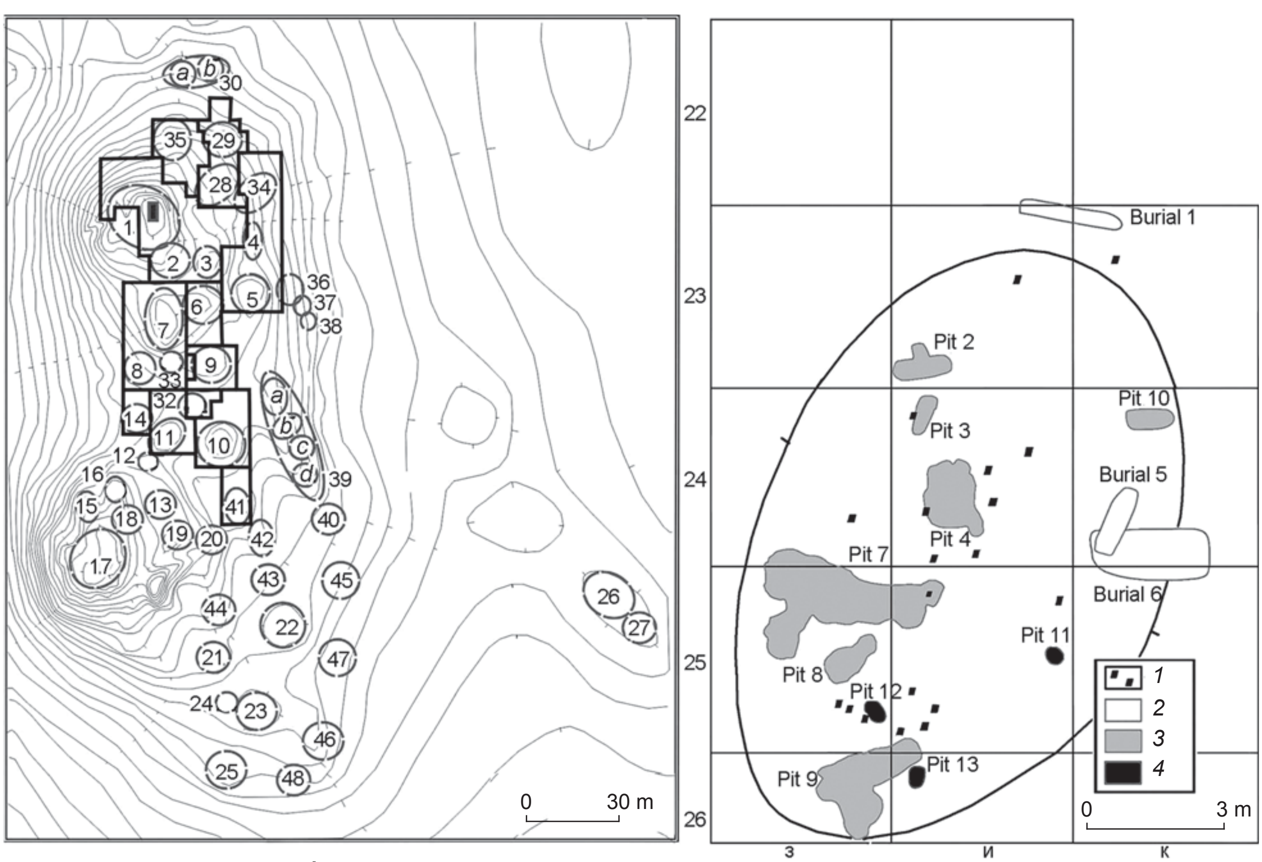
Stationary excavations began in 2010. The site was excavated continuously throughout the area, since the mounds were located quite close to one another. Signs of extension of the mounds and ground fences were identified. The items of burial goods were scattered over

Fig. 1. Location of the Uyelgi and Aktobe cemeteries.

a large area, owing to the looting of mounds in ancient times. It was also revealed that mounds (ground fences) were recurrently constructed over one another. As a result, the total number of excavated mounds increased every year. Under the covers, typically in the form of attached soil (humus) fences or mounds (according to the data of A.S. Yakimov, a Leading Researcher at the Earth Cryosphere Institute, SB RAS), there were from two to ten or more grave pits. In the course of the excavation campaign of 2010–2021, 21 mounds and up to 150 burials were uncovered. The chronological range of the burial complexes is 200–250 years within the late 8th to 10th centuries AD.

Results of the study of mound 11

The materials from mound 11 excavated during 2018, 2019, and 2021 contain an array of information. The mound is located in the central part of the Uyelgi cemetery, in the saddle between two hills. It is a low (up to 0.45 m) oval mound (8.3 × 12.5 m) oriented along the NE–SW line. A small altar (up to 0.9 × 1.1 m) containing the remains of horse skulls (one skull?) and teeth was found at a depth of 0.12–0.18 m from the surface in the western part of the mound. Three meters to the south and northeast from the altar, at a depth of 0.2 m from the surface, there were lenses of the calcined ground measuring 1.5 × 0.5 m and 0.5 × 0.8 m. During the unearthing of the mound, in various parts of the platform



I

II

Fig. 2. Location of the mounds and excavation areas of 2009–2021 at Uyelgi (I), and map of mound 11 (II).
1 – finds from the mound and the platform under it; *2* – intact burial; *3* – looted burial; *4* – pit.

under it, decoration sets from horse bridles and belts, sewn-on plaques, a ring, and numerous potsherds were found. A special group of artifacts includes the items in the so-called Hungarian (Carpathian) style: round bimetallic plaques decorated with four-petaled motifs, a hemispherical protrusion in the center, and a border of alternating ovals and circles (n=4); trapezoidal plates with floral patterns (n=12); a plate with images of birds and a pendant ring; a plate with a cross-shaped ornament and an a lotus-shaped ending; a plaque with an imitation of an eyelet in the upper part and a sophisticated floral pattern; silver sewn-on plates; a harness strap divider; a pendant with a loop and three protrusions; and a fragment of a ring with a chalcedony insert (Fig. 3, I).

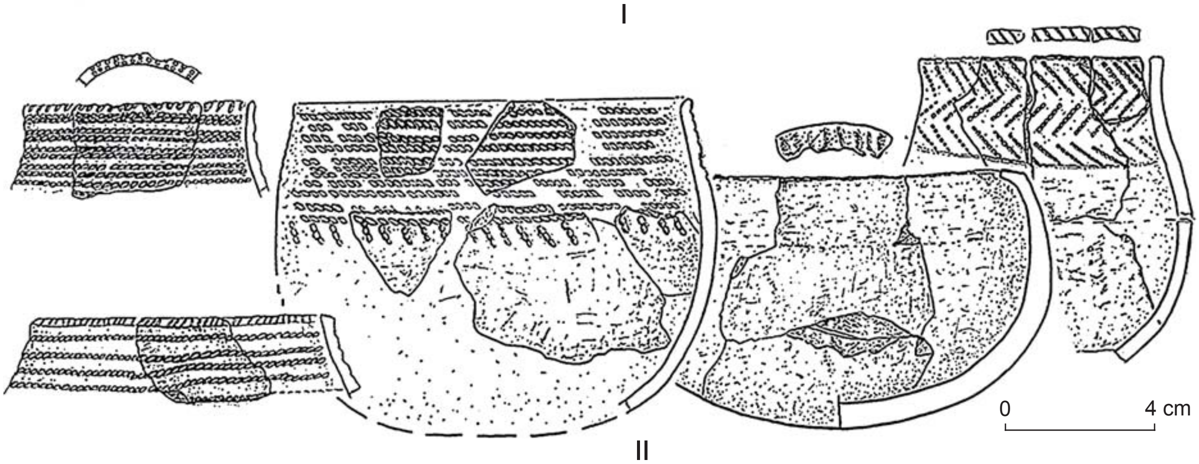


Fig. 3. Artifacts (I) and graphical reconstruction of pottery (II) from mound 11 and the platform under it.
1–5, *10–12*, *15–17*, *19* – silver; *6–9*, *18*, *20*, *21*, *23–26* – gold-plated silver; *13*, *14* – silver, stone; *22* – silver, leather; *27–29* – iron.

Under the mound, 13 pits were cleared, three of which (No. 1, 5, and 6) were unlooted burials (see Fig. 2, II).

The other pits (No. 2–4 and 7–13) of various sizes have been classified as follows: the largest are No. 4, 7, and 9 (2–4 × 1.0–1.5 m); the medium-sized are No. 2, 8 (1.0 × × 0.7 m); and the small pits are No. 3, 10–13 (0.5–0.9 × × 0.3–0.4 m). Because of the heavy looting, it is difficult to identify the graves accurately. The outlines of burials and their historical and cultural features can be tentatively determined by the established spatial distribution of artifacts inside the mound and on the platform under it. Artifacts were found mainly in sq. З–И/24–25 in the area of large pits 4, 7, and 9. The largest amount of metal ornaments in the "Hungarian" style was discovered in sq. И/25 and in the baulk of line 24–25. This suggests that they were thrown out of the burial in pit 9.

The spatial distribution of potsherds from the mound is noteworthy. Seven fragments of a Kara-Yakupovo vessel and five fragments of the Petrogrom-Yudina vessel with cord pattern were found in the northern part of the mound (sq. И/24). Most likely, these potsherds come from burial pit 4. Three separate fragments of the Bakal and Petrogrom-Yudina ceramics were discovered in sq. И/25, closer to grave pit 9 (see Fig. 3, II).

Burial 1 is located on the northeastern periphery of the mound; its shallow (15–17 cm) pit, 7.7 × 1.6 m, is oriented along the WNW–ESE line (Fig. 4, I). An adult male was buried in an extended supine position, with his head to the west-northwest. His face was turned to the north. Five iron arrowheads were found close to the bones of the right hand (Fig. 4, II, *6*); just below them there was a belt tip, heart-shaped plates with skin remains, and a strap divider (Fig. 4, II, *2*). The assemblage also contains remains of wood. These indicate the presence of a quiver in the burial goods. Close to the hips of the deceased, there was a belt tip, several heart-shaped plates with skin remains and fragments of wood, a strap divider, and a buckle, all located horizontally. Another strap divider (from which a line of small heart-shaped plates extended) and a massive buckle were found between the

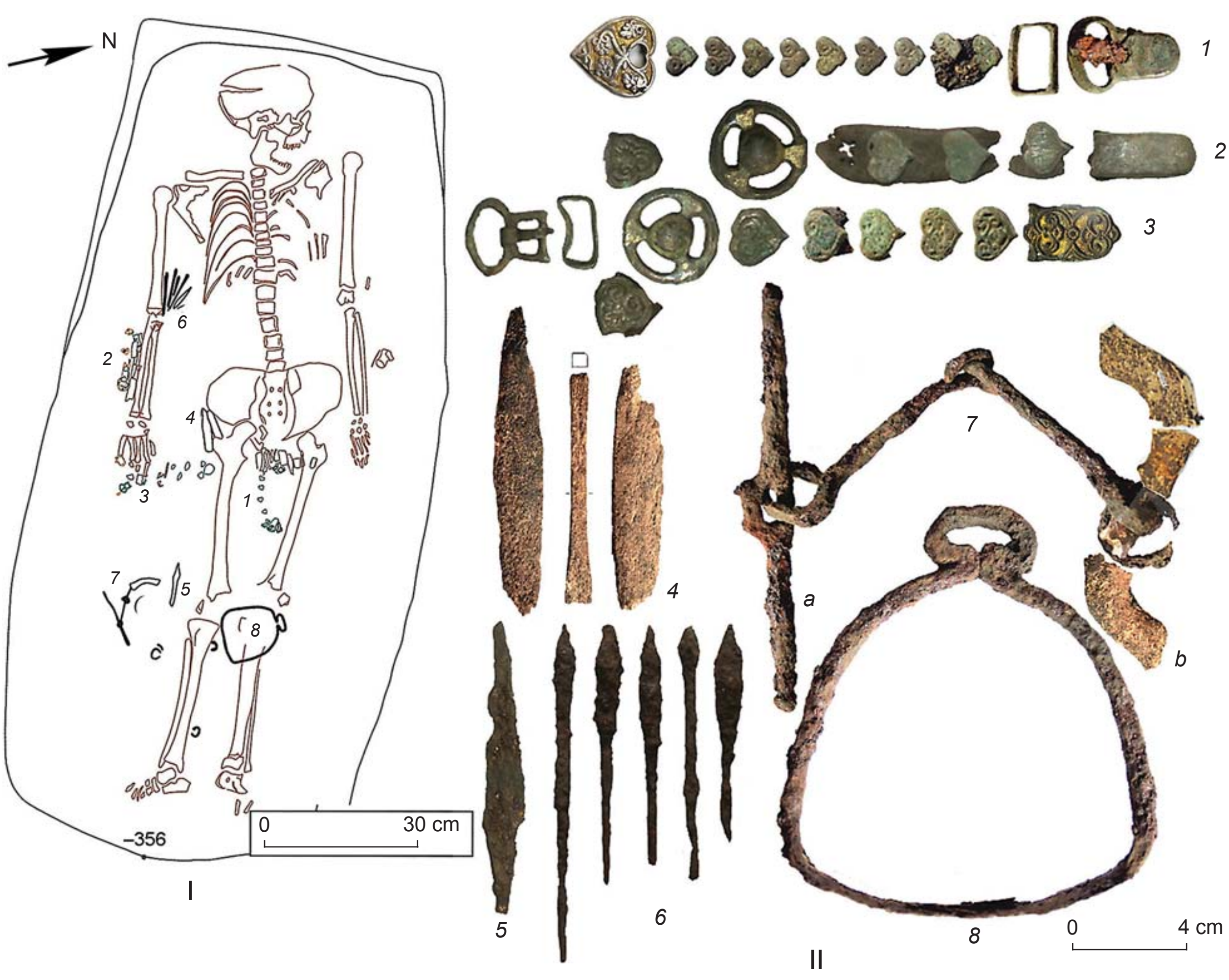


Fig. 4. Plan of burial 1 (I) and the finds therefrom (II).
1 – belt set for a bag; *2*, *3* – archers' belts *4* – onlays on bow; *5* – knife; *6* – arrowheads; *7* – bits; *8* – stirrup.
1–3 – bronze, silver, leather; *4*, *7*, *b* – bone; *5*, *6*, *7, a*, *8* – iron.

thigh bones. These finds are probably the remains of an archer's belt (Fig. 4, II, *2*, *3*). Near the right hip joint, bone bow-onlays were discovered—two flat frontal pieces and one lateral piece. On the left tibia, there was a stirrup. A knife was found at the right femur, and a bit with a straight iron cheek-piece and a broken slightly curved bone one were located at some distance from the knife (Fig. 4, II, *4*, *5*, *7*, *8*). Parallels to the found artifacts occur in the Srostki tradition of the Altai and Eastern Kazakhstan (Mogilnikov, 2002: Fig. 41, *2–4*; 47, *1*, *7*, *13*, *25*; 48, *7*, *10*, *16*; 91, *1*, *2*; 116, *6*; 171, *7*; Arslanova, 2013: Fig. 4, 5; photo 14, *20–24*, *29–31*).

Burial 5 was made in a shallow (12–15 cm in the northern and central parts, and up to 20 cm in the southern part) pit, 1.2 × 1.7 m, oriented along the NNE–SSW line. The buried individual was laid with his head to the SSW (Fig. 5, I, II). The skull was crushed. The remains of wood decay (apparently from a coffin) were recorded on the right side of the ribs and on the bones of the right leg. Under the mandible, a bone spoon was located (Fig. 5, III, *4*). At the interior side of the right humerus, arrowheads were found. At the left side of the hip joint, there were two flat median bone bow-onlays; and close to the radius, a heavily corroded iron item, probably a knife, was noted (Fig. 5, III, *1–3*). A tip plate, apparently decorating a waist belt, was found between the femurs (Fig. 5, III, *5*), and a bone buckle from a saddle-girth belt, between the tibias (Fig. 5, III, *6*). On the left side of the pelvic bone, there was a bone plate. An iron stirrup with a flat footrest and a ringed bit were found close to the right tibia, to the right of the deceased (Fig. 5, III, *7*, *8*).

In terms of cultural and typological characteristics (shallow pit, skeleton orientation, presence of bone parts of a bow, stirrup), this burial belongs to the Srostki tradition. However, several elements are original: a bone spoon and tip plate with a zoomorphic pattern (Fig. 5, III, *4*, *5*). It depicts, most likely, a simurgh. All currently known finds with zoomorphic images are

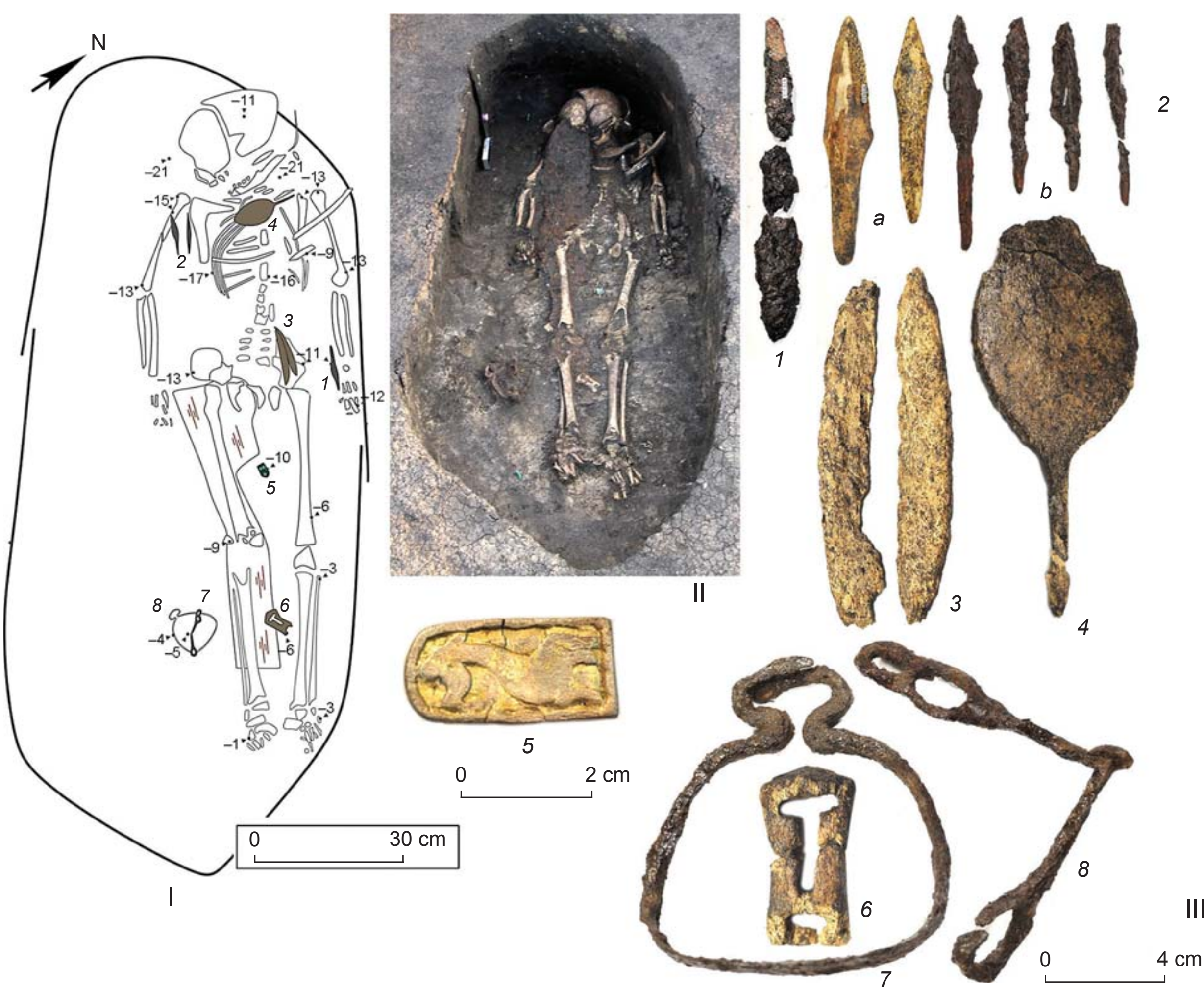


Fig. 5. Plan (I) and general view (II) of burial 5; the finds therefrom (III).
1 – knife; *2* – arrowheads; *3* – onlays on bow; *4* – spoon; *5* – belt tip; *6* – buckle; *7* – stirrup; *8* – bits.
1, *2*, *b*, *7*, *8* – iron; *2*, *a*, *3*, *4*, *6* – bone; *5* – gold-plated silver.

summarized in A.V. Komar's publication; he emphasizes their connection with Sasanian and East Iranian toreutics (Komar, 2018: 126–131).

Burial 6 was made at a level of –75 cm and oriented along the W–E line; its dimensions are 1.1 × 2.8 m. The grave pit was filled with dense clay and fine rock debris, which suggests that it was deliberately compacted in order to avoid looting. This assumption is confirmed by the presence of an ancient looter's pit (almost along the entire contour of the grave), which never reached the depth of the burial itself. An adult male was buried in an extended supine position, with his head turned to the left, to the west. The body was placed in a subrectangular wooden coffin, whose remains preserved the outlines and some parts of the cover (Fig. 6, I, II). A broadsword with a straight guard, a pommel, and a scabbard bracket (Fig. 6, III, *2*) lay on the right side, along the humerus, radius, and femur; an iron dagger in a silver scabbard (Fig. 6, III, *1*) was located on the left side, along the arm bones. Close to the right arm, twelve iron double-bladed and tetrahedral arrowheads, a quiver hook, a belt buckle, six-petaled plaques, and bronze bridle strap dividers with the remains of straps decorated with clips and figured plates were found (Fig. 6, III, *3*, *4*, *7*, *8*, *11*), which indicates the presence of a quiver in the burial goods. A belt, which consisted of a series of rectangular plates with a cutout at the bottom, lay crosswise above the pelvis bones; part of the belt, consisting of heart-shaped plates, was located along the left radius; parts of the belt made of small similar plates were located to the right and left of the pelvis. The belt's tip plate lay between the thigh bones. Solitary fragments of straps with plates were found between the knee joints and at the exterior side of the left tibia (Fig. 6, III, *13–16*). Just above the skull, thin plates with wooden remains, probably the remains of a saddle pommel (Fig. 6, III, *12*), a bell, and a silver earring (Fig. 6, III, *6*, *9*) were discovered. A ring with an amber insert was located on phalanx of the little finger of the left hand (Fig. 6, III, *5*). A ceramic round-bottomed vessel of the Kushnarenkovo type (Fig. 6, III, *10*) and bone from a sacrificial animal (a horse) were found close to the lower bones of the left leg.

This burial shows typical features of the cultural traditions of nomads of the 9th century in the Southern Urals. The closest parallels are the Bekeshevo, Khusainovo, Yamashi-Tau burial mounds (Mazhitov, 1981: 30–132; 1993: 131–134).

Study results

The relative chronology of the described complexes can be traced both in evident different features of the burial goods and in the derived radiocarbon dates. For burial 5 (1220 ± 30 BP), two ranges of calibrated dates were obtained, of which the date of 771–888 BP can be considered the most probable. Burial 6 (1195 ± 30 BP) seems to be almost synchronous according to the calibrated dates: 771–895 BP. The authors believe that the earliest and the latest dates, falling in the 8th and 10th centuries, should be discarded owing to their low reliability and inconsistency with the typology of the recovered artifacts.

The currently available radiocarbon dates for the cemetery (including the part excavated in the early 2010s) indicate the period of the last quarter of the 8th to the first quarter of the 11th century (Grudochko et al., 2018). These dates can be quite confidently grouped into the early (last quarter of the 8th to the early 10th century, mainly the entire 9th century) and late (10th to the first quarter of the 11th century) sets. Radiocarbon dates and the typology of the grave goods suggest the turn of the 8th–9th centuries as the most probable time of construction of mound 11. The younger horizon of burials 1 and 5 has yielded artifacts of the Srostki type; the parallels are available in the East Kazakhstan and Altai complexes dating to 800–1000 AD.

The items of a belt set from the mound and the platform under it, representing the so-called Hungarian (Carpathian) style, are of particular interest. The closest parallels to round plaques with symmetrical petal-shaped motifs and a hemispherical protrusion in the center (see Fig. 3, I, *20*, *21*, *24*) were established among the items of the Redikor hoard (Volga region) and the artifacts from the Carpathian Basin (Komar, 2018: 365, fig. 49, *3*; Révész, 1996: 229, 244, 245, 315, 318, 385, 386; A honfoglaló magyaság…, 1996: 154, 182–183, 233, 238, 357).

A fragment of the belt set, consisting of a polymetallic buckle and two plates (see Fig. 3, I, *7*, *8*, *18*), is noteworthy in this group of items. These bear a slightly different floral ornamentation of discs, in the form of leaves and curls, and a border decorated with a chain of oval protrusions. A similar pattern has been recorded on the belt set from burial 556 at Kryukovsko-Kuzhnovsky cemetery (Tambov Region) (Ivanov, 1952: Pl. XXXIV; Komar, 2018: 366, fig. 50); solitary similar artifacts have also been reported from the Carpathian Basin (A honfoglaló magyarság…, 1996: 204, 238), which makes it possible to attribute this set to the Magyar antiquities as well.

The fact of the stylistic, typological, and technological similarity between the Uyelgi finds and the items in the "Hungarian" style had been noticed in the early years of research at the site. However, these items originated mainly from looted graves; this did not provide reliable grounds to identify the ways in which such artifacts ended up in the burials of the Uyelgi and Sineglazovo cemeteries.

In the fall of 2021, a new medieval site at Aktobe was discovered in the course of rescue archaeological

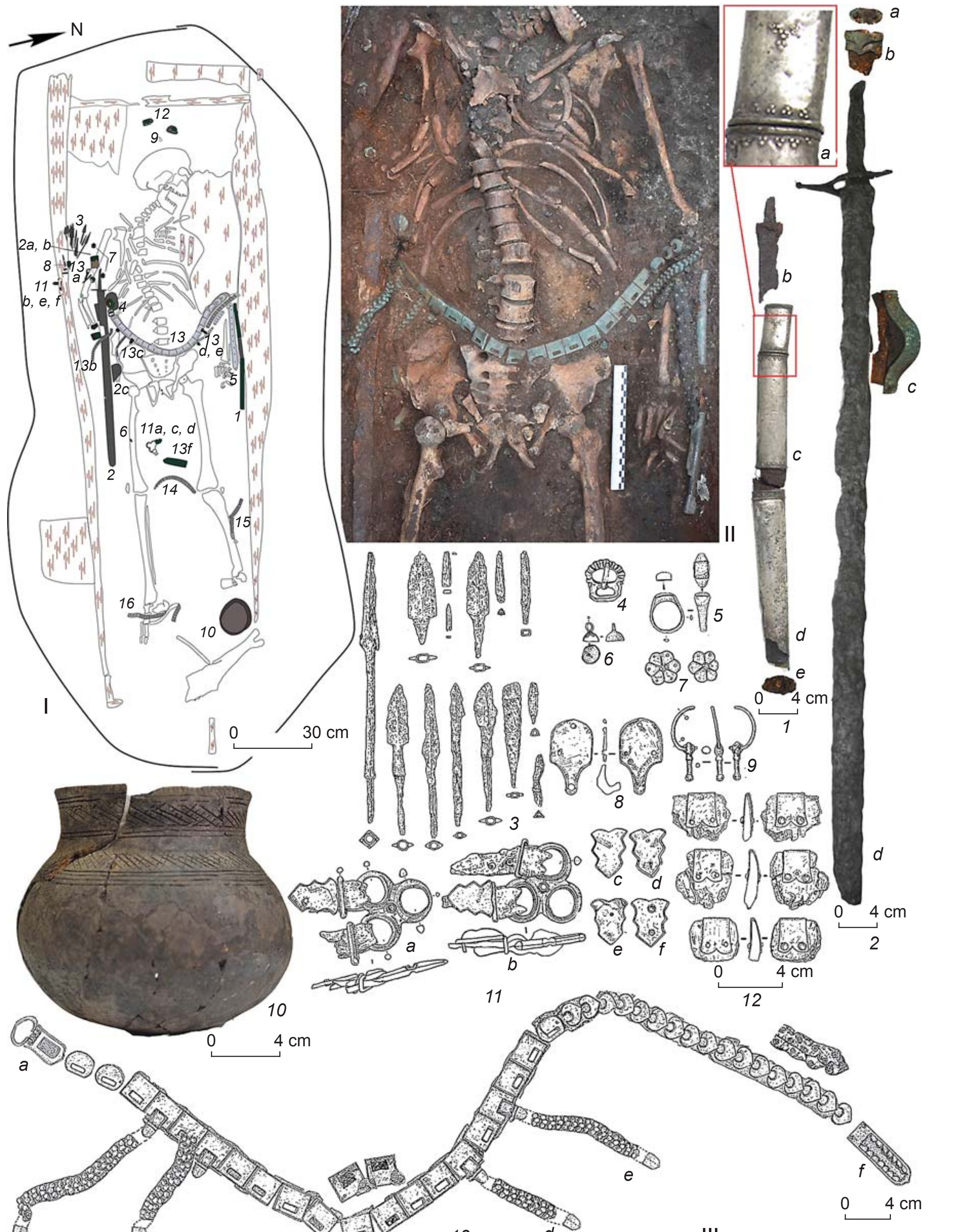


Fig. 6. Plan (I) and close-up (II) of burial 6; the finds therefrom (III).
1 – dagger and its elements; *2* – broadsword and its elements; *3* – arrowheads; *4* – buckle; *5* – finger-ring; *6* – bell; *7* – six-petaled plates; *8* – quiver hook; *9* – earring; *10* – vessel; *11* – strap dividers of archer's belt, and its plates; *12* – saddle pommel brackets; *13* – belt (reconstruction); *14–16* – separate straps with plates (their composition is similar to the hanging straps of the main belt *13*, *b–e*).
1, *a* – silver; *1*, *b*, *2*, *d*, *e*, *3* – iron; *1*, *c* – silver, iron; *2*, *a*, *4*, *6–9*, *11*, *c–f* – non-ferrous metal; *2*, *b*, *c* – non-ferrous metal, wood; *5* – silver, stone; *10* – ceramics; *11*, *a*, *b*, *12*, *13* – non-ferrous metal, leather.

survey. The site is located 25 km southeast of the Uyelgi cemetery. These sites are likely contemporaneous and belong to the same culture. During the excavations, two disturbed burials were discovered. One burial (male) yielded a part of the harness set: a fragment of a saddle, a stirrup, and richly decorated crupper belts (Fig. 7). The plaques (n=21) and strap dividers (n=2) are made of silver, with gold plating, in an exclusive "Hungarian" style: a border in the form of alternating ovals and circles, each oval containing four "pearls", a hemispherical protrusion

Fig. 7. Aktobe burial complex.
I – plan; II – burial view; III – burial goods: *1*, *25–27*, *34–36* – silver, gold, leather; *2–23*, *28–33* – silver, gold; *24* – silver; *37* – wood; *38* – iron.

in the center, framed by a chain of "pearls", from which three or four petals/buds extend (Botalov et al., 2021) (Fig. 7, III, *2–22*, *34–36*). The large cast heart-shaped petals/buds bear images in the form of the Latin letter V, with its upper ends rounded downwards, and an arc (in some cases, double) limiting the upper part. This image is executed by a technique other than casting, and is possibly an element of decoration or tamga.

This set, along with the Uyelgi and Sineglazovo artifacts, suggests the targeted entry of such complexes into the Southeastern Urals in the 10th century. The "Hungarian" historical and cultural stratum apparently arose here owing to the arrival of a group of nomads from the Southern Urals who earlier had direct contacts with a related population of the Carpathian Basin. Some burials at the Bayanovo cemetery in the Perm Region (Fodor, 2015: 121–128) likely represent the similar process.

The Aktobe burial also yielded a belt set of silver items, consisting of a buckle with a movable rectangular tongue, six heart-shaped plates with holes, and three arched plates (with a hole in one) (Fig. 7, *24–33*). These items, with one exception, are gold plated and decorated with floral patterns. As in the case of the Uyelgi finds, these items demonstrate the Srostki style typical of the Eastern Kazakhstan and Altai sites. Thus, the Aktobe artifacts clearly illustrate the combination or counter penetration of two cultural traditions: western (Carpathian) and eastern (Altai-Kazakhstan).

It should be noted that the ceramic complex found in Uyelgi mound 11 and on the platform under it demonstrates a specific ethnic-cultural process. The found potsherds represent five vessels: three crushed vessels and two ornamented fragments of neck (see Fig. 3, II). Three potsherds show corded ornamentation characteristic of pottery of the forest-steppe and forest Petrogrom-Yudina stratum (Gushchina, Botalov, 2016: 406–407, fig. 41, 42; p. 482–483, fig. 3). Two other vessels show similarities in shape and decoration patterns to the post-Bakal and Kara-Yakup pottery of the Eastern Urals. These ceramic traditions are associated with the East Uralic and West Siberian Ugric population, and mark the presence of one more cultural group in the collection from this mound.

Conclusions

The study of the Uyelgi cemetery mound 11 has shown that burial 6 discovered in the low horizon demonstrates the cultural and typological features of the nomads of the Southern Urals, while burials 1 and 5 in the upper layer refer to the Altai (Srostki) historical and cultural tradition that produced items in the so-called Hungarian style. This observation makes it possible to infer: the back migration of some groups of the South Uralic population from the west co-occurred with the counter migration from Eastern Kazakhstan and Altai. This assumption is supported by the materials from the Aktobe cemetery, which include both the items of a "Hungarian" (Carpathian) appearance and the plates and a belt buckle of the "Srostki" style. Hence, the materials of Uyelgi mound 11 demonstrate at least four historical and cultural strata: South Uralic, Hungarian (Carpathian), Altaic (Srostki), and Ugric (East Uralic/West Siberian). This combination reflects the ethnic-cultural processes that took place in the region from the late 8th to the 10th century.

The preliminary systematization of items (usually belt sets) from surface collections (up to 300 spec.) and materials from excavations of the first years made it possible to identify five stylistic cultural groups: 1) South Uralic, 2) Ural-Kazakhstan, 3) "Hungarian", 4) East Kazakhstan, Altaic, and 5) Ugric. The relevant descriptions and illustrations have been published elsewhere (Botalov, Grudochko, 2011; Grudochko, Botalov, 2013; Botalov, 2018). These initial observations were later largely confirmed by the results of excavations. Despite the total looting of the cemetery—up to 85–90 %, probably in ancient times—thanks to the technique of continuous excavation, it was possible to correlate the materials from the looted graves with the artifacts thrown out.

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Types of Construction Nails from Markul, Abkhazia (Based on Metallographic Analysis)

During excavations at the Markul fortified settlement, Republic of Abkhazia, a cluster of iron items, including nails, was found. Nails usually draw little attention as they cannot serve as chronological indicators. Several attempts at constructing a typology of nails have proved unsuccessful. The quality of metal of which they were forged has not been studied purposefully, although it can be relevant to the use of nails and construction practices. Here, we present the results of a metallographic analysis of 19 nails from Markul (13 spec. from a simultaneously formed cluster of iron items, and six spec. found elsewhere at the site). The findings suggest that they can be subdivided into three types in terms of metal structure and, accordingly, of properties of nails: those with a ferrite structure ("soft"), those with a ferrite-pearlite structure ("strong"), and those with a cementite structure ("extra strong"). These types correlate with three types of construction materials used in Abkhazia in the Late Classic and Medieval period. Lack of correlation between metric properties of nails and metal structure suggests that the latter was intentionally formed for specific tasks, depending on the characteristics of the details joined by nails.

Keywords: *Metallography, nails, Abkhazia, Black Sea coast of the Caucasus, Markul fortified settlement.*

Introduction

Metallography is a traditional method for analyzing metal artifacts discovered during research into historical and cultural heritage (Kolchin, 1953: 10–15; Ryndina, 1965, 2006: 6; Zinyakov, 1989: 76–79; 1997: 26, 69–70; Chindina, Zinyakov, 2020; Zavyalov, Terekhova, 2021; Zavyalov, 2021; Vodyasov et al., 2021; and others). Although this method was used for studying weaponry, jewelry, and other important and unique items from the archaeological sites of Abkhazia (Bgazhba, 1983; Terekhova, Rozanova, Bgazhba, 1987), mass-produced and ordinary items, such as forged iron nails, have hardly attracted any attention from scholars, largely because throughout almost their entire history the shape of nails has remained unchanged. Their manufacturing technology had also remained the same from the turn of the Common Era until the 20th century, and was as follows: the blacksmith heated an iron rod, sharpened one end, made a thickening in the place of the future head, and chopped off the rod; the resulting blank was inserted into the hole of a special nail header iron plate where the thick end was flattened with a hammer thus forming the head.

Some attempts to systematize the evidence were made in the studies on the nails of the Russian Middle Ages and Modern Age. For his systematization of nails, P.A. Korchagin used the categories of length, thickness, and weight, but did not analyze the metal. He wrote: "It is possible to determine the function based on the data on the length of the nail, the shapes of its shank and head, etc., and thereby draw conclusions as to what kind of production (shipping, carpentry, shoemaking) was practiced in ancient times at the excavation site" (Korchagin, 2011: 62). S.F. Tataurov also left metal analysis aside, arguing that it was not possible to subdivide nails typologically and they could not serve as chronological markers (2001, 2004). The latter statement may be true; this was precisely the main reason for the lack of interest in nails despite their widespread use.

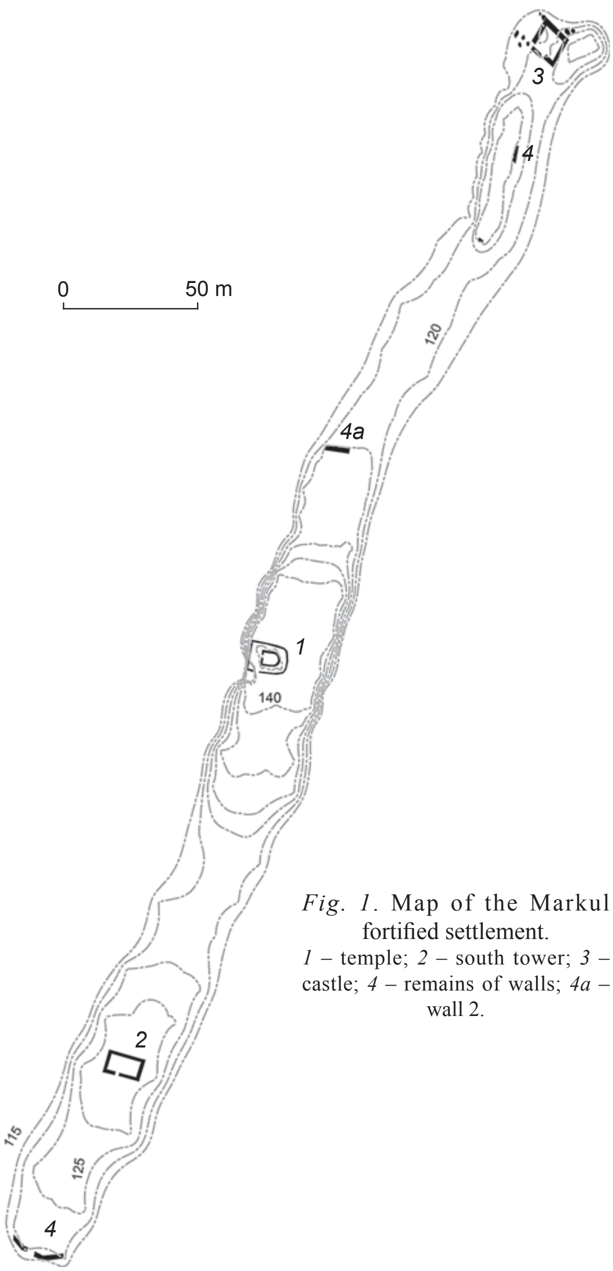

Fig. 1. Map of the Markul fortified settlement.
1 – temple; *2* – south tower; *3* – castle; *4* – remains of walls; *4a* – wall 2.

Notably, in addition to metric parameters, metallographic analysis of nails may indicate the scope of their application and the variety of construction technologies. It helps to determine the quality of raw materials, forging technology, and level of its development, which generally characterizes the level of technical and economic development of society.

Science-based methods were applied to studying nails used for decorating and padding shoes (17th–18th centuries), which were discovered in Tara. The results of X-ray fluorescence analysis revealed that metal of the nail heads that decorated the vertical bar of the heel contained tin remaining from their tinning. However, a detailed analysis of the structure of the iron-containing base has not been carried out (Osipov et al., 2017). The only study that analyzed the metal of nails was a collective monograph on the blacksmithing of Northeastern Semirechye (Kazakhstan) (Savelieva, Zinyakov, Voyakin, 1998), although unfortunately its authors did not draw any conclusions based on its results.

During excavations of the Markul fortified settlement, located in the Ochamchirsky District of the Republic of Abkhazia (Trebeleva, 2019), a joint expedition from the Institute of Archaeology of the Russian Academy of Sciences and the Abkhazian Institute for Research in the Humanities of the Academy of Sciences of Abkhazia accumulated a large collection of iron nails of various sizes and degree of preservation, coming mostly from different layers and locations in that site. During the excavations in 2021, a large pile of metal fasteners (clamps, nails, onlays) from the same structure was found near wall 2. The thirteen nails discovered there became the main object of this research. Nails from two other areas of the settlement—temple and castle (Fig. 1)—were used as comparative evidence.

Material and methods

Nineteen nails (Fig. 2) were examined from three areas of the settlement, which were designated as "wall 2", "temple", and "castle" (see *Table*). Wall 2, near which the excavations were carried out, was a part of the remaining stonework on the northern edge of the first plateau. Its maximum height above the ground surface

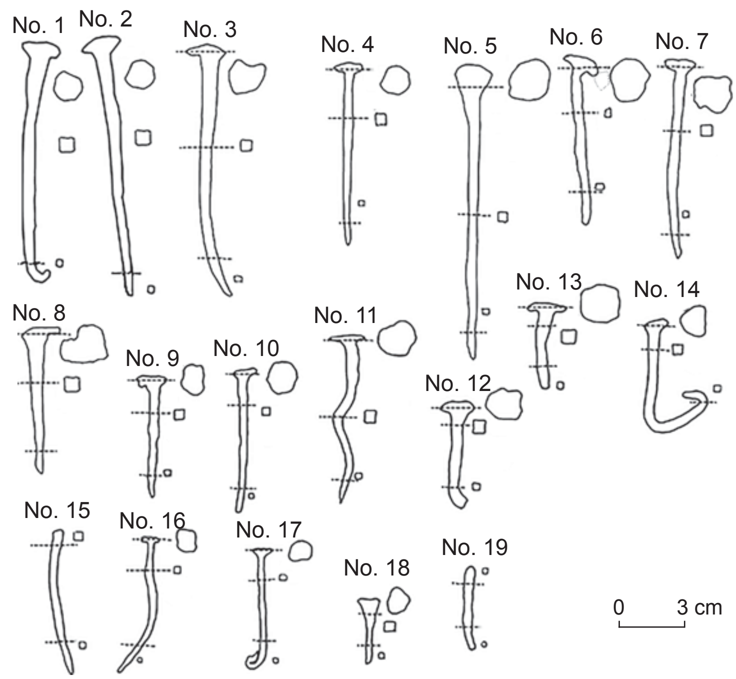

Fig. 2. Images of nails, indicating sampling locations.

was 1.5 m, length 4 m, and thickness 1.3 m. The excavation pit was made on the southern side of the wall along its visible section, and later a small trench was added in the eastern direction, revealing the continuation of the wall below the level of the daylight surface. Its total length was 6.68 m. The wall did not run along a straight line, but bent along the edge of the plateau almost going into a cliff, where robust tree roots, possibly destroying a part of the wall, came close to it (Fig. 3).

A pile of metal items, mainly fastenings (nails, clamps, hooks, plates), was discovered in the northeastern corner of the excavation pit. The pile was located under a rectangular hole (25 × 30 cm) in the wall, in a place where the wall dropped sharply. There was

Nails analyzed

No.	Place of discovery	Length, cm	Head size, cm	Thickness, mm		State of preservation
				under the head	2 cm from the end	
1	Castle, sq. 3B, level 11	10.5	1.5 × 1.5	8 × 8	3 × 3	Curved
2	Castle, sq. 5B, level 3	12.0	1.4 × 1.3	8 × 8	2.7 × 3.0	Straight
3	Temple, sq. 5, sector 3, level 6	11.5	1.5 × 1.3	6 × 5	3 × 4	"
4	Temple, sq. 6, sector 1, level 5, 6	8.5	1.5 × 1.4	5 × 5	3 × 3	"
5	"	14.0	2 × 2	4 × 4	3 × 3	"
6	Temple, sq. 6, sector 2, level 5	7.5	2 × 2	4 × 4	3 × 3	"
7	Wall 2, sq. A2, level 3	9.5	1.8 × 1.5	5 × 5	3 × 3	"
8	"	6.5	1 × 1	4 × 4	4 × 4	"
9	"	6.5	1.5 × 1.5	5 × 5	3 × 3	"
10	"	7.3	2 × 2	4 × 4	3 × 2	"
11	"	8.0	2 × 2	6 × 6	3 × 3	Curved
12	"	5.5	2.0 × 1.5	4 × 4	4 × 4	"
13	"	4.5	2 × 2	7 × 7	3 × 3	"
14	"	5.5	1.5 × 1.5	5 × 5	3 × 3	"
15	"	7.0	…	…	3 × 3	Fragment
16	"	8.0	2 × 2	4 × 4	2 × 2	Curved
17.	"	6.0	2 × 2	7 × 7	2 × 2	Bent
18	"	4.5	…	5 × 5	3 × 3	Fragment
19	"	4.0	…	…	1.5 × 1.5	Fragment

Fig. 3. Excavation site "wall 2".
a – view from the east; *b* – orthophotomap. The arrows indicate the location where the pile of iron items was discovered.

probably some kind of a wooden structure, and the hole was the place of a fastening beam. The fasteners obviously belonged to this structure, which suggested their simultaneity.

Pottery from the layer where the pile of metal items was found was local, typical of the Tsebelda period (2nd–7th centuries AD). In 2014, a fragment of a Roman red-glazed vessel was found in a test pit in the area next to this wall (Trebeleva et al., 2019). These facts allow the iron items, including 13 nails, to be attributed to the Tsebelda period.

Four nails were taken for analysis from the temple area (Fig. 4, *a*) (Trebeleva, Shvedchikova, 2019). They came from two different grids, but from the same level. Unfortunately, today, these items cannot be dated with certainty, because the layers near the temple were mixed. Generally, the temple dates back to the period from the turn of the 4th–5th centuries to the 14th century. Therefore, the nails might have belonged to both the Tsebelda period and the Middle Ages.

Since two nails from the castle area (Fig. 4, *b*) (Trebeleva, 2020) were found in different layers, they belonged to different periods. The castle, like the temple, was dated widely to the time from the second half of the 3rd century to the 14th century. One nail (No. 2) was found in the top layer near a narrow, pyramidal arrowhead, square in cross-section, with a waist at the tang (type 95 (Medvedev, 1966: 84)). Such points were widespread in Eastern Europe and Caucasus from the 8th to the 14th centuries. The second nail, discovered in the lower layer along with fragments of red-glazed pottery, may date back to the Late Classic and be contemporaneous with the nails from the excavation pit near wall 2.

To study the structure of nails from the "temple" and "wall 2" areas, three thin sections were made from each sample: from the head (if it survived), from the middle part, and at a distance of 1.0–1.5 cm from the pointed end. In the nails from the "castle" area, only the latter fragment was studied (see Fig. 2). The samples were pressed into conductive resin with their end faces, and were prepared for metallographic analysis by sequential grinding on a Piatto diamond grinding disc with grit P220 (3–5 min), P600 and P1200 (3–5 min), polishing paper with grit P2500 and P4000 (5 min), Akasel Daran velvet with DiaMaxx Poly suspension with diamond particle sizes of 1 μm, and Akasel Chemal foamed neoprene with a colloidal suspension of silicon oxide with particle sizes of 0.05 μm (10 min). A Buehler Phoenix 4000 polishing machine (USA) was used for polishing the samples. The surface was etched with solution of HNO_3 (3 parts) and C_2H_5OH (97 parts) for 10 sec. Then, the thin section was washed with running water and ethyl alcohol.

Thin sections were examined using an Altami MET 5C microscope with a built-in high-resolution video camera (14 megapixels), and special Altami Studio 4.0 software. The set of lenses has made it possible to obtain magnifications of 50 to 2000. Images were captured in unpolarized light at the highest brightness.

Results

Sample 1. Its structure shows a band of hypoeutectoid low-carbon steel among two bands of softer iron. Iron with different carbon content was used to manufacture this nail, which is confirmed by the presence of purely ferrite, as well as ferrite-pearlite, areas in the structure (hereafter, Fig. 5).

Sample 2. It reveals the microstructure of hypereutectoid steel: pearlite and secondary cementite.

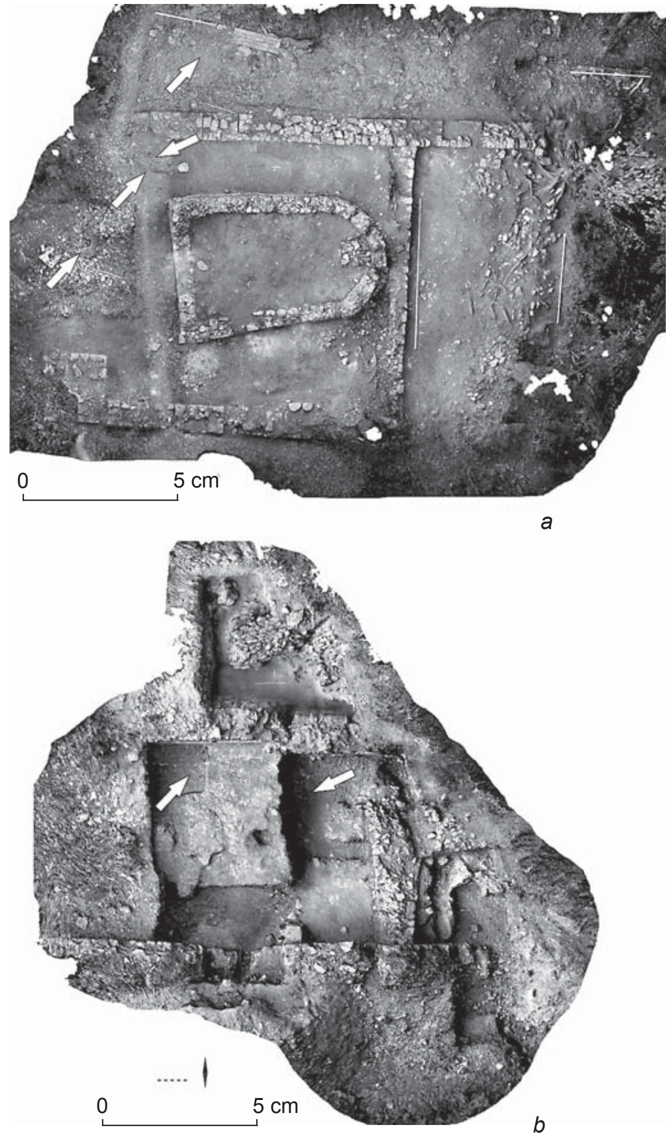

Fig. 4. Orthophotomaps of the "temple" (*a*) and "castle" (*b*) excavation areas. Arrows indicate locations where the nails were found.

Sample 3. The structure of the head shows both ferrite areas with small and medium-sized grains, and ferrite-pearlite areas. In the middle part and the end of the nail, the structure is mainly ferrite. A small amount of slag inclusions is observed. Iron with different carbon content was used to manufacture this nail, which is confirmed by the presence of purely ferrite, as well as ferrite-pearlite, regions in the structure.

Sample 4. A uniform ferrite-pearlite structure with fine grains appears in the head and the end of the nail. Pearlite-cementite structure is in the middle part. Slag inclusions are almost absent. This nail was made of medium carbon steel.

Sample 5. In the head, the structure shows mainly ferrite, possibly with an admixture of granular pearlite with small amount of slag. In the middle part, the structure reveals ferrite and pearlite with numerous slag inclusions. The end of the nail has a ferrite structure with small grain sizes. A small amount of slag is observed. The nail was made of low-quality steel.

Sample 6. All parts of this nail have a uniform ferrite structure with medium and small grains, and slag inclusions. The nail was made of iron.

Sample 7. Its structure is similar to the previous one.

Sample 8. All parts of this nail have a ferrite structure with medium-sized and fairly large grains. Small number of banded slag inclusions are observed. The nail was made of iron.

Sample 9. The structure reveals ferrite with small and medium-sized grains in all parts of this nail. There is a fairly large number of slag inclusions. Alternating layers with small and medium grains are in the middle part. The nail was made of iron.

Sample 10. All parts of this nail have the ferrite structure with medium-sized and large grains, and a large amount of slag. Etched slag inclusions are observed along the grain boundaries. The nail was made of iron.

Sample 11. The head has the ferrite-pearlite structure with grains of various sizes. The amount of carbon is lower in the middle part and the end of the nail. The structure consists mainly of ferrite with small ferrite-pearlite areas with grains of different sizes and numerous slag inclusions. The nail was made of unevenly carburized hypoeutectoid steel.

Sample 12. The head has the uneven ferrite-pearlite structure. The areas of both pure ferrite and ferrite-pearlite with slag inclusions are present in the middle part and the end of the nail, which was made of unevenly carburized hypoeutectoid steel.

Sample 13. The structure of the head is ferrite-pearlite turning into ferrite with fine grains. It is ferritic with small ferrite-pearlite areas, medium-sized and large grains, and small amount of slag inclusions in the middle part and the end of the nail, which was made of hypoeutectoid steel.

Sample 14. All parts of this nail have the ferrite-pearlite structure with fine grains. Layering, which could have emerged during the forging process, is observed. Slag inclusions are insignificant. The nail was made of hypoeutectoid steel.

Sample 15. The structure is ferrite, with small grains and a large number of slag inclusions. The nail was made of iron.

Sample 16. The structure of the head consists of ferrite and ferrite-pearlite layers. Grains are small-sized. Slag inclusions are observed. The middle part and end of the

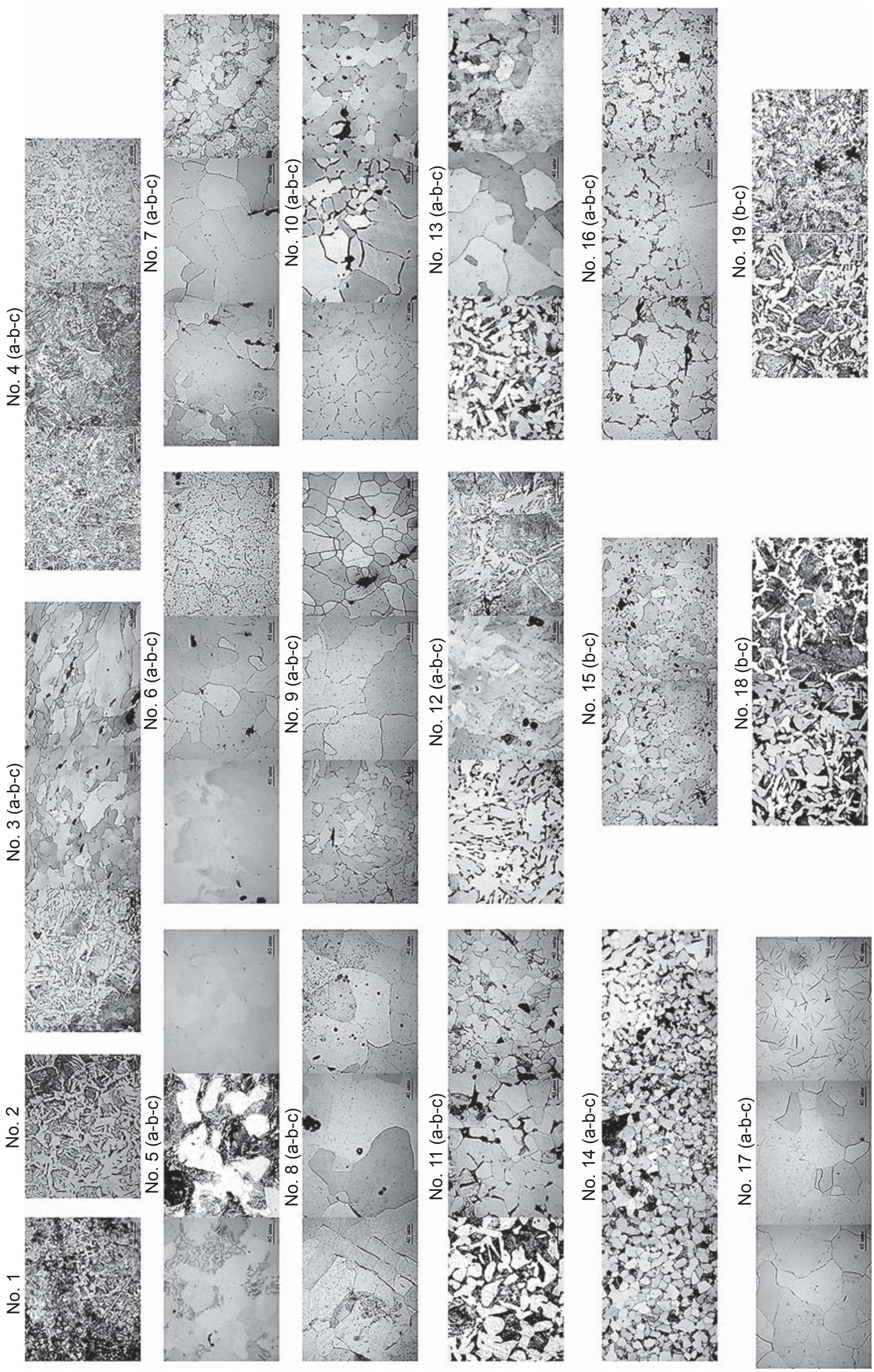

Fig. 5. Microphotographs of samples.

nail also have ferritic and ferrite-pearlite areas. The nail was made of unevenly carburized steel.

Sample 17. The structure of the head and middle part is ferrite, with large grains and a small amount of slag. Inclusions of banded defects are observed in the ferrite matrix at the end of the nail, which was made of iron.

Sample 18. A transition from the ferrite-pearlite structure to the pearlite-cementite structure with fine grains and small amount of slag inclusions is observed in thin sections from the middle and end of this nail, which was made of carburized steel.

Sample 19. In its middle and end parts, this nail has a uniform ferrite-pearlite structure with fine grains. Slag inclusions are observed. The nail was made of carburized steel.

Discussion

The results of the analysis show that, according to the structure of the metal, the nails can be classified into three types: 1) fairly hard, but ductile, made of carburized steel with the ferrite-pearlite structure (conventionally, "strong"); 2) soft and ductile, made of pure iron, intended for driving into fairly soft materials, since they most likely simply could not penetrate hard materials (conventionally, "soft"), and 3) very strong, but brittle, made of highly carburized steel with cementite in its structure (conventionally, "extra strong"). There were six nails of the first type, six nails of the second type, and one nail of the third type in the pile near the wall. Samples from the "castle" section were "strong" and "extra strong". Among the nails from the temple area, two nails were "strong", one was "extra strong", and one was "soft". All three types of nails were present in each area (with the exception of the "castle" where only two samples were taken for analysis).

Comparison with the analysis of 17 nails from the Northeastern Semirechye (Savelieva, Zinyakov, Voyakin, 1998: 71–74, 92, 99) has revealed that the absolute majority of them (15 spec.) were made of hypoeutectoid ferritic-pearlite steel corresponding to our "strong" group, and two were made of pure iron ("soft" group). There were no nails containing cementite ("extra strong") in their structure.

An important issue is the presence/absence of correlation between the type of metal and the metric parameters of the nail. In this case, complete analysis is hampered by the fact that some of the nails were bent or fragmented. By reconstructing the lengths of the curved nails and averaging the parameters, it was established that the length ranged from 5 to 14 cm, with slight variability in thickness (from 4 to 8 mm under the head). There was no correlation between the structure of metal and the metric parameters. There was also no connection with the degree of preservation: three fragmented nails from the pile near wall 2 manifested all three types.

Conclusions

Abkhazia may rightly claim the role of a main center of iron metallurgy. Iron products appeared here as early as the 8th century BC; and in the 7th–6th centuries BC, local artisans mastered the methods of steel carburizing and hardening. The technology of metallurgy and blacksmithing in the region was highly developed and rich in its traditions. Sources of raw materials were also local (Bgazhba, 1983: 11–12).

The pile of iron items near wall 2, where the nails under discussion were found, was most likely the remains of fasteners (onlays, clamps, nails) of an unpreserved wooden structure. Assuming that the metal plates were parts of hinges with which this structure was attached to the wall, a set of nails would be needed to nail them both to the wooden structure and the stone wall. These different materials, into which the nails were to be driven, required different strengths for them. Most likely, this explains the presence of both "strong" and even "extra strong", and "soft" nails in the excavation pit.

Three main types of material, i.e. wood of varying degrees of density, as well as stones of soft (such as spongy tuff, sandstone, and limestone) and very dense (sea and river pebbles) structure, may be observed in buildings of Abkhazia. These types of material may correlate with three types of iron nail, which suggests the targeted production of nails of different qualities, intended for driving into materials of different densities. Currently, this is only a hypothesis requiring further research. However, there is no direct correlation between the metric parameters of nails and the structure of the metal: "extra strong" nails could be both large (No. 2) and medium-sized (No. 4). The length of "strong" nails varies from 5.5 (No. 12) to almost 11.5 cm (No. 3), while the length of "soft" nails varies from 6.5 (No. 8 and 9) to 14 cm (No. 5). The situation is the same with nail thickness, which ranges from 5 (No. 4, 18) to 8 mm (No. 2) in "extra strong" nails, from 4 (No. 12, 16) to 8 mm (No. 1) in "strong" nails, and from 4 (No. 5, 6, and 8) to 7 mm (No. 17) in "soft" nails.

Thus, it may be concluded that the metric parameters of nails were determined by the sizes of the objects intended to be fastened, while the structure of metal was determined by the characteristics of the material with which it was supposed to provide fastening. This indicates the presence of a highly developed specialized production of nails in both the Tsebelda and Medieval periods.

Acknowledgments

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A Log Structure in the Northern Palisade of Fort Umrevinsky

The study describes the findings of excavations at the northern palisade of Fort Umrevinsky. We revealed the basis of a log structure with a floor made of planks, adjoining the central part of the northern palisade. A tight joining of the palisade ditch with the two preserved rows of logs indicates a single construction episode. At this area, another entrance to the territory of the fort was revealed, situated right opposite the southern one. Design features of the foundation of the log structure (the way of cutting logs, the floor made of planks), dimensions (6 × 6 m), and location suggest that this was the base of the northern passage tower. Spatial structure, location, and size of the structure match those of wooden towers of Siberian forts. During earlier studies at one of the corner towers of Fort Umrevinsky, built as early as the second quarter of the 18th century, a plank floor was also revealed. The northern passage tower was erected at the initial stage (before the first third of the 18th century) of the fort's existence. This wooden defensive structure suggests that Fort Umrevinsky was one of border fortifications, each of which had a sub-rectangular palisade and a single entrance tower. The foundation of the northern entrance tower was probably described in 1741 by J.G. Gmelin as a ruin of a guardhouse. Towers of Siberian forts were multifunctional. Apart from their defensive function, they served as guardhouses and were also destined for living and storage.

Keywords: *Upper Ob basin, Peter the Great period, fortification, fort, tower, Tsardom of Muscovy.*

Introduction

Archaeological research of wooden defensive structures of Siberian forts provides new information on the features of defense in various construction and historical periods of border fortifications in Siberia. In restoring the original appearance of these structures, it is methodologically and factually incorrect (Chernaya, 2002: 131) to contrast different types of sources (written, pictorial, and archaeological) (Kurilov, 1989: 87). One of the main requirements of modern methodology for historical interpretations and reconstructions is representative combination of different types of sources, which complement and correlate with each other (Chernaya, 2016: 116, 117). Detailed location records of individual wood slabs, logs, and boards during archaeological excavations help to reliably reconstruct the forts (Molodin, 1980: 137). This is the main approach in the study of defensive structures of Fort Umrevinsky, which functioned in the Novosibirsk Ob region in the first half of the 18th century.

Evidence and sources

Archaeological study of the northern palisade in Fort Umrevinsky started over twenty years ago (Figs. 1, 2). In 2000, A.V. Shapovalov explored its two corners

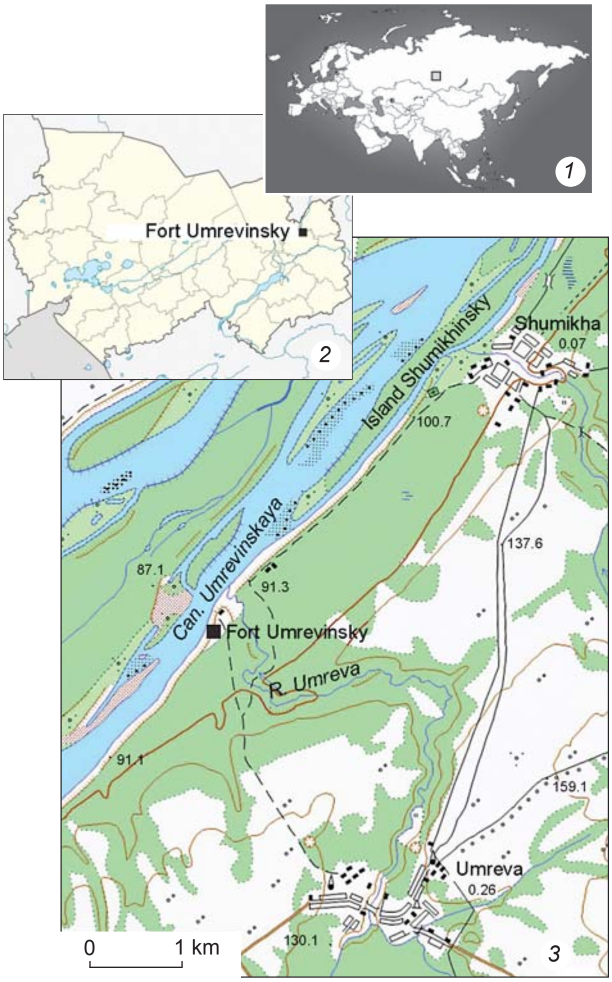

Fig. 1. Location of Fort Umrevinsky on the map of Eurasia (*1*), Novosibirsk Region of the Russian Federation (*2*), and its surrounding area (*3*).

(northwestern and northeastern). Excavations revealed the palisade ditch and decay of several dozen palisade logs of different diameters (Shapovalov, 2000: 65). The foundations of 16 palisade logs have survived in the northwestern corner. Seven of them were located in a branch of the palisade ditch, perpendicular to the western wall. The length of this external structure at the junction of the western and northern palisade walls was 1.5 m. Several variants of protruding elements of palisade walls are known from the forts of the 17th century, for example, "lumber extensions with side branches and protrusions" (Balandin, 1974: 13, 15, 16, fig. 3, *a*). The cross-section of the surviving palisade logs in the area of the outer protrusion was predominantly flattened and elliptical, which may have resulted from logs split in half. Similar cross-section of palisade logs was subsequently identified in the ditches of the western palisade wall and foundation of the southwestern corner tower (Borodovsky, Gorokhov, 2008: 78, fig. 13, *2*; 2009: 158, fig. 25), where a foundation coin—*denga* from 1730, the beginning of the reign of Empress Anna Ioannovna—was discovered in 2002 (Borodovsky, Gorokhov, 2008: 78, fig. 13, *1*; 2009: 44, 50, 51). Such referential numismatic evidence and use of logs split in half permit attributing this structural element of the palisade wall to the second construction period of not earlier than the first third of the 18th century, which is indirectly confirmed by the written sources (Borodovsky, 2021a: 99, fig. 6).

In 2021, archaeological excavations explored a section of the northern palisade wall, perpendicular to the Umrevinsky channel of the Ob River (Fig. 3). Eight bases of palisade logs have survived there. Five of them were probably made of logs split in half like those on the opposite corner; three were made of whole

Fig. 2. General view of the area of Fort Umrevinsky.

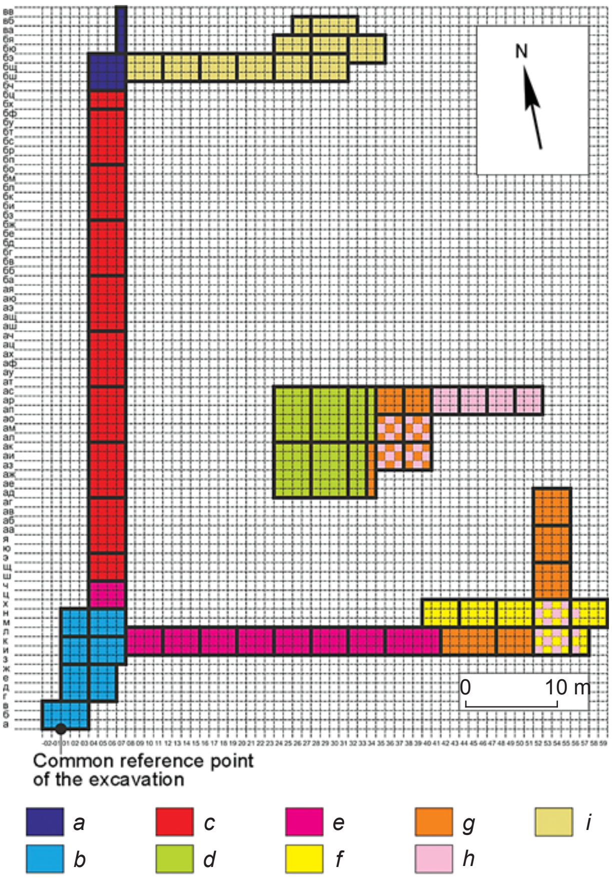

Fig. 3. Spatial distribution of excavations at Fort Umrevinsky.
a – excavation of 2000; *b* – 2002; *c* – 2003; *d* – 2004; *e* – 2015; *f* – 2018; *g* – 2019; *h* – 2020; *i* – 2021.

logs. These two types of palisade logs have already been identified as a part of this wooden defensive structure (Borodovsky, Gorokhov, 2008: 75, fig. 7, *1*, *2*; Borodovsky, 2021a: 99, fig. 6). A copper coin of unknown denomination minted in 1796 (the final period of the reign of Empress Catherine II) was discovered in the cultural layer outside the palisade ditch. It serves as referential numismatic evidence and gives a relative dating to the emergence of a section of buried soil at the base of the already destroyed northern palisade wall in Fort Umrevinsky. Two more bases of wooden poles 15–20 cm in diameter, which were on the interior side of the northern palisade ditch, probably belonged to the enclosure (*zaplot* of horizontally stacked logs between posts) of the cemetery in the fort area. They were set on the edge of discharged soil from the cemetery ditch. Two bronze buckles, possibly of the 18th century, were found on the interior side of this section of the northern palisade. The northern edge of the necropolis, which subsequently emerged in Fort Umrevinsky, was also discovered there as both single and layered burials (Fig. 4).

In the central part of northern wall of the fort, the palisade ditch tightly joined the decay remaining from the foundations of a logwork 6 × 6 m in size (Fig. 5, 6). It continued to the east of this structure. The bases of three palisade logs have also been identified there. Several coins from the late 18th and early 19th centuries were discovered in this area of the palisade, including *dengas* of 1739 (final period of the reign of Empress Anna Ioannovna), 1771, and 1793 (reign of Empress Catherine II), as well as two coins of Nicholas I (10 kopecks of 1839 and 3 silver kopecks of 1845). A kettlebell-shaped button was found inside the log foundation at the southwestern corner. Such buttons were common in the 18th and early 19th centuries. Similar finds have already been made several times at Fort Umrevinsky, including the necropolis, and in the surrounding area (Borodovsky, Gorokhov, 2009: 205, fig. 75, *3*, *4*).

The subsquare logwork, which was built into the central part of the northern palisade wall, was constructed from logs up to 40 cm in diameter laid on the ground surface. This construction technique was typical of wooden fortifications in the 18th century in Western Siberia. For example, the lower layers of logs in the towers of Fort Kazym were laid on sandy soil (Kradin, 1988: 93, ill. 150). This tradition survived during the

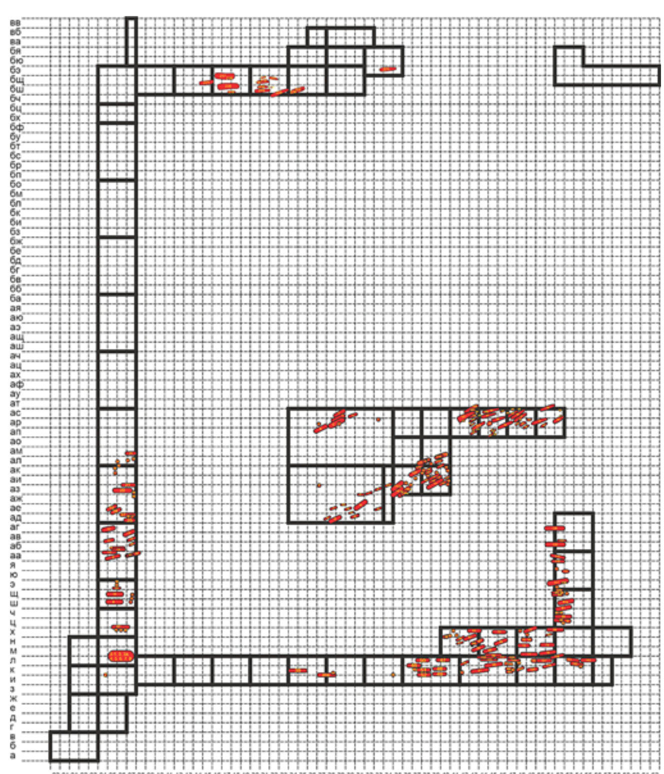

Fig. 4. General spatial structure of the late necropolis on the site of Fort Umrevinsky.

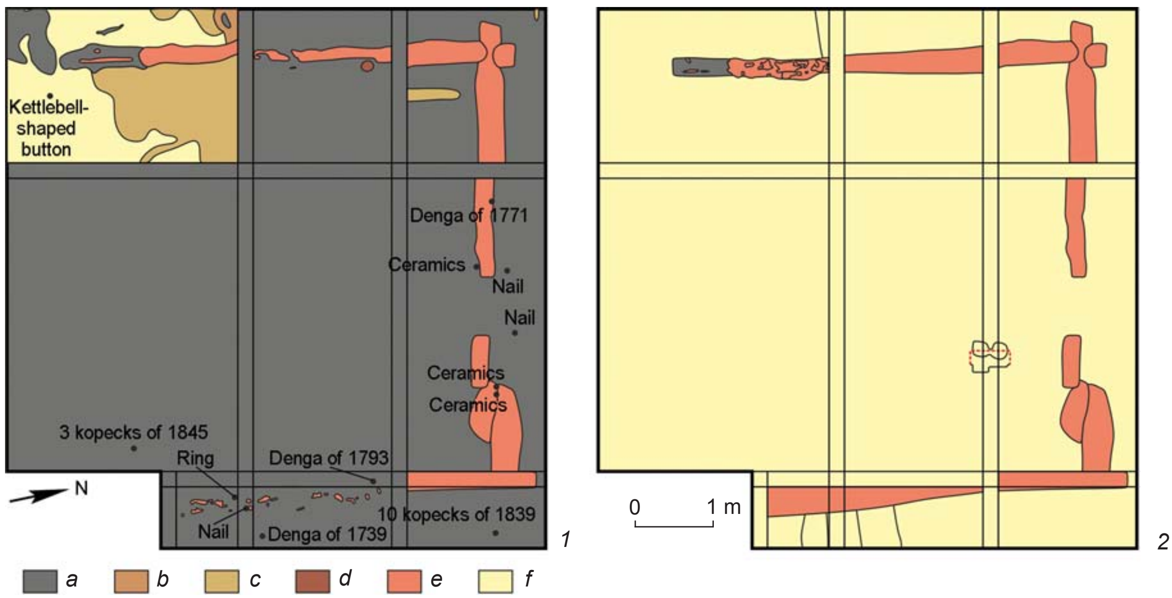

Fig. 5. Plan of the foundation of a logwork structure in the central part of the northern palisade.
1 – first horizon; *2* – second (virgin) horizon.
a – humus; *b* – incompletely mixed mixture of humus and clay in equal proportions; *c* – completely mixed mixture of humus and clay in equal proportions; *d* – wooden pole; *e* – horizontally lying log; *f* – virgin surface.

Fig. 6. Foundation of a logwork structure from the southwest (*a*) and northwest (*b*). *Photo by A.P. Borodovsky*.

construction of log dwellings in Siberia in the 18th century (Etnografiya…, 1981: 112).

Northern, western, and eastern sides remained from the foundations of the Umrevinsky log structure in the center of the northern palisade. At the corners, both traces of joined logs of the logwork were quite clearly visible and wood fibers, revealing the technique of joining by the saddle notch (Fig. 7). According to this technique, logs protrude beyond their intersection by 25–30 cm; corners and walls of the structure become well protected from external natural impact, and logwork is the most stable. Only one layer has survived from joined logs in the northwestern corner of the logwork. Based upon the overlap of the "northern" log with the "western" log, the joint was made with the notch facing down. According to this construction technique, the logwork is less susceptible to various external impacts. Notably, the corners of the lower layers of towers in Fort Kazym were also joined with the saddle notch, with the notch facing down (Kradin, 1988: 93, ill. 150). Evidence of this construction technique has survived in a much worse state on the opposite, eastern side of the Umrevinsky log structure. Only two layers of fairly thick logs have remained from the lower part of the logwork. Some parallel is the foundation of the log house of Peter the Great, built in 1702 on Markov Island at the mouth of the Northern

Dvina River*. Initially, this log structure most likely had a high subfloor formed by two lower layers of particularly thick logs. Previously, logwork joined by the saddle notch was found in a burnt dwelling in the central part of Fort Umrevinsky (Borodovsky, Gorokhov, 2009: 167, fig. 34, p. 170, fig. 38). The protruding ends of logs at the corners of this structure (log house and oven foundation) were preserved very well and protruded outward up to 25 cm.

Discussion

The size of the logwork structure in the central part of the northern palisade of Fort Umrevinsky generally corresponds to average standards of log structures common for the Russian culture in the 10th–14th centuries (Drevnyaya Rus…, 1985: 147). The design of the lower part of the log house was always given special attention, since durability of wooden building depended on it. The basis of the structure was the foundation layer of logs, which determined the plan and proportions of the entire building. That layer was in the most unfavorable conditions, i.e. in contact with the ground. Therefore, it disintegrated faster than other parts of the wooden structure. For this reason, fairly thick logs were chosen for the foundation layer (Ibid.: 148).

Several fragments of boards laid along west–east have survived in the internal space of the logwork under discussion on the western and eastern sides. Judging by the remaining wood fibers, their width was 30–40 cm. Three more fragments of the end of boards of similar width, laid on a separate joist, which was located at its edge, have also survived on the interior side of the northeastern log of the structure. Floors in log cabins, warm rooms, and utility rooms were often made at the level of the second log layer. The floorboards were made of planks 5–6 cm thick. They lay freely on beams (joists) and rested with their ends on the logs of the foundation, which ensured the rigidity of the entire flooring structure (Ibid.). This explains the lack of fastening of the floorboards at the junction with the foundation layer of the logwork in the northern palisade of Fort Umrevinsky.

When constructing a floor above the second layer of logs, posts of the particular height were usually placed under the joists at a certain step. The ends of the flooring joists were often cut into the logs of the logwork. This was done in two ways: through and blind. The latter way, when the socket in the log of the wall was cut down to its half, was more widespread and technologically advanced. The outermost joists were located at a distance from one to one and a half diameters of the log in the foundation layer

Fig. 7. Logs of a log house joined by the saddle notch (from the northwest). *Photo by A.P. Borodovsky*.

(Ibid.). This design can be reconstructed from wood decay on the eastern wall of the logwork. Notably, fragments of the plank floor were previously discovered in the corner southwestern tower of Fort Umrevinsky (Borodovsky, Gorokhov, 2008: 78, fig. 13, *1*; 2009: 50). This matches a trend of equipping high-status structures with flooring of boards, which became widespread in wooden architecture of the early 18th century (Gromov, 1985: 327).

The support of the board floor in the logwork in the central part of the northern palisade of Fort Umrevinsky included several piles 30–40 cm high. One of them has survived near the eastern wall of the structure. A double depression in the sterile surface, located almost in its center, remained from another pile. This design created a space between the ground and floor, which remained open and served for ventilation (Blomkvist, Galitskaya, 1967: 134, fig. 33, A, B, pl. XXXVI, XXXVII). A low subbasement (*podklet*) of two log layers in the Umrevinsky logwork structure could have had exactly this function. In this regard, it is important to emphasize that references to subbasements in Siberia disappeared from the written documents only in the late 18th century (Etnografiya…, 1981: 123).

The northern edge of the logwork foundation has been preserved only partially (Fig. 8). However, it was possible to find a fragment of a beam of smaller diameter than logs of the logwork in its foundation, with traces of intense burning, in this area. It could have been a part of the upper structure fallen down after the fire. This fact significantly expands the topography of traces of fire on wooden defensive structures of Fort Umrevinsky. Previously, they were observed in its central (dwelling) and southwestern (tower) parts (Borodovsky, 2020).

There are several possible interpretations of the log structure built into the northern palisade of Fort Umrevinsky. Particular attention should be paid to its location, shape, and size. Passage and blind towers,

*At present, this building is an exhibit item of the Moscow State United Art Historical-Architectural and Natural Landscape Museum-Reserve in the village of Kolomenskoye.

Fig. 8. Northern wall of a logwork structure (from the north). *Photo by A.P. Borodovsky*.

Fig. 9. Passage tower of Fort Kazym (Yuilsky) (Open-Air Museum of the IAET SB RAS, Novosibirsk). *Photo by A.P. Borodovsky*.

dwellings, chapels, churches, and barns are known among log structures built into the walls (Balandin, 1974: 30; Berezikov, 2016) (see also: GATO. F. 521, Inv. 1, D. 1, fol. 2r-2v). The location of such structure in the center of the palisade wall corresponds to one of the most common layouts of Siberian forts (Balandin, 1974: 32, fig. 6, p. 35, fig. 10) (Fig. 9). Most of these fortifications, made in the early 18th century in the Ob region, had a passage through sub-rectangular defensive structures. For example, there were passage towers in the northern and southern walls in Fort Chaus (Minenko, 1990: 25; Gorokhov, 2018: 136, ill. 2).

The use of the structure built into the palisade as a guardhouse should also be considered for Fort Umrevinsky. This function was often performed by passage towers (Balandin, 1974: 28). When visiting Fort Umrevinsky in 1741, in addition to the palisade made of split logs, J.G. Gmelin mentioned a destroyed guardhouse (1752: 77). This written evidence correlates with archaeological data and makes it possible to ascribe the log structure under discussion to the first construction period in the early 18th century.

For attributing the log structure, its northern location is no less important. Usually, grain barns were built in the northern part of Siberian forts. This placement was associated with the most favorable conditions for storing grain. Northern location of such buildings is known from Fort Chaus (Gmelin, 1752: 88–90). Grain barns were important in fortifications of the 18th century. An example is the construction of barn-granaries by A.D. Menshikov in the occupied Shlisselburg in 1704 (Iogansen, Kirpichnikov, 1974: 31). It is known from the written sources of the first quarter of the 18th century that there were several barns in Fort Umrevinsky. Some of them already existed in 1729 (Emelyanov, 1980: 187); two were built in 1748 (Ibid.: 215). Granary towers built into the walls in the corners were in 1745 in the Zmeinogorsk fortress. The size of these structures in ground plan was 7 × 7 m (Sergeev, 1975: 15). In the Northern and Central Russia, typical barn was a log house (on average, 4 × 4 m) placed on low wooden posts ("chairs") or less often on stones for protection against ground dampness. The barns of Fort Sayan had similar sizes (5 × 5 and 4 × 5 m) (Mainicheva, Skobelev, Berezhenko, 2018: 104). Structurally, the foundation of the log structure in the northern wall of Fort Umrevinsky, with space between the ground and floor of the building to ensure ventilation (Blomkvist, Galitskaya, 1967: 134, fig. 33, A, B, pl. XXXVI, XXXVII), shows some similarity with barns. Thus, the low subbasement of two log layers with supports under the floorboards in the Umrevinsky logwork could have served for storing grain, flour, etc.

Grain barns were typical of forts and other defensive structures of the early 18th century.

The size of this log structure in plan view (6 × 6 m) corresponds to the standards of both barns and fort towers. Many such wooden towers are known from Siberian fortifications of the late 17th–early 18th centuries (Balandin, 1974: 26, 27, pl. 2; Alekseev, 1996: 25, 99, pl. 16). However, it has long been known that towers of the 17th–18th centuries in Siberia were quite multipurpose and often combined the functions of a defensive structure with religious, residential, and utility space (Balandin, 1974: 29) (see also: GATO. F. 521, Inv. 1, D. 1, fol. 2r-2v).

If at the first construction stage in the early 18th century, wooden defensive fortifications (palisade) of Fort Umrevinsky included one multifunctional tower, it was the most sophisticated structure (Morgunov, 2009: 43) of this border point from the Peter the Great period. This conclusion is based not only on completely different timber quality required for a quickly built palisade, but also on a higher level of carpentry needed to make such a structure as a long-term fortification.

Conclusions

Identification of the foundation of a logwork structure in the northern wall resumes the discussion about the number of towers in Fort Umrevinsky throughout the period of its existence in the 18th century. Written sources from the first half of the 18th century contain discrepancies on the presence of several (one, two, or three) towers. For example, the travel diary of D.G. Messerschmidt from 1721 does not mention any towers whatsoever (1962: 79); the "Historical and Geographical Description of the Tomsk Uyezd" of 1734 mentions two towers (Elert, 1988: 76), whereas only one tower is described in the questionnaire of G.F. Miller dated to 1740 (RGADA. F. 199, Portf. 481, Pt. 2, fol. 97); no evidence of towers, except for a destroyed guardhouse, appears in the description by Gmelin from 1741 (1752: 77, 78). Earlier, relying on the archaeological evidence, I supported the point of view that in the first construction period (early 18th century), Fort Umrevinsky had no towers at all, its defensive structures were a rectangle of palisade walls, while two corner towers of the "bastion" type were build on the southern line of fortifications in the second period after the first quarter of the 18th century (Borodovsky, 2021a: 100; 2021b: 98). The research of 2021 revealed that these assumptions need significant adjustments. The structural relationship between the palisade and log structure in its central part suggests that, in the early 18th century, fortifications of Fort Umrevinsky were a rectangle of palisade walls, with one passage tower on the northern side. Based on the written sources, in 1706, Forts Verkhtomsky and Melessky had similar defensive structures (Iz otcheta…, 1978: 30, 31).

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An Archaeobotanical Study of the Bukhta Nakhodka Fort, the Yamal Peninsula (13th to Early 14th Century)

We present the findings from an archaeobotanical study of samples from the habitation layer of Bukhta Nakhodka, a 13th to early 14th century fort on the Yamal Peninsula, Western Siberia. On the basis of a detailed analysis of the taxonomic diversity of macro- and micro-remains of plants, the vegetation around the site is reconstructed as grass, moss, and subshrub tundra. The abundance of pollen and vegetative plant parts in habitation deposits inside buildings support an earlier hypothesis that peat and turf briquettes, resulting from turf removal, were used for construction. The vegetation cover of tundra area within the site and immediately adjoining it had changed. Its integrity was disrupted during construction of the fort, after which ruderal tundra apophytes expanded rapidly, and the turf layer was partly recovered during the fort's existence. A secondary grass cover, differing from that of the natural tundra communities, formed after the fort had been abandoned. A few remains of wild food plants were found, but none of cultivated plants. On the basis of archaeobotanical data, it is concluded that the pre-Nenets people used the plant resources of the Yamal subarctic tundra mostly for construction, domestic needs, and possibly as food.

Keywords: *Plant macrofossil analysis, pollen analysis, archaeology, pre-Nenets population, subarctic region of Western Siberia.*

Introduction

The development of the Arctic regions of Northern Eurasia is associated with the medieval warm period or medieval climatic anomaly (950–1250 AD). In the 10th–14th centuries, when the climate, according to dendrochronological data, was warmer and probably drier than the average throughout our era (Shiyatov, Hantemirov, 2005), stationary settlements of both indigenous people and Europeans appeared on the Yamal Peninsula and adjacent territories (Istoricheskaya ekologiya…, 2013: 232–233; Plekhanov, 2013; Vizgalov, Kardash, Konovalenko, 2018; Kardash et al., 2018; and others). By that time, tundra communities already predominated on the peninsula, and woody vegetation occupied intrazonal landscapes along the valleys of large rivers in its southern part, gradually forming the northern border of the forest and the forest-tundra type of vegetation south of the Arctic Circle (Volkova, Bakhareva, Levina, 1989; Telyatnikov, Pristyazhnyuk, 2002; Vasilchuk, 2007: 155; and others).

Archaeological complexes of stationary settlements in the subarctic region of Western Siberia provide valuable information about the subsistence system of the population, and about the natural conditions at that time. Despite many years of research into such objects, only a few sites have been studied using archaeobotanical methods (Panova, 1998, 2008; Panova, Yankovska, 2008; Zhilich et al., 2016; Korona, 2010, 2013, 2015; Anderson et al., 2019).

The purpose of the work is to carry out a comprehensive in-depth archaeobotanical study in order to reconstruct plant communities in the vicinity of the Bukhta Nakhodka fort, and to identify anthropogenic changes caused by the economic activities of the aboriginal population living at that time.

Archaeological essay and brief results of the earlier interdisciplinary studies

The fort of Bukhta Nakhodka (67°19′N, 72°10′E) is located on the subarctic territory of the Yamal Peninsula (Fig. 1), within the moderately cold and humid subarctic climate zone, where the temperature of the coldest month (January) is –24…–26 °C, that of the warmest (July) is +8…+12 °C, average annual precipitation is ca 300–400 mm (Natsionalniy atlas…, 2008: 158–159). The site is located in the subzone of subshrub tundras, which are characterized by moss-lichen dwarf-birch communities with *Betula nana, Empetrum hermaphroditum, Carex globularis* (Ibid.: 328–330). The immediate vicinity of the fort is dominated by tundra communities without tree vegetation, but with shrub thickets (*Salix* sp., *Betula nana, Alnus alnobetula* subsp. *fruticosa*) and a coastal raised bog with *Rubus chamaemorus*.

The archaeological study at the site in 2006–2014 has shown that this was a settlement of Sikhirtya—the pre-Nenets population of the Yamal tundra. The layout of the fort was of a mirror-symmetrical type (Fig. 2). All the studied buildings were two-chambered dwellings, each consisting of a bypass gallery and a living space with a central hearth. The gallery served as a thermal-insulation layer and was likely used for storing food, clothing, and utensils, i.e. it had an economic purpose (Kardash, 2011: 16–21).

According to the results of dendrochronological dating of the wood of the buildings, the last building-horizon uncovered by excavations dates to the 13th to early 14th centuries AD (Sidorova, Büntgen et al., 2017). Archaeozoological study of osteological material has shown that the main economy of the fort's population was hunting wild reindeer; in addition, they hunted arctic fox, and caught fish (mainly sturgeon) and marine mammals (Kardash, Lobanova, 2008; Istoricheskaya ekologiya…, 2013: 257). The site functioned in the autumn-winter period, and from May to September only a small group of people remained there (Kardash, 2011: 42–45).

Material and methods

Samples for the archaeobotanical study were collected within the 2014 excavation area (Fig. 2). The tested cultural layer, both inside and outside the buildings, is homogeneous, humic, dark brown in color, and contains a mass of wooden chips, grass, and half-decayed organic remains. Under laboratory conditions, samples (weighing ca 25 g) were taken from the soil monoliths for pollen analysis, and samples (in the volume of 300–600 ml) for the plant macrofossil analysis. From the sediments of the gallery of buildings 3 and 5, each 50 cm thick, continuous columns of 10 samples each were selected in accordance with the weight and volume of the samples indicated above.

The samples were processed and analyzed using standard methods (Grichuk, Zaklinskaya, 1948; Nikitin, 1969). Pollen and spores were determined in

Fig. 1. Location of a number of forts in the subarctic region of Western Siberia.
1 – Bukhta Nakhodka; *2* – Yarte VI; *3* – Tiutei-Sale-1; *4* – Polui promontory fort; *5* – Nadym; *6* – Ust-Voikary.
a – Arctic Circle; *b* – modern northern border of forest vegetation.

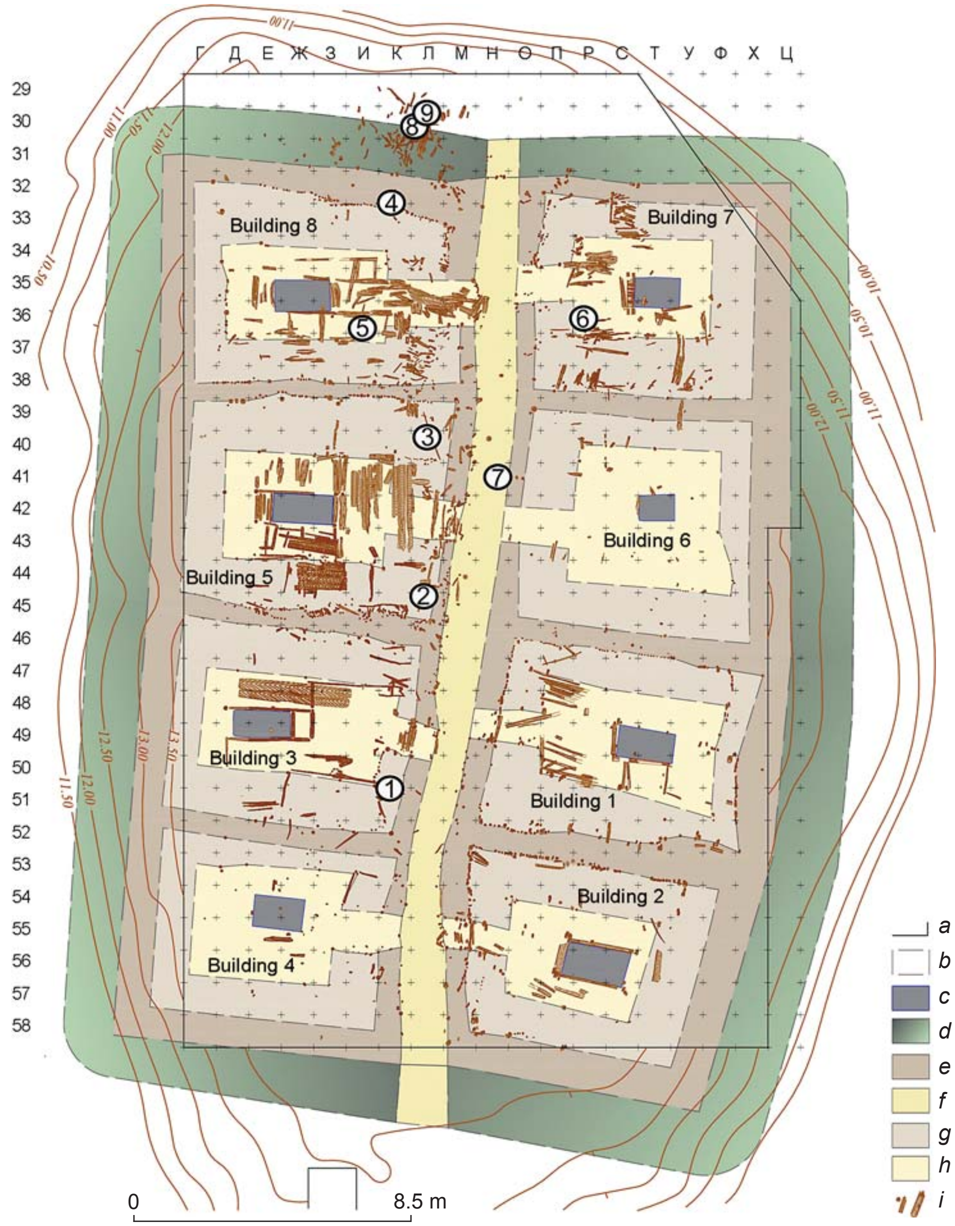

Fig. 2. Plan of the defense and residential area (DRA) of Bukhta Nakhodka and the site of sampling for archaeobotanical study.
a – boundary of the excavations; *b* – boundary of DRA; *c* – hearth; *d* – ramp slope; *e* – DRA walls; *f* – central passage of DRA; *g* – building gallery; *h* – central room of the building; *i* – remains of wooden structures. *1–9* – sample numbers.

temporary glycerol preparations using an Olympus BX51 microscope at ×400 magnification. For each sample, at least five preparations were examined, counting 100–300 pollen grains from terrestrial plants and simultaneously recording spores of higher spore-bearing plants and coprophilous fungi. The exceptions are three samples with very low concentrations of pollen, in which fewer than 100 pollen grains were counted. The material for studying plant macrofossils was sieved on a column of sieves (minimum cell diameter 0.25 mm) and viewed using a Carl Zeiss Stemi 2000-C microscope. To determine taxonomic affiliation, reference collections of pollen and spores, fruits and seeds from the Museum of the Institute of Plant and Animal Ecology, Ural Branch of the Russian Academy of Sciences and atlases were used (Dobrokhotov, 1961; Kats N.Y., Kats S.V., Kipiani, 1965; Beug, 2004). The obtained data were processed and the diagrams were constructed using the software package Tilia, v. 2.0.41 (Grimm, 2004). On the pollen diagram, the proportion of pollen of taxa of trees and shrubs, subshrubs and herbs was calculated from the total amount of pollen of woody and herbaceous plants, taken as 100 %. The

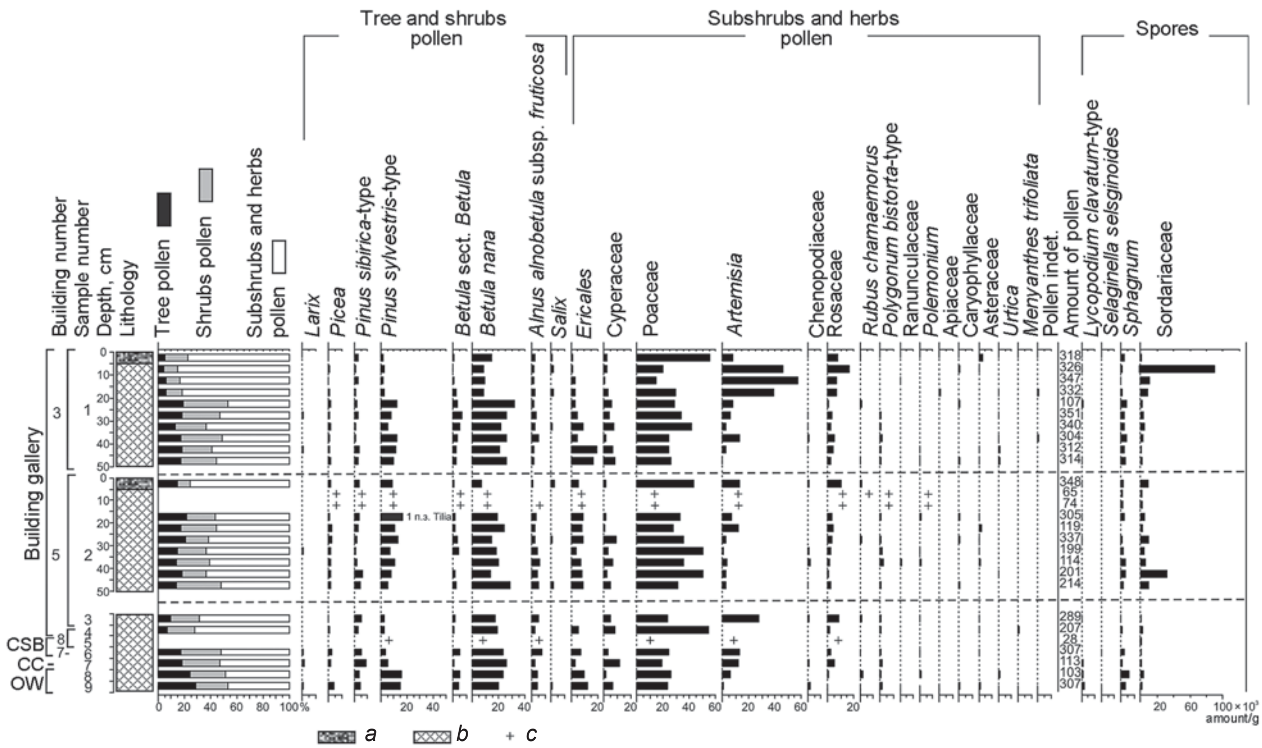

Fig. 3. Pollen diagram.
a – turf, *b* – cultural layer; *c* – single pollen. CSB – central space of the building, CC – central corridor, OW – outer wall.

content of spores of higher spore-bearing plants and coprophilous fungi is given as concentration (Fig. 3). The diagram of plant macrofossils shows the absolute amount of remains of a particular taxon in the studied volume of each sample (Fig. 4).

Results of archaeobotanical study and discussion

According to the findings of archaeobotanical study, no significant differences in taxonomic composition were found between any of the studied samples; no specific features in the species composition of micro- and macro-remains from various functional parts of the fort's buildings have been identified at this stage. The identified taxa of pollen and macro-remains of shrubs, subshrubs, and herbs correspond to the modern flora of Yamal (Poluostrov Yamal…, 2006).

The obtained pollen spectra and complexes of plant macrofossils characterize the vegetation of the southern shrub tundras: sedge-graminoid communities with tundra forbs, herbaceous-subshrub associations, thickets of dwarf birch and willows with the addition of alder, groups of wormwood and mayweed on non-turfed substrates of river slopes, peat-bog communities of sedges, Labrador tea, heather subshrubs, cloudberries, cotton grass, and sphagnum mosses. Such diversity in the vicinity of the site is still observed today. Similar tundra plant communities were reconstructed on the basis of pollen data from the deposits of the archaeological sites of Yarte VI (11th–12th centuries AD) and Tiutei-Sale-1 (the upper cultural layer dates back to the 12th-14th centuries AD), located northwest of Bukhta Nakhodka (Panova, 1998, 2008; Anderson et al., 2019: 13–15).

The obtained pollen spectra revealed a high content of pollen from grasses (Poaceae), dwarf birch (*Betula nana*), and heather subshrubs (Ericales). In plant macrofossil collections, the last two taxa, together with *Sphagnum* sp., are also abundant, while the grasses are represented by single specimens (see Fig. 3, 4). The study of the structure of the external and internal walls of buildings has shown that the space between two rows of vertical poles, beams, logs, and slabs was filled with peat and turf briquettes, waste materials, and wood chips (Kardash, 2011: 21). The revealed composition of pollen spectra and macrofossil collections likely reflects the plant communities that existed during the construction of the fort; to fill the internal space of the walls, people used tundra turf consisting of herbs, moss, and subshrubs. The noticeable difference between the amount of Poaceae pollen and macrofossils can be explained by the fact that the houses were built in mid-summer. At this time, the flowering of wild graminoids and sedges had already ended; most of the pollen rain settled on the surface; however, the seeds of

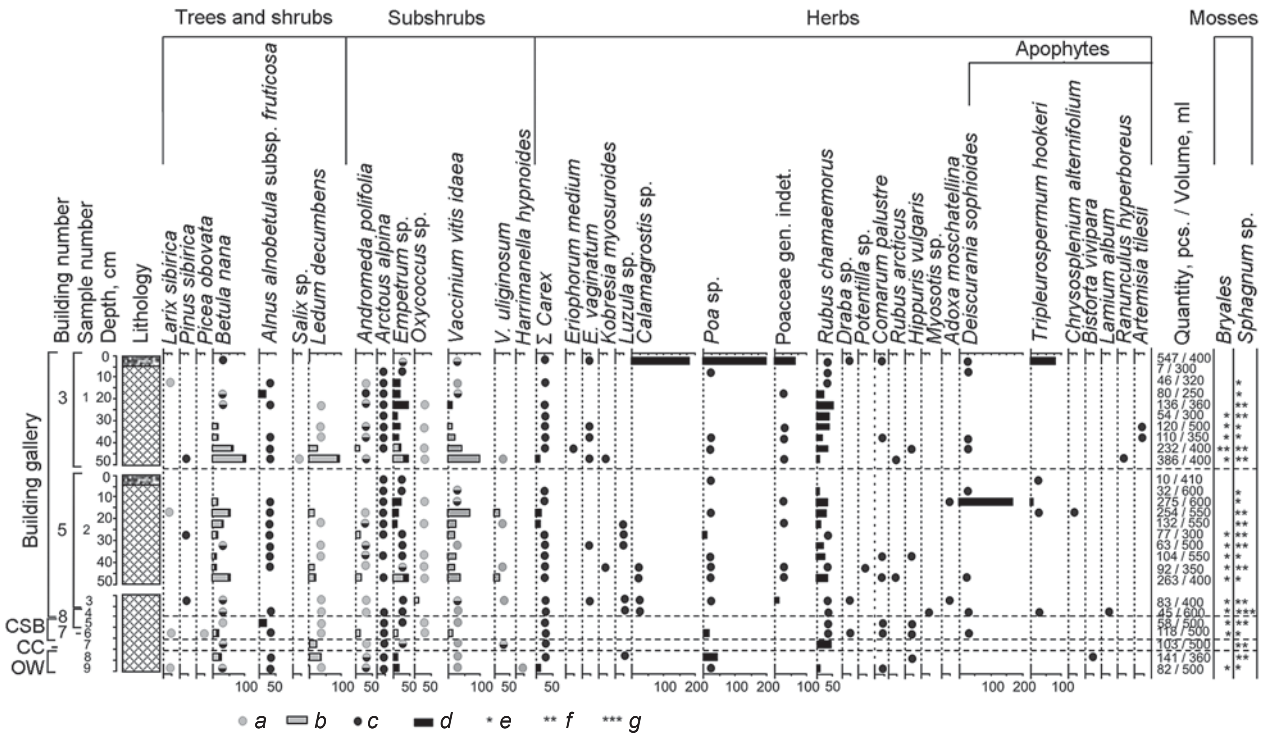

Fig. 4. Composition and content of plant macrofossil.
Vegetative parts: *a* – less than 10 spec., *b* – more than 10 spec.; fruits and seeds: *c* – less than 10 spec., *d* – more than 10 spec.; mosses: *e* – single, *f* – many, *g* – abundant. Legend to lithology and sampling sites same as on Fig. 3.

Amount of taxa and their macrofossils in cultural layers of archaeological sites of the Subarctic region of Western Siberia

Group of plants	Bukhta Nakhodka Fort (13th to early 14th century AD)		Fort Nadym (Korona, 2015) (Mid-15th to early 18th century AD)		Polui promontory fort (Korona, 2013) (late 16th to early 18th century AD)	
	Taxa	Macrofossils	Taxa	Macrofossils	Taxa	Macrofossils
Cultivated	–	–	–	–	1	2/0.01
Wild food, including	7	817/22.4	9	1574/22.5	7	2893/15.8
crowberry (*Empetrum* sp.)	1	266/7.3	1	24/0.3	1	2036/11.1
cloudberry (*Rubus chamaemorus*)	1	507/13.9	1	857/12.2	1	690/3.8
Weeds, в including apophytes	7	285/7.8	10	4335/61.8	17	13,939/76.1
Other	32	2548/69.8	26	1099/15.7	17	1491/8.1
Total	46	3650/100	45	7008/100	42	18,325/100

Note. Numerator indicates the absolute number, denominator indicates the percentage.

grasses and sedges had not yet reached their technical maturity, so these haven't been preserved.

Among the variety of discovered macrofossils, noteworthy is a group of wild food-plants (cloudberry, arctic raspberry, crowberry, lingonberry, blueberry, cranberry). Its share is more than 22 % of the total amount of macrofossils (see *Table*). Similar data were obtained from the study of the cultural layer of Fort Nadym (Nadymsky gorodok) (see *Table*), where the species diversity of food plants is higher: not only the hypo-arctic species are present, but also mountain ash (*Sorbus aucuparia*) and bird cherry (*Padus padus*) (Korona, 2015: 194). In the Polui promontory fort (Poluisky mysovoy gorodok), the remnants of this group account for ca 16 % (see *Table*). The diet of the aboriginal population of all three forts included the fruits of edible wild plants, but gathering was not significant in the nutritional structure.

No pollen or macrofossils of cultivated plants were found in samples from Bukhta Nakhodka (see Fig. 3, 4). Pollen grains of such plants are also absent in samples from Yarte VI and Tiutei-Sale-1 (Panova, 1998, 2008; Anderson et al., 2019: 13–15). In Fort Nadym, macrofossils of this group were not found (see *Table*); and in Polui, only two fragments of oat grains (*Avena* cf. *sativa*) were discovered (Korona, 2013: 368; 2015: 195), which is probably because of the proximity of Russian settlements.

Noteworthy is a group of plants that can be conditionally classified as weeds, namely apophytes. These rapidly spread in areas altered by human economic activity, but at the same time maintain their strong position in local flora. These plants constitute less than 8 % of the total amount of macrofossils found (see *Table*). In several samples, seeds of alpine bistort (*Bistorta vivipara*), arctic buttercup (*Ranunculus hyperboreus*), and golden saxifrage (*Chrysosplenium alternifolium*) were found—typical tundra plants of turf substrates growing in meadow-shrub communities in river valleys, in wet meadows, and tundra meadows. The seeds of flixweed (*Deiscurania sophioides)*, mayweed (*Tripleurospermum hookeri*), and Telesius wormwood (*Artemisia telesii*) were classified as taxa of non-turfed substrates in the tundra, including coastal outcrops, screes, and alluvial sand and pebble deposits. In the pollen spectra, pollen of *Artemisia* sp. is abundant, and pollen grains of Asteraceae are found, predominantly of the *Matricaria*-type morphological group, which also includes the genus *Tripleurospermum*. Under anthropogenic load on vegetation, the above plants become tundra ruderals, settle in secondary communities in areas with disturbed soil cover, and grow in garbage areas, near residential buildings, and along paths and trails (Dorogostaiskaya, 1972: 103, 105, 114, 132, 145; Sekretareva, 2004: 75, 102). In sample No. 4 from the gallery of building 8 were discovered single seeds of white dead nettle (*Lamium album*), which is a nemoral-boreal species of forests of the Northern Hemisphere moderate temperature zone. This species was probably introduced into the tundra by humans, and is now occasionally found in willow forests and mixed-grass meadows along the slopes of the main shore of the Gulf of Ob, reaching 69° N along river valleys (Poluostrov Yamal…, 2006: 48; Govorukhin, 1937: 433).

The share of weed seeds in Nadym and Polui forts was 62 % and 76 %, respectively (see *Table)*. The most abundant are stinging nettle (*Urtica dioica*), white goosefoot (*Chenopodium album*), and white dead nettle (Korona, 2013: 369; 2015: 195). In the Far North, these species often occur as ruderals in habitats with well-fertilized soils, near dwellings, and along paths and roads (Dorogostaiskaya, 1972: 89, 94, 132).

The species composition and the amount of macrofossils of weeds at three archaeological sites in the subarctic region of Western Siberia reflect different degrees of anthropogenic impact on the surrounding vegetation. In the vicinity to the Bukhta Nakhodka fort, because of economic activities mainly associated with the use of turf-moss layer during the construction of the site, the integrity of the vegetation cover was disturbed. As a result, tundra plants appeared near the fort, which were capable of rapidly colonizing unturfed substrates. The population of the Nadym and Polui forts had a significant impact on the surrounding vegetation, which led to the widespread distribution of typical ruderal weeds both on the territory of the settlements and in the surrounding area.

In the studied samples from the cultural layer of the Bukhta Nakhodka fort, small amounts of micro- and macro-remains of tree species were identified (see Fig. 3, 4). Single pollen-grains, stomata of needles, and shortened shoots of larch were found. Xylotomic analysis of archaeological wood samples from the ruins of buildings showed that it was Siberian larch (*Larix sibirica*) that was used during construction (Sidorova, Omurova et al., 2017: 77). According to the cutting dates, buildings 5 and 3 were erected no earlier than 1233 and 1235, respectively (Ibid.; Sidorova, Büntgen et al., 2017: 149–151). This suggests the simultaneous construction and functioning of these dwellings.

According to paleoclimatic reconstructions made using samples of subfossil wood from alluvial deposits of rivers of the Yamal Peninsula in the range from 67° to 68° N, the average summer temperature in the 11th–13th centuries AD remained consistently above the long-term average (Hantemirov, 1999: 188–189). This contributed to the growth of larch woodlands in the southern part of the peninsula, possibly in the immediate vicinity of Bukhta Nakhodka. At the same time, larch logs could have been transported to the construction site from the valleys of the larger rivers Khadytayakha, Yadayakhodayakha, Bolshaya and Malaya Kharutta, where islands of degrading larch woodlands are still found (Poluostrov Yamal…, 2006: 198).

In the pollen spectra, the pollen content of spruce (*Picea* sp.) and birch tree (*Betula* sect. *Betula*) does not exceed 5 % and 10 %, respectively. Only a few fragments of birch bark and one fragment of spruce needle (*Picea obovta*) were found in the collections of plant macrofossils. At present, these plants do not grow in the vicinity of the archaeological site. Mountain birch (*Betula tortuosa*), which belongs to the group of tree-like forms, and Siberian spruce (*Picea obovta*) are occasionally found in larch woodlands in the south of the Yamal Peninsula

(Ibid.). In the collections of subfossil wood, the share of Siberian spruce is small (ca 5 % of the total number of fossil wood cuts), birch occurs sporadically (Hantemirov, 1999: 186). This also suggests a low distribution of these tree species in historical time.

In the collections of plant macrofossils, fragments of Siberian-pine seed shells (nuts) were found; in the pollen spectra, the proportion of *Pinus sibirica*-type and *Pinus sylvestris*-type pollen is 5–15 %. The study of the subrecent pollen spectra of modern plant communities in the southern subarctic tundra of the Yamal Peninsula has shown that pine pollen is a permanent long-distance component, and its content usually does not exceed 20 %. Macrofossils of tree species were not discovered in subrecent complexes of zonal plant communities (Lapteva et al., 2013). The pine pollen found in samples from Bukhta Nakhodka was likely brought inside the closed buildings after pollen rain had settled on the daytime surface of the sod-moss layer, which was then used in construction. Single fragments of Siberian pine seed shells cannot indicate the presence of this tree species in the vicinity of the site. These finds rather suggest trade relations between its inhabitants and the population of the forest-tundra or taiga zone of Western Siberia, who still eats nuts today. Such contacts are also confirmed by the presence, in the cultural layer of the fort, of bones of predominantly forest animals such as beaver (*Castor fiber*) and sable (*Martes zibellina*) (Istoricheskaya ekologiya…, 2013: 255–256).

Notably, in most of the studied samples, there is an abundance of vegetative parts of sphagnum mosses (*Sphagnum* sp.) and a small amount of remains of green mosses (Bryales). These mosses are an integral component of the tundra ground cover. As mentioned above, during the construction of the fort, the internal spaces of the walls of the buildings were filled with peat and turf briquettes. The use of sphagnum mosses ensured better thermal insulation and maintained the microclimate by absorbing excess moisture. The population of the fort probably used sphagnum mosses in everyday life, as a hygroscopic material, and in the manufacture of small ropes (a fragment of such a rope was found in sample No. 5 from the central space of building 8).

Almost all the obtained pollen spectra contained various spores of fungi of the family Sordariaceae (see Fig. 3). Fungal species of this taxonomic group are predominantly obligate coprophilous fungi, which use organic substances from the excrement of animals—mainly herbivores, but also dogs and humans (Prokhorov, Armenskaya, 2001). The coprolites of dogs and humans were discovered in the frozen cultural layer of the Bukhta Nakhodka fort.

Conclusions

The archaeobotanical study of the upper part of the cultural layer of the Bukhta Nakhodka fort has identified pollen and spores, vegetative parts, fruits and seeds of wild plants of the modern flora of the Yamal Peninsula. No significant differences or features in the taxonomic composition of micro- and macro-remains of different utilitarian/functional parts of the fort were revealed.

The abundance of pollen and remains of vegetative parts of plants in the cultural layer inside the structures confirmed the assumption previously made during archaeological excavations about the use of peat and turf briquettes in the construction of the fort. The revealed taxonomic composition of micro- and macrofossils characterizes grass, moss, and subshrub tundras. Peat and turf briquettes were likely obtained by the removal of turf layer precisely in such widespread tundra communities.

The activities of the pre-Nenets aboriginal population led to the anthropogenic transformation of the tundra vegetation on the territory of the fort and its immediate vicinity. As a result of violation of the soil cover integrity during the construction and operation of the site, plants of non-turfed substrates settled widely in the vicinity and on the surfaces of the structures themselves. Later, when the turf layer was restored, tundra ruderals spread in the communities adjacent to the fort. Subsequently, after the end of the site's functioning, a secondary turfed ground cover of wild graminoids, sedges, and herbs was formed on the territory of the fort, and was already different from the natural tundra communities.

The diversity of fossils of wild food plants suggests the use of local plant resources by the inhabitants of the site. The small number of seeds of these plants may be due to the fact that the fort was populated mainly in cold seasons. No remains of cultivated plants were found during the study. This confirms the existing opinion that the pre-Nenets population was not yet familiar with plants of this group and/or did not use their fruits and seeds.

Thus, in the 13th to early 14th centuries AD, in the subarctic tundra of the Yamal Peninsula, there was a functioning fort of Sikhirtya people—the indigenous pre-Nenets population. Residents, as a result of their economic activities during the functioning of the site, transformed the surrounding plant communities. The assessment of the degree of anthropogenic impact of the indigenous population on the tundra plant communities of the subarctic region of Western Siberia in the first half of the 2nd millennium AD will be possible only with further detailed archaeobotanical studies of the cultural layers of the already known or new archaeological sites, contemporaneous to the Bukhta Nakhodka fort.

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Archaeological and Anthropological Study on the Grave of Eunuch-Official Couple Serving for a Royal Court of Joseon Kingdom

This article presents the findings of the study of a co-burial of a eunuch-official and his wife, found in the city of Uijeongbu, Gyeonggi-do Province, made in accordance with Confucian traditions during the Joseon Dynasty period. A description of finds, perfectly preserved in the grave sealed with lime-soil mixture and charcoal barrier, is given. The writings on the banners draping the coffins are studied. These say that in the left coffin the husband named Lee was buried; he was an official who oversaw the management of palace goods and held the position that was given only to *eunuchs. In the right coffin, according to the writing, there was the body of the wife; she was awarded a lady's rank corresponding to her husband's status. Special focus is given to the description of clothes and fabric on the bodies of the buried. The results of anthropological analysis of the remains are given. Morphological features of the pelvic and skull bones provided the information on the sex of the deceased. According to the condition of the auricular surface of the left pelvic bone, the age of the eunuch-official and his wife was determined as more than 60 years. It is concluded that the research materials significantly supplement the scientific information on the position of eunuch-officials in the society during the Joseon Dynasty period.*

Keywords: *Korea, eunuch, Joseon period, clothing, grave, anthropology.*

Introduction

The Joseon kingdom's graves in South Korea have been examined comprehensively by archaeologists, anthropologists, and textile historians. During the 15th to 19th centuries, those graves (*Hoegwakmyo* in Korean), where the coffins are usually surrounded by a cement-like barrier, had been built in almost every corner of the kingdom (Shin M.H., Yi, Bok et al., 2008; Shin D.H., Oh, Hong et al., 2021a). In history, the Joseon graves emerged abruptly for political reasons. In the late 14th century, the Confucians of Korea toppled the Buddhists' politico-cultural hegemony in the country. The Confucians' subsequent radical reforms targeted the Buddhist's rituals, especially the funeral ceremonies and the grave types that were prevalent up until that time. Cremation funerals and stone chambers for storing the bones were no longer accepted in Korean society; the tombs and graves had to be changed to a way that was more faithful to Confucian doctrines (Shin D.H., Oh, Hong et al., 2021a).

The structure of Joseon graves followed the orthodox Confucian axioms: the space around the coffin was filled with lime-soil mixture and charcoal, which hardened to a concrete-like block (Shin M.H., Yi, Bok et al., 2008; Shin D.H., Oh, Hong et al., 2021a; Lee et al., 2013). Such solid structures protected the graves reliably from robbers and insects (Shin M.H., Yi, Bok et al., 2008; Shin D.H., Oh, Hong et al., 2021a). In some graves, the buried bodies did not rot, but preserved their original form even after a long period of time (Shin D.H., Oh, Hong et al., 2021a). Korean archaeologists inferred that the presence of "concrete" barriers or charcoal layers in Joseon graves might have induced oxygen deficiencies due to complete sealing effect, and the high temperatures caused by the lime's exothermic reactions, which contributed to the successful preservation of human and cultural remains (Shin M.H., Yi, Bok et al., 2008; Shin D.H., Bianucci, Fujita et al., 2018: 5, 6; Shin D.H., Oh, Hong et al., 2021a; Oh, Shin, 2014; Chang Seok Oh et al., 2018).

This became very bad news for the descendants, who expected their ancestors' bodies and cultural relics to rot safely in their graves. Hundreds of years later, as the Joseon burials were investigated by archaeologists, they found well-preserved artifacts and remains that could not be obtained from the other types of ancient or medieval tombs in Korea (Shin M.H., Yi, Bok et al., 2008; Shin D.H., Oh, Hong et al., 2021a; Lee et al., 2013). It gives scientists a chance to examine various circumstances at the time vividly and to supplement their knowledge of the 15th to 19th century Joseon society and its people (Lee et al., 2013; Shin D.H., Oh, Hong et al., 2021a).

Clothing is one of the most crucial cultural remains from Joseon graves. To date, the articles of clothing that are maintained as large collections in institutions or museums throughout South Korea are a great source for a scholarly understanding of dress history before the 20th century (Lee et al., 2013; Song, Shin, 2014; Shin D.H., Bianucci, Fujita et al., 2018: 5–9; Shin D.H., Oh, Hong et al., 2021b). For several decades, studies on mummies found in the graves have also provided valuable information on the health and disease status of Korean people during the Joseon Dynasty period.

However, the findings obtained so far do not provide information evenly on all social classes of Joseon society. Most of the research was conducted on the graves of the Joseon gentry (*Sadaebu*), with higher social status. Burials of other members of Joseon society are very little studied. In the present article, we explore the grave of eunuch-official who worked for the royal court of the Joseon Dynasty. Eunuchs were administrators who handled various things in the royal court. It is difficult to say that the eunuchs were respected by the upper-class people, but they belonged to politically important persons at the time. By duty, they were very close to the Joseon Kings, and often appeared in many historical events at the court; but little is known about their daily lives, because detailed records of them have been very rare in history. Reflecting this situation, historical works specializing in them are also extremely rare to date in Korea. In this sense, the investigation of the recently discovered, eunuch-official couple's grave is of great academic value in the study of Joseon society.

The purpose of this article is to introduce the obtained information into scientific use.

Archaeological considerations

The grave is located in an area (20,283 m²) at Uijeongbu city, Gyeonggi-do (Fig. 1). Since the city has been important in history as a transportation and military hub of the Korean peninsula, many ancient ruins have been reported therefrom. In March 2021, during the construction of new houses and a park, a preliminary archaeological investigation was carried out on this place by the Sudo Institute of Cultural Heritage (Paju, South Korea). The geographical coordinates of our excavation site are 37°43′50.8″ N and 127°03′44.4″ E. The excavations were conducted in compliance with South Korea's *Act on the Protection and Investigation of Buried Cultural Properties in Advance of Construction*.

The archaeological survey revealed several ruins of residences and graves. Seven graves, belonging to the Joseon period, were covered with a lime-soil mixture barrier. Grave No. 4 was found in excellent preservation; it was completely sealed by a 30 cm thick lime-soil mixture barrier (Fig. 2). Below the barrier, wooden boards with numbers from 1 to 5 could be identified (Fig. 3, *A*). The numbers likely represented the order for the placement of boards upon the coffins. After removing the wooden boards, we found banners draping both coffins (Fig. 3, *B*). The banners contained writings, which look crucial to confirming the identity of the buried persons. In

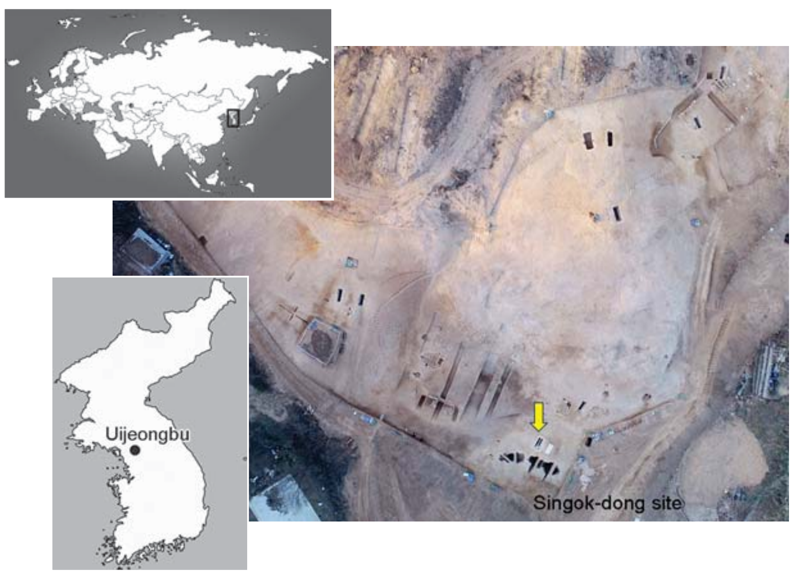

Fig. 1. Location of the grave under study (indicated by yellow arrow).

Fig. 2. Grave No. 4 (*A*), 30 cm thick lime-soil mixture barrier (*B*).

Fig. 3. Wooden boards found below the lime-soil mixture barrier (*A*), two coffins underneath, covered with funeral banners (*B*).

grave No. 4, we found two coffins, possibly those of the couple who were buried together inside the same grave. The coffins were very well preserved and contained clothing and funerary goods. The finds were transported to the laboratory of Eulji University for further scientific research.

Writings on the banners

According to the writings on the banners, the grave was evidently a co-burial of a eunuch-official and his wife. The official ranks they received from the King during their lifetimes could be identified on the banner. In the burials of Joseon period gentry, such coffin banners contained information on the order of official rank, office, position in the office, clan's name, and full name of the deceased. These data are helpful for revealing the personal identity of a buried individual.

On the left-hand coffin's banner (Fig. 4, *A*) was written "通訓大夫(*tonghundaebu*) 行內

Fig. 4. Writings on the left (*A*) and right (*B*) funeral banners.

侍府(*naeshibu*) 尙洗(*sangsae*) 李公之柩(*leegongjigu*)", which means that the coffin contained the husband's body. We established that the last name of the deceased was Lee; he worked for the government office as eunuch-official *naeshibu* and was awarded an official position that was given only to a eunuch-official *sangsae*. At this position, he oversaw the management of palace goods such as gunpowder, drugs, candlelight, lantern management, etc. Although the position in the palace was relatively low, the official rank *tonghundeabu* awarded to him was quite high, which was not uncommon in the hierarchy of the Joseon Dynasty offices. In the writings on the banner, the clan name and full name of the deceased were missing.

On the right-hand coffin's banner (Fig. 4, *B*) was written "淑人(*sookin*) 靈山辛氏(*youngsan Shin*) 之柩(*jigu*)". This means that the eunuch-official's wife was awarded the lady's rank *sookin* by the King, which matches the husband's rank. Unlike her husband, the name of her clan *youngsan Shin* was written on her banner.

Fig. 5. Jungchimak man's coat (26) and *daeryeomgeum* quilt (30) (*A*), two *jeogori* jackets (31, 32) (*B*), *jeogori* jacket (32), and *daeryeomgeum* quilt (30) (*C*).

Clothing and fabrics on the deceased's body

The coffin contained the deceased's body, which was dressed in an officer's coat and tightly wrapped with multiple other clothes and textiles (Fig. 5). The clothes surrounding the deceased's body were actually worn by the people at the time; therefore, they were important materials for the research of clothing history in Korea.

From the eunuch-official's coffin, we acquired a number of clothes and fabrics (*n*=20) (Table 1). In the process of investigation, we first collected a *jungchimak* ('man's coat') and *otshi* ('muff') (Fig. 5, *A*). The dead body was surrounded by a *daeryeomgeum* ('quilt'), which was well tied with horizontal and vertical straps to prevent it from being dismantled (Fig. 5, *A*). After loosening the surrounding quilt, two *jeogori* ('jacket') were identified below it (Fig. 5, *B*, *C*), and thereunder we could see the *danryeong* ('officer's coat') that the deceased seemed to have worn during his lifetime. On the chest part of the officer's coat, a large embroidered painting of a crane was attached (Fig. 6, 7), which was a symbol worn by officials of different ranks. Two cranes corresponded to the status of the highest officials of the Joseon Dynasty. The eunuch's coat had only one crane, which meant that the man held a more modest position. His *danryeong* is almost identical to those of other Joseon bureaucrats of the 17th–

Table 1. **List of finds**

No.	Item	Material	Features
			From the wife's coffin
1	*Myeongjeong*	Silk	A flag that lists the official rank and name of the deceased, leading the way in front of the funeral bier; during the burial, it covers the coffin; red-colored; writings identified
2	*Hyeonhoon*	"	Red- and yellow-colored fabrics; a gift of cloth to the Gods
3	*Guii*	"	The cover of a coffin
4	*Onang*	"	Small pouch, writings identified
5	*Ibul (Daeryumgeum)*	"	Quilt used for bundling; brown-colored
6	*Jeogori*	"	Jacket; brown-colored
7	*Daedae*	"	Belt; red-colored
8	*Wonsam*	"	Woman's ceremonial robe
9	*Jeogori*	"	Jacket; no-colored
10	*Jeogori*	"	Jacket; purple-colored
11	*Jeogori*	"	Jacket; no-colored
12	*Chima*	"	Skirt
13	*Baji*	"	Trousers
14	*Baji*	"	"
15	*Baji*	"	"
16	*Gwadu*	"	Sash
17	*Moja*	"	Hat
18	*Myeokmok*	"	Face cover
19	*Seupshin*	"	Shoes
20	*Aksu*	"	Gloves
21	*Toshi*	"	Muff
22	*Jiyo*	"	Funeral rug
			From the coffin of eunuch-official
23	*Myeongjeong*	"	A flag used for funeral; writings identified
24	*Hyeonhoon*	"	A gift of cloth to the Gods
25	*Cheongeum*	"	Funeral small duvet
26	*Jungchimak*	"	Man's coat
27	*Po*	"	Coat. Fragmentary
28	*Ibul*	"	Duvet
29	*Toshi*	"	Muff
30	*Ibul (Daeryumgeum)*	"	Duvet
31	*Jeogori*	"	Jacket
32	*Jeogori*	"	"
33	*Samo*	"	Official's hat
34	*Myeokmok*	"	Face cover
35	*Gadae*	"	Belt
36	*Danryeong*	"	Official's coat
37	*Aksu*	"	Gloves
38	*Yeompo*	Cotton	Rope for bundling
39	*Dongjeong*	Silk	Decoration of a collar
40	*Som*	Cotton, wool	Cotton (found below the chin)
41	*Jonggyo*	Cotton	Rope for bundling (longitudinal)
42	*Hoenggyo*	"	Rope for bundling (horizontal)

Fig. 6. Under the *jeogori* jackets, a *gadae* belt (35) and a *danryeong* officer's coat (36) were found (*A*), an embroidered painting (asterisk) was attached to the officer's coat (*B*).

18th centuries (Fig. 8), showing his status as a governmental official.

The wife's coffin yielded clothes and fabrics (Fig. 9, 10). The collected clothes were moved to the laboratory of Seoul Women's University. Some clothing could be successfully restored and researched (Fig. 11).

Anthropological study

After investigation of the bundle of clothing, an anthropological survey was conducted on the bones from the tombs of the eunuch-official and his wife. The sex estimation was conducted by morphological differences: indicators of pelvic dimorphism were chosen as the main criteria (left pelvic bone) (Buikstra, Ubelaker, 1994); and those of skull structure as the secondary criteria (Ibid.: 19–21; White, Folkens, 2005: 387–391] (Table 2). Sex differences in the structure of the studied skeletons are quite distinct and well consistent with archaeological criteria.

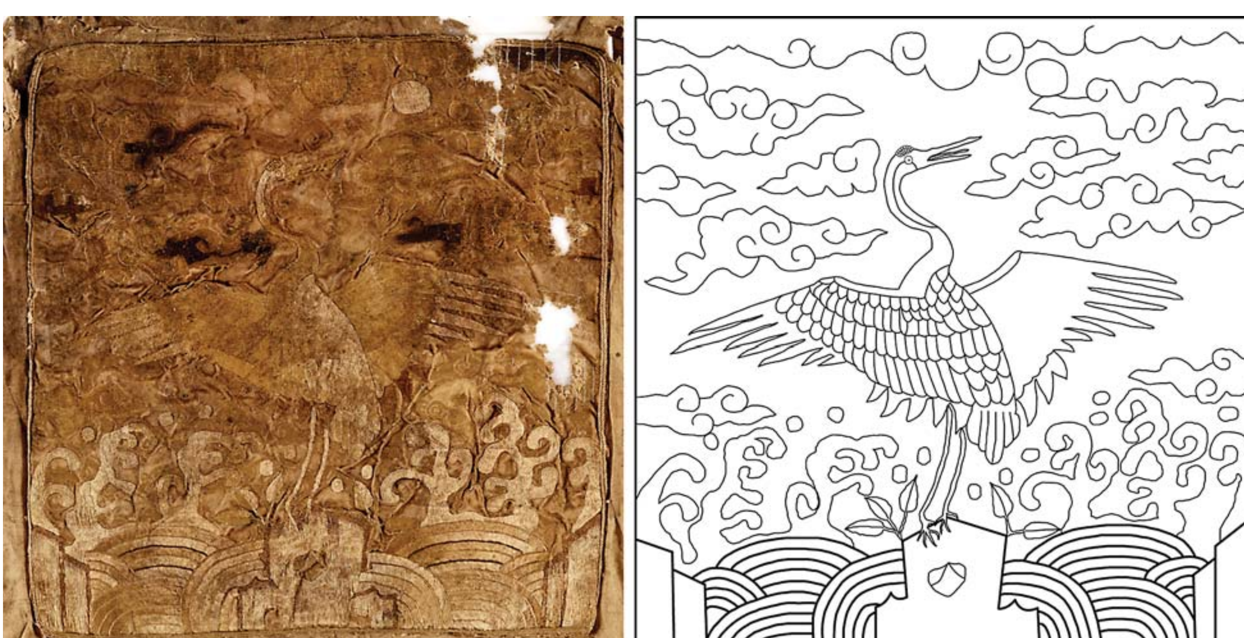

Fig. 7. Embroidered symbol on the *danryeong* officer's coat.

The age estimation was conducted only for auricular surfaces of the ilia, owing to the loss of symphyseal surface in pubic bone (Lovejoy et al., 1985) (Table 3). The analysis has shown that both the eunuch-official and his wife were over 60 years old. Stature estimation based on long-bone length was conducted by the method of Fujii (1960). The estimated statures of eunuch-official and his wife were 177.4 cm and 141.5 cm, respectively. As for pathological findings, in the case of the eunuch-official, a healed fracture of the left 3rd rib and osteoarthritic signs in the left and right elbow joints could be identified. As regards his wife, button osteoma was found on her right parietal bone; and osteophytes were observed on her vertebrae. Since the two individuals were thought to have been aged 60 or older, it is natural that degenerative changes could be observed in their bones.

Discussion

In Korean history, eunuch-officials in the King's court appeared in the Unified Silla Period (676–935 AD) (Jang, 2003: 11–12). Their duties included food management in the palace, delivery of orders from the King, cleaning of the palace, etc. They didn't come to the front of the political arena of the kingdom. However, since the eunuch-officials worked near the King, there was always a possibility that their political power might have become more enlarged than necessary. To prevent this situation, they were always checked by gentry or other courtiers throughout the Joseon Dynasty period. Nevertheless, eunuch-officials of the Joseon Dynasty sometimes took part in important political events of the kingdom, thus often rising to very high positions in the government (Ibid.: 159–185).

Fig. 8. The portrait of Jeong Jae-Hwa (1754–1790), by courtesy of Suwon Hwaseong Museum (Suwon, South Korea).

Fig. 9. *Jeogori* jackets (9, 10) from the wife's coffin.

Fig. 10. *Baji* trousers (13–15) and *gwadu* sash (16) (*A*) from the wife's coffin; a sewing mark on the cloth (*B*).

Fig. 11. *Wonsam* woman's ceremonial robe (8) from wife's coffin.

Table 2. **Data for sex determination**

Feature	Eunuch-official	The wife	Feature	Eunuch-official	The wife
	*Main criteria**			*Minor criteria*	
Greater sciatic notch	5	1	Nuchal crest	2	2
Pre-auricular sulcus	None	Present	Mastoid process	3	1
Subpubic angle	Narrow	Wide	Supraorbital margin	2	2
Ischiopubic ramus	Broad	Sharp	Glabella	2	1
Subpubic concavity	–	–	Mental eminence	5	2
Ventral arc	–	–			

*For left hip bone.

Table 3. **Data for age determination***

Feature	Eunuch-official	The wife
Auricular Surface		
Transverse organization	Irregular surface	Irregular surface
Porosity	Macro	Little macro
Granularity	Destruction of bone	Depression
Retroauricular activity	Marked	Marked
Apical activity	"	"
Symphyseal surface	–	–

*For left hip bone.

Eunuch-officials of the Joseon period differed in origin. As compared to the other Asian countries, Joseon's eunuchs were unique because they could get married and adopted sexually crippled children to form their own families. Mimicking a biological family, they even had a genealogy, consisting of eunuchs who had been adopted by their eunuch-parents for generations. Actually, not all eunuchs in the Joseon society were married, but more than 60 % of them seem to have married women and adopted their eunuch sons. According to the eunuch genealogy *Yangsegaebo*, published in 1829 and updated in 1920, as many as 578 people were listed in the family of one famous eunuch-official (*Deuk-bu Youn* family), of which 511 people adopted their eunuch sons (Shin M.H., 2005).

In Joseon society, eunuchs were subject to contempt as socially incomplete men. When they became officials in the government, they were commonly expelled from their original kinship families. So, when a eunuch-official formed his own family with his wife and adopted sons, as socially marginalized people, the emotional solidarity between them was not inferior to that of other biological families at all. Although there were Joseon society's negative feeling against the eunuchs' families, the tradition could contribute greatly to a eunuch-official's emotionally stable life (Ibid.).

In the Joseon Dynasty period, eunuchs were socially despised, but it was not uncommon for them to become high-ranking officials. Owing to the nature of their work in the royal palace, their role in the history of the Joseon Dynasty was never small. Eunuch-officials moved busily backstage but never came out on stage. They couldn't appear on the surface of politics; therefore, very few detailed records of them are left in history. In this sense, the academic meaning of this article adds significantly to the existing knowledge.

Conclusions

The paired burial of the eunuch-official and his wife is a very rare archaeological find. This determines the high scientific significance of the presented multidisciplinary study.

The eunuch and his wife, who were buried in the same grave, were old at the time of their deaths, but their overall health did not appear to be bad except for some degenerative signs. At the time of burial, the eunuch-official was wearing a uniform that he could have worn during the execution of his official duties in the government. The findings obtained from this research will greatly expand the understanding of the position of eunuch-officials in the society during the Joseon Dynasty period.

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Traditional Bow of the Selenga Buryats (Based on a 2019 Field Study)

Three Buryat bows, studied at Tashir village, in the Selenginsky District, Republic of Buryatia, in 2019, are described. They are relatively well preserved, and one is still functioning. A detailed description of their design is given. The specimens are similar in terms of morphology and technology (specifically, an outline without strings), design of transition zones, section of elastic part, and the shape and position of horn overlays. The tension force of the bows is evaluated, and conclusions are made about the impact of force and practical use. Comments made by a Buryat archer (the bow's owner) are cited about specific use under various weather conditions. The information is compared with that gained from ethnographic sources, and archival illustrations made in late 1800s and early 1900s are given.

Keywords: *Traditional bow, Selenga Buryats, weapons, Trans-Baikal, 19th–20th centuries, hunting.*

Introduction

Bows and arrows are traditional weapons that are studied today by weapons specialists based mainly on materials from archaeological excavations, museum collections, and various illustrations. Many such items, preserved in family collections, often remain beyond the awareness of researchers. The analysis of these items is very important, because they usually retain their design and reflect the final stage in the evolution of hand-held projectile weapons. Despite their sporting or fishing purpose, these are genetically related to ancient weapons. Their study allows us to trace those essential details that in most cases are not preserved at archaeological sites. In addition, the analysis of entire structures makes it possible to verify and correct the known classifications of archaeological material for the correct identification of the main features.

Trans-Baikal is one of the regions of Russia where the tradition of archery has been preserved to this day. The composite Buryat traditional bow has repeatedly become the object of study by domestic researchers (Badmaev, 1997: 74–76; Gombozhapov, 2016; Zhambalova, 1991: 52–56; Mikhailov, 1993: 11–16; Sandanov, 1993: 11–14; Tugutov, 1958: 39–42). Publications most often provide general information about the process of making composite bows in different territories, provide characteristics of the materials used and brief descriptions of the components. Attempts were also made to characterize individual decorative features (Badmaev, 1997: 75). According to published data, the Buryat bow is a form of the "composite Central Asian bow". To date, local variants, their morphological features, and qualitative characteristics have not been described. This does not allow us to single out the Buryat bow as a unique phenomenon among the projectile weapons of the peoples of Siberia and Central Asia.

Shooting according to traditional rules is popular in Buryatia. This explains the special attention paid to ancient bows, which are carefully stored, repaired, and even occasionally used. Buryat athletes also show interest in them. One of the representatives of modern Olympic archers who are not indifferent to the history and traditional competitive culture of the Buryats is Vilikton Yuryevich Irintseev, an archery coach at the Sports School of the Olympic Reserve in Gusinoozersk. At his invitation, in August 2019, we visited the village Tashir of the Selenginsky District of the Republic of Buryatia in order to study the traditional bows he has.

This territory is inhabited by the Selenga Buryats—an ethno-territorial (rather complex and heterogeneous) subgroup within the Buryat ethnic group. As noted by D.D. Nimaev, "in the pre-revolutionary period, in general terms, Selenga people were understood as the Buryat population living in the Selenga valley south of Verkhneudinsk to the Mongolian border and along the tributaries of the Selenga: Temnik, Dzhida, Chikoy, and Khilok… In other words, these are the territories of modern Ivolginsky, Selenginsky, Dzhidinsky, Kyakhtinsky and, partially, Bichursky districts of Buryatia" (2015: 9). The stabilization of the ethnic composition of the Selenga Buryats was facilitated by the conclusion of the Burin Treaty between Russia and China in 1727, which prohibited the free movement of people on both sides of the Russian-Chinese border. By 1735, the bulk of the Selenga Buryats consisted of representatives of clans of "Western Buryat origin" and "Mungal natives" (Ibid.). In the 18th century, many Buryats were resettled to Trans-Baikal from other territories to perform Cossack service on the border (Nanzatov, Sodnompilova, 2019a: 126). The tribal composition of the Selenga Buryats in the 19th century, according to research by B.Z. Nanzatov and M.M. Sodnompilova (Nanzatov, 2019; Nanzatov, Sodnompilova, 2019a, b), included such ethnic groups as *Sartuls*, *Atagan*, *Tabangut*, *Alagui*, *Uzon*, *Tsongol*, *Ashibagat*, *Kharanut*, *Khatagin*, *Buyan*, etc. According to D.D. Nimaev, on the territory of the Iroi valley, in the 1970s, lived representatives of the *Olzon*, *Yengut*, and *Bulut* clans, and today, *Kharanut*, *Alagui*, *Shono*, and *Khatagin* (2015: 10). The complex tribal composition of the Selenga Buryats was formed as a result of the resettlement of various Mongol-speaking groups of Cisbaikalia, Western Transbaikalia, and Mongolia to the region. It is natural that the material culture of the Selenga people was formed under the influence of ethnic groups from the designated territories, and retained their individual features.

The purpose of this study is to introduce the data on composite bows identified during field surveys in 2019 in the village of Tashir, Selenginsky District, Republic of Buryatia, and to provide their interpretation.

Study methods and materials

The methodological basis of the study is an integrated approach. The presented items are considered as complex systems, the individual elements of which reflect the features of manufacturing technology and functional specificity. The study is carried out using morphometric and functional analyzes of individual structural elements. The characteristics of the whole structure are given according to the following indicators: the external geometry of the whole item in the position without a bowstring, the method of designing the transition zones between the elastic limbs and ears, and the combination options of the presented overlays. Noteworthy is also the importance of the retrospective method, which evaluates the design and characteristics of the traditional bow from the point of view of modern national archers.

In 2019, in the village of Tashir, three completely preserved Buryat bows were recorded (bows 1–3). A photo of bow 1 was published earlier by A.A. Badmaev (2005: Fig. 10). The exact time and place of manufacture of the items is unknown; however, according to the testimony of V.Y. Irintseev, bows 1 and 2 were stored at Tashir for a long time, and were probably made by craftsmen from the Selenga Buryats (Fig. 1, 2). Bow 3 was handed over to Irintseev for "repair" by an archer from the village of Zhargalanta (Fig. 3).

All three items are damaged to varying degrees. Bow 1 was damaged around the lower elastic limb and reinforced on the outer and inner sides with the limb plates of a modern sports bow using insulating tape. On one side surface, in the arched cutouts for the bowstring, thin wooden plates are glued, probably necessary to align the bow axis. Bow 2 was split along the wood fibers (could not withstand the load) in the elastic limb; it also lacks supports for the bowstring and a short plate of one long end frontal overlay. Bow 3 has one string support removed, and the birch-bark on the back is partially damaged. The items show numerous minor signs of damage and abrasion; in some places, there are additional strips of reinforcement with insulating tape.

The original geometry of the items, although they had been used for a long time, probably changed insignificantly. This makes it possible to compare the items in question with each other and with traditional bows from other collections.

The bows described are classified as composite*. They are typologically close: the profile without a bowstring is similar—the items have a straight handle, elastic limbs smoothly curved towards the back, rather long

*Composite bows mean traditional bows that have stiff end zones that work like a lever, which are a fundamental improvement in the design.

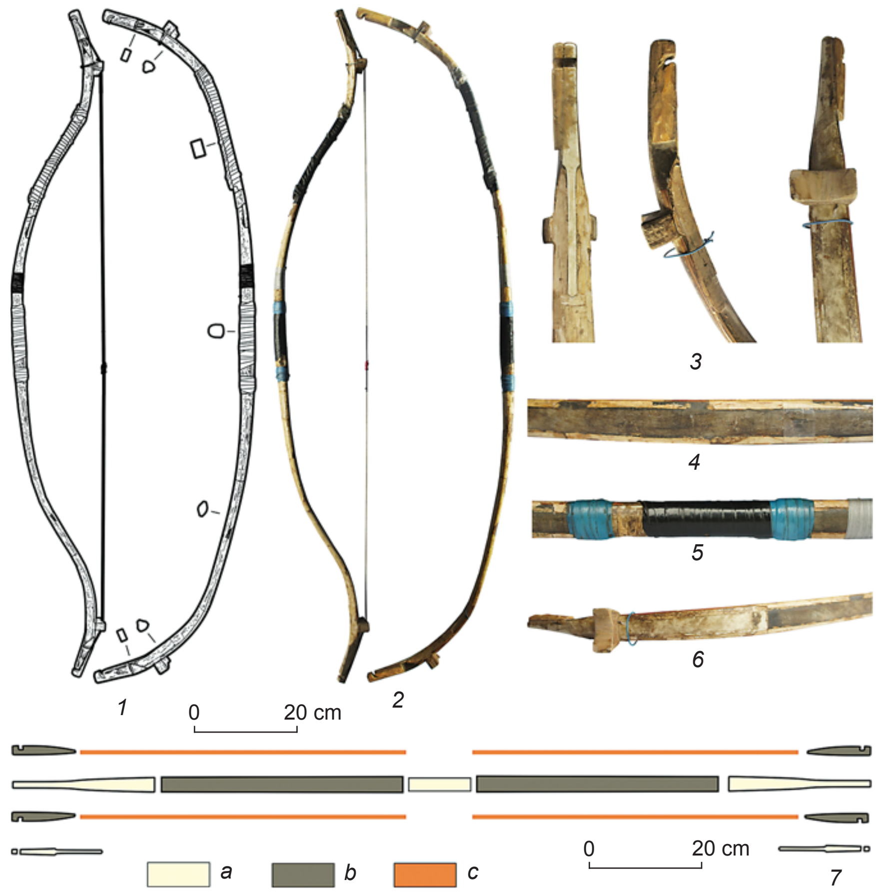

Fig. 1. Bow 1.
1, 2 – general view; *3* – stiff bow ear; *4* – inner surface of the elastic limb, reinforced with a frontal overlay made of hollow horn; *5* – inner surface of the handle; *6* – transition zone, reinforced with a frontal overlay made of deer antler; *7* – diagram of the arrangement of overlays on the core: *a* – made of deer antler, *b* – made of hollow horn, *c* – made of reed/wood.

(about a quarter of the length of the body) uniformly curved transition zones, and relatively short straight bow ears. Bows without strings are curved in the direction of the arrow's flight, and in this state resemble half a flattened ellipse; in the transition zones, they bend evenly, are reinforced with frontal overlays made of deer antler, and do not differ in cross-section from the elastic limbs; the latter have a biconvex shape in cross-section. All the items have a similar set of overlays: solid frontal limb overlays (hollow horn), side limb (made of reed?, the integrity cannot be established) overlays, long end frontal overlays, those covering transition zones and stiff bow ears (deer antler, bow 1 has solid overlays, bow 2 and 3 have composite overlays); end lateral overlays (hollow horn (bows 1 and 3) or combination with deer antler (bow 2)), end rear overlays (deer antler (bow 1) or reed (bows 2, 3)) (Table 1). Bow 1 has a visible middle frontal sub-rectangular overlay made of deer antler; bows 2 and 3 have hidden handles, but that their handles most likely

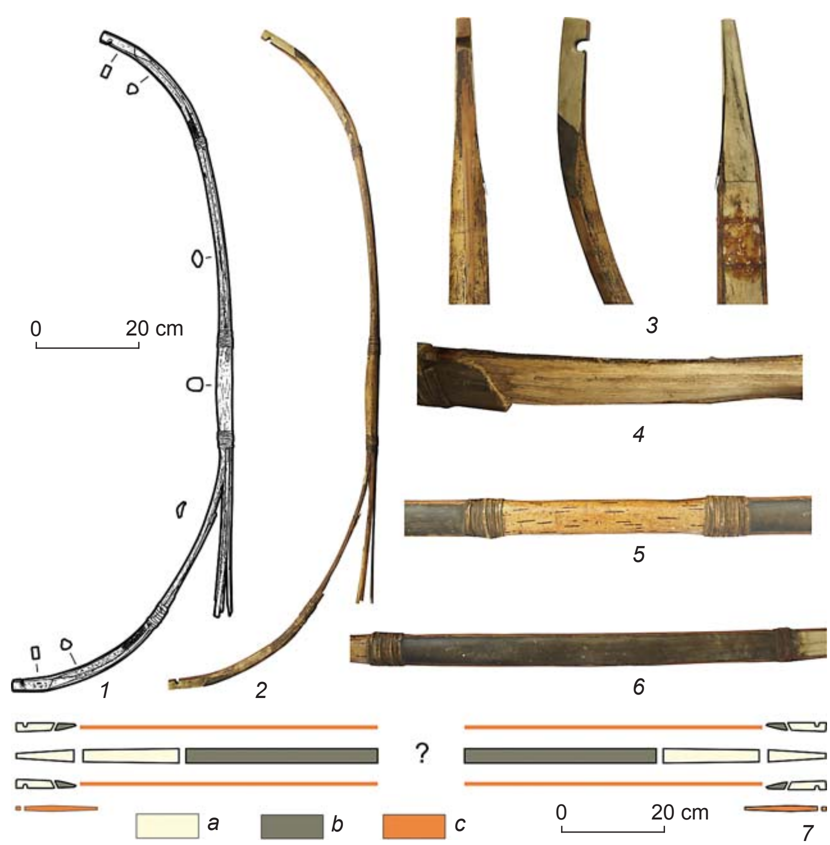

Fig. 2. Bow 2.
1, 2 – general view; *3* – stiff bow ear; *4* – place of breakage of the core; *5* – inner surface of the handle; *6* – inner surface of the limb, reinforced with a frontal overlay made of hollow horn; *7* – diagram of the arrangement of overlays on the core: *a* – made of deer antler, *b* – made of hollow horn, *c* – made of reed/wood.

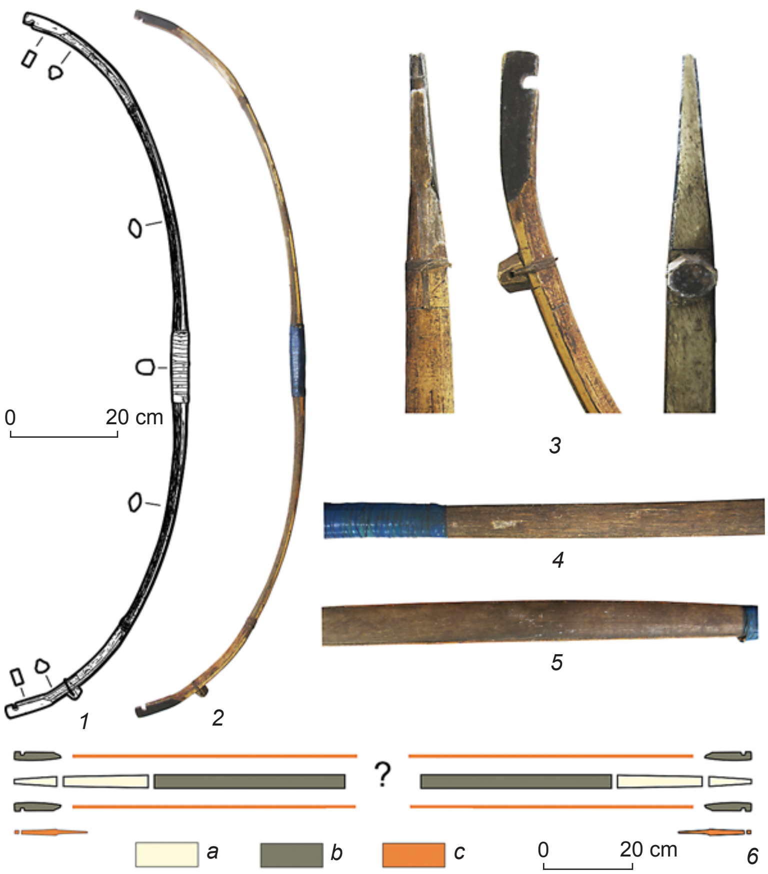

Fig.3. Bow 3
1, 2 – general view; *3* – stiff bow ear; *4* – outer surface of the body, reinforced with sinew; *5* – inner surface of the elastic limb, reinforced with a hollow horn overlay; *6* – diagram of the arrangement of overlays on the core: *a* – made of deer antler, *b* – made of hollow horn, *c* – made of reed/wood.

were also reinforced with middle frontal plates, though their shape, size, and material could not be determined. The variability of shape and arrangement of overlays is insignificant and does not fundamentally affect the design. On the back, along the entire length of the body, each item is reinforced with several layers of sinew and covered with birch-bark.

All items are similar in size and proportions of individual zones (Table 2). The length of the body is close to 160 cm. In the grip area (a section with insulating tape (bows 1, 3), or between the leather windings at the junction of the handle with the limbs (bow 2)), it is straight and rounded in cross-section. The width of the body in this place is unchanged (bows 1, 3) or increases slightly from the center to the limbs (bow 2); the thickness is also either unchanged (bows 1, 2) or decreases towards the limbs (bow 3). Owing to the continuous wrapping of the handle with insulating tape (bows 1, 3) or pasting over with birch-bark (bow 2), it is impossible to establish the shape and size of the middle overlays; however, as noted above, these most likely were present.

The handle merges into curved elastic limbs (the elastic working part of the body). Their length corresponds to the distance from the handle to the areas where the body is reinforced with long frontal end overlays made of deer antler. The cross-section changes to elliptical. The elastic limbs are almost the same in length; relative to the handle, the width increases slightly, and the thickness gradually decreases towards the end. The internal surface in these areas is reinforced with solid frontal limb overlays made of hollow horn, repeating the shape and size of the elastic limbs, as well as with side limb overlays made of reed, which also cover the area of transition zones. The edges of the frontal overlays at the handle and at transition zones are hidden under windings and pastings.

In curved transition zones, the cross-sectional shape of the bow's body, from the elastic limbs to the stiff ears, does not change. The length of these sections is limited by the junction of the hollow horn and deer antler overlays on one side and by a sharp change in the cross-section of the stiff bow ears (it becomes sub-rectangular) on the other. The width of the body from the elastic limbs towards the ears decreases slightly, the thickness increases. On the inside, the body in these areas is reinforced with long frontal end overlays made from deer antler. For bows 2 and 3, these overlays are composite, the joint of the plates falls on the border between the transition zones and the ears (however, taking into account the fact that these are made of the same material, it is more correct not to separate them and consider them as long end ones); for bow 1, the overlays are solid. Like the limb frontal ones, the long end frontal overlays follow the shape and size of the body in these areas, except for thickness.

The joints of the limb frontal plates and the long end frontal plates were reinforced with leather cord (bow 2) or sinew (bow 3). Bow 1 does not have such a winding, but the traces of it are clearly visible.

In the zone of stiff bow ears, the cross-section of the items changes to sub-rectangular. Towards the ears, the body narrows, the thickness either decreases (bow 1) or remains unchanged (bows 2, 3). Cutouts are made 2 cm from the ears on the back, to secure the bowstring. The ears of the bow are reinforced with the above-mentioned long end frontal, rear, and side overlays.

All the overlays follow the shape and size of the body. The frontal plates are made of deer antler, the side plates with a cutout for the bowstring are made of hollow horn (bows 1, 3) or of two plates of deer antler and a hollow horn (bow 2). The rear plates are damaged, but their shape is clearly discernable: they have a narrow area covering part of the transition zone (most likely, this is an imitation of the additional edge in the transitional zones of bows of the Manchu design), and a wide area, following the shape of the ear, including after the cutout. Back plates are made of reed (bow 2, 3) or deer antler (bow 1).

On the outside, wooden cores, along their entire lengths, are reinforced with several layers of sinew. The outer surface with sinew (bows 1–3), the entire handle (bow 2) and partially the inner surface along the overlays (bow 1) were covered with birch-bark. Currently, in some places, birch-bark is missing or damaged. The limb side and end overlays were not covered with birch-bark.

All the items were equipped with wooden supports for the bowstring. Bow 1 has preserved two trapezoidal supports with a curved sub-rectangular platform 13 cm from the ends; bow 3 has one straight support with an octagonal platform (the second is lost) 13 cm from the ends; bow 2 lacks the supports, but shows their traces 16 cm from the ends.

In some areas on bow 2, a wooden base is visible. At the place of breakage of the limb, a solid base consisting of one plate is discernible. There are also no complex wooden joints at the place of missing end frontal overlay. This allows us to assume that the core, even if it was not solid wood, was not reinforced with several layers of longitudinal plates.

Bow 1, despite its age and damage, is still functional. Irintseev uses a modern bowstring ca 140 cm long. The distance from the string to the handle (bow base) is 19 cm. With the string on, the limbs relative to the handle are smoothly curved back; approximately in the middle of the limb, the bend changes direction towards the back. The ears are slightly directed forward.

According to Irintseev, bow 1 showed smooth tension and the absence of strong recoil. At the time of fixation, the strength of this bow reaches 12.9 kg, with a string tension of 72 cm. Importantly, the above-described transition zones of the bow (long curved, reinforced with frontal overlays made of deer antler) have elasticity and are

Table 1. **Dimensions (from handle to ends) and shapes of the overlays on the studied traditional Buryat bows**

Overlays	Bow 1		Bow 2		Bow 3	
	Length / width / thickness, cm	Shape / material	Length / width / thickness, cm	Shape / material	Length / width / thickness, cm	Shape / material
Middle frontal	– / 2.5 / –	Sub-rectangular / deer antler	–	–	–	–
Frontal limb	45 / 2.8–2.6 / –	Sub-rectangular / hollow horn	40 / 3 / 0.2–0.5	Sub-rectangular / hollow horn	45 / 3.2 / –	Sub-rectangular / hollow horn
Side limb	<60 / 0.5–0.7 / 0.1–0.2	Sub-rectangular (thin plates) / shrub	<60 / 0.7 / 0.2	Sub-rectangular (thin plates) / shrub	<60 / 0.5 / 0.2	Sub-rectangular (thin plates), composite / shrub
Long end frontal	27 (17 – wide part, 10 – narrow part) / 2.6–2.0–1.2 / –	Trapezoidal, with narrowing at the end / deer antler	19 / 3.0–2.5 / – 12 / 2.5–1.0 / 0.3	Trapezoidal (composite), with narrowing at the end (junction of overlays on the edge of functional zones) / deer antler	19 / 3.0–2.3 / – 10 / 2.3–1.0 / –	Trapezoidal (composite), with narrowing at the end (junction of overlays on the edge of functional zones) / deer antler
End lateral	12 (widening 2.5) / 0.7–1.7–1.5 / –	Sub-rectangular, with cutout for the bowstring and semi-arch widening / hollow horn	8 / 1.3 / 0.2 6 / 0.3–1,5 / 0.2	Composite: sub-rectangular, with cutout for the bowstring / deer antler, and sub-triangular widening / hollow horn	11 (widening 1.8) / 1.0–2.2–2.0 / –	Sub-rectangular, with cutout for the bowstring and semi-arch widening / hollow horn
End rear	20 (8 – narrow part, 12 – wide part) / 0.7–1.5–1.0 / –	Sophisticated shape / deer antler	17 (9 – narrow part, 8 – wide part) / 0.7–1.5–1.0 / –	Sophisticated shape / shrub (damaged)	15 (7.5 – narrow part, 7.5 – wide part) / 0.3–1.3–0.8 / –	Sophisticated shape / shrub (damaged)

Table 2. **Dimensions of body (cm) and other features of the studied traditional Buryat bows**

Indicator	Bow 1	Bow 2	Bow 3
Length of body	158	160	160
Angle of ears relative to the handle	105º / 105º	122º / –	110º / 110º
Length of limbs	72 / 72	71 / 71	74 / 74
Length of handle / grip area	14	18 / 15	12
Width / thickness of body in the center of handle	2.5 / 3.0	2.5 / 2.7	3.0 / 2.9
Width / thickness of body at the junction of limbs with handle	2.5 / 3.0	3.0 / 2.7	3.0 / 2.5
Length of elastic limbs	45	40	45
Maximum width of body at elastic limbs	3*	3.2*	3.4*
Minimum thickness of body at elastic limbs	1.7**	2**	1.6*
Length of transition zones	17	19	19
Width / thickness of body at the junctions of elastic limbs with transition zones	2.8 / 1.7	3 / 2	3 / 2
Length of stiff bow ears	10	12	10
Width / thickness of body at the junctions transition zones with stiff bow ears	2.0 / 2.1	2.7 / 2.0	2.5 / 2.2
Width / thickness of body at the ends	1.2 / 1.5	1.2 / 2.0	1.0 / 2.2
Distance from ends to supports	13 (glue)	16 (traces)	13 (glue)
Shape of platform, material of supports	Curved quadrangular, wood	–	Straight octagonal, wood

*In the center of elastic limbs.
**At transition zones.

not excluded from the work of the limbs. The use of bow 1 as a classic example of this design, according to Irintseev, is least effective during the hot season, since the weapon becomes somewhat weaker at high temperatures. Irintseev considers the autumn-spring period the most suitable for the bow functioning, because this is when sudden overheating that affects shooting is not an issue.

Discussion

All the bows under study are typologically similar. They have close morphological and technical characteristics; discrepancies appear in the details of the overlays design. The items are similar in metric parameters, but differ in certain design techniques. Thus, the bows can be attributed the same production tradition, but not to the products of a single artisan.

An important feature of the described design is the small spread of values of the metric indicators of individual zones: there is no sharp change in the proportions of handles and elastic limbs, as, for example, in bows of the Manchu design, in which the rounded handle sharply merges into flat and wide limbs (Solovyev, Kharitonov, 2020: 621). Hence, the limbs of Selenga bows can be considered to be relatively narrow. The proportions change over rather extended areas, so the outlines look smooth.

The question arises as to the purpose of the bows in question. The tension force of bow 1 (12.9 kg with a 72 cm string tension) appears to be small. It is unlikely that the craftsmen of the past, who spent a lot of time on labor-intensive technological operations, expected to obtain such a weak bow, and even one that lost its properties in the heat. There is no doubt that the bow was originally much more powerful.

A preliminary expert opinion on the initial performance of bow 1, based on its design, was given by A. Karpowicz, a famous researcher of traditional bows, the author of popular publications translated into several languages, as well as many reconstructions of Turkish, Tatar, Scythian, Xiongnu, and other bows and their experimental studies (2006, 2015). He estimated the tension force of the bow string of 72 cm (28 in.), with all its materials functioning normally, at 25–29 kg (55–65 lb.), at an ambient temperature of 15–25 °C and air humidity close to 50 %. According to Karpowicz, the bow is intended for use with longer arrows—from 81 (32 in.) to 86 cm (34 in.). In this case, the tension force of the bowstring can range from

32 (70 lb.) to 36 kg (80 lb.)*; this will transfer more energy to the arrow, and produce a more effective shot. Notably, the dimensions of the arrows shown in ancient images are very close to those proposed by Karpowicz: with a conventional bow length of 160 cm, the length of arrows to the tip varies from 81 to 87 cm (Kharitonov R.M., Kharitonov M.A., 2021: Fig. 3, 4). The lengths of the arrows interpreted as Buryat, from the National Museum of the Republic of Buryatia, are the following: MIB OF 1169 is 87 cm (draw length to the tip 74 cm), MIB OF 1147 is 93 cm (draw length 81 cm).

The performance of bow 1 modeled by Karpowicz, based on the experience of the master manufacturer, although very conditional, is currently the only qualitative characteristics available to us of a traditional bow of the described design. More accurate data can only be obtained by creating experimental replicas.

The "weakening" of bow 1 is associated with the age of the item, the gradual wear of materials, according to Karpowicz, and the loss of glue properties. The proportions of the limbs, as well as the modeled performance given above, preclude the attribution of the weapon to the category of specialized combat weapons. Notably, there are no clear criteria for differentiation of Buryat bows by purpose. Most likely, the bows in question were made as multi-purpose, and were used mainly for hunting and competitions.

Bows 1–3, according to the owner, were most effective in the autumn-spring period. Certain issues related to the impact of climate change on the efficiency of structures were considered by foreign experts. Particular attention was paid to air humidity. It was found that one of the varieties of Turkish bows needed special drying before use (Klopsteg, 1987: 38). However, the issue of variability in the characteristics of traditional bows at different temperatures is not at all described in weapons science.

A classification of Buryat bows by decoration was proposed by A.A. Badmaev. He notes that the Irkutsk and Olkhon Buryats decorate bone overlays with elements of circular patterns and "parallel lines"; the Barguzin Buryats, with alternating "bone, ordinary horn, and figured horn plates"; Alar, Khori, Tunka, and Chita Buryats did not decorate the body at all (Badmaev, 2005: 75). Most likely, according to Badmaev, the items described above belong to the category of Barguzin Buryat bows: the items are reinforced with plates of deer antler and hollow horn, which, judging by their position on the core, "alternate"; at the ends, there are "figured" plates.

One of the bows (ANM OF-628) kept in the Tsibikov Aginskoye National Museum (Aginskoye, Aginsky District of the Transbaikal Territory), is decorated with "alternating plates" and circular patterns, although it was made by a Buryat artisan in the territory of Trans-Baikal (according to the Badmaev's classification, it can be attributed to two groups at once). One Buryat bow from the Russian Museum of Ethnography (St. Petersburg) is also noteworthy. The bow REM 4048-155, discovered near the Tsugol Datsan in 1923, is decorated with elements of a circular pattern. The combination of different decorative elements on one item may be due to contacts between different groups of Buryats; however, at present, it is not possible to draw clear conclusions about this. All this actualizes the problem and makes it possible to raise new questions in the study of the design features of Buryat bows.

In the context of the study of the described items, the most interesting is the work of I.E. Tugutov, which provides a detailed description of the process of manufacture of a traditional bow, compiled on the basis of information from an artisan from the Khargana ulus, Ivolginsky Aimak (now the village of Khargana, Selenginsky District, Republic of Buryatia) (1958). The scholar notes that Manchurian wapiti or elk antlers were used to reinforce bow ears, handle, and transition zones; solid birch was used as a base; the finished bow looks like a chord-semicircle (Ibid.: 40). An item sketched by Tugutov (Ibid.: 41), in its general appearance, almost completely corresponds to the bows of Irintseev. Most likely, Tugutov recorded the process of making a bow of the same design (or one of the variants) as described above.

An item identical to the bows of Irintseev, is kept in the National Museum of the Republic of Buryatia (Ulan-Ude), under the inventory number MIB OF-17848; it was described earlier (Kharitonov, Butukhanova, 2017). According to the museum data, the bow was made in the late 19th century by an artisan from the Tamcha ulus, Selenga region. The "redesigned" bow of D.-N.R. Erdyniev has the same ears with transition zones as bows 1–3 (Kharitonov, 2020: Fig. 1, *2*). Despite the lack of reliable information about the origin of the items, the owner considered them to be products of the Selenga Buryats.

The items discussed differ from Mongolian and Chinese imports. They have a smoother geometry, a different cross-section of elastic limbs and transition zones (the Manchurian design and its variants have a pronounced additional rib on the back) (Solovyev, Kharitonov, 2020), without bright decoration. Items discovered in Tashir, unlike the bows of the northern peoples, are made using sinew, are reinforced with overlays and equipped with supports; a different wooden core design is presented. The above data indicate the manufacture of bows of this design by local Buryat craftsmen. This original design has become widespread in the territory of the modern Selenginsky District of the Republic of Buryatia.

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*Data from the personal correspondence with A. Karpowicz.

There is no clear information about the time of manufacture of the items under study, so they can be dated tentatively. Traditional bows, similar in geometry, are shown in photographs from the late 19th to early 20th centuries (Kharitonov R.M., Kharitonov M.A., 2021). If the museum inventories are accurate, one of the identical bows (MIB OF-17848) was made in the 1880s. Most likely, this design became widespread much earlier, and is directly related to its military counterparts. Around the mid-20th century, Buryat craftsmen began to make bows of a different design, intended for sports competitions; these are still manufactured today by Agi artisans (this design has a number of differences (a classic example is the "broken bow" of D.N.-R. Erdyniev) (Kharitonov, 2020: Fig. 1, *1*)). Thus, the described items can be dated back to the mid-19th to early 20th centuries. At that time, specialized sports options had not yet appeared, and craftsmen made bows without simplifying their design, as evidenced by many overlays. Meanwhile, according to ethnographic information, bows and arrows were used by the Buryats of Trans-Baikal back in the 19th to early 20th centuries during battues (Zhambalova, 1991: 52).

Conclusions

The provided data suggest that the three described bows represent a distinctive local tradition, widespread in the modern territory of residence of the Selenga Buryats. In design, these bows differ from others. In shape, they resemble half a flattened ellipse: they have a straight handle, elastic limbs smoothly curved towards the back, distinct evenly curved transition zones, and straight, relatively short ears; the transition zones are reinforced with frontal overlays made of deer antler, and do not differ in cross-section from the elastic limbs; they are equipped with a similar set of overlays; the width and length of the body change slightly and relatively smoothly; limbs are relatively narrow, backs are reinforced with sinew.

Based on indirect evidence, the items can be dated to the mid-19th to early 20th centuries; however, most likely, bows of this design were common earlier, too. During this period, these were no longer related to military affairs and were used in commercial and hunting activities. These bows were somewhat weaker than their military counterparts, with more protected wooden bases. Meanwhile, the described design represents one of the stages in the evolution of hand-held projectile weapons, genetically related to earlier combat or multi-purpose forms.

Single specimens of similar items were recorded not only in the territory of the Selenga Buryats, which makes it impossible to accurately indicate the zone and time of their distribution. Now we can speak about the existence of several variants of the Buryat traditional bow, similar in geometry and metric characteristics, but differing in the design of transition zones and the set of overlays from Selenga items (a preliminary typology of completely preserved Buryat bows was proposed earlier (Kharitonov, 2022)). This study demonstrated the importance of analyzing the items from private and family collections. A comprehensive study of them, with the involvement of a wide range of sources, opens new avenues for research.

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The Jade Path of Professor Tang Chung

This year, which is so notable for many remarkable anniversaries, also marks an important milestone in the life of Professor Tang Chung (Deng Cong)*. This outstanding Chinese archaeologist and ethnologist was born on December 30, 1953, in Hong Kong (currently, Hong Kong Special Administrative Region, People's Republic of China). Tang Chung graduated from the Department of History at the Chinese University of Hong Kong, where he received a bachelor's degree in 1977 and a master's degree in 1979. Among his mentors was the famous Chinese-British scientist Zheng Dekun (Cheng Te-kun). In 1979–1985, Tang Chung studied archaeology at the graduate school of Tohoku University (Sendai, Japan), where he received a Doctor of Philosophy (PhD) degree. In 1996, under the guidance of Professor Kato Shimpei, he prepared and defended a dissertation at the University of Tokyo for the academic degree of Doctor of Literature (D.Litt.), on the topic "Study of the Technological Complexes of the Upper Paleolithic Microblade Industries of North China".

From 1985, Tang Chung has worked at the Chinese University of Hong Kong. In 1994, he became the head of the Center for Chinese Archaeology and Art, and from 2006 to 2019 he was a professor in the Department of History. At present, he is a professor at the Institute of Cultural Heritage of Shandong University in Qingdao, an honorary professor and member of the academic council of the Department of History at the Chinese University of Hong Kong. In addition, he serves as an advisor to the Hong Kong Museum of History and the Hong Kong Heritage Museum (since 2000), and works in the editorial boards of a number of reputable archaeological journals. Tang Chung is a corresponding member of the German Archaeological Institute (since 2009), a board member of the Archaeological Society of China (since 2018), and a recipient of the Yangtze River Distinguished Professor Award from the Ministry of Education of the People's Republic of China. He worked as a special guest lecturer and researcher at many universities in China and Japan.

Symbolically, Tang Chung's homeland of Hong Kong is a city whose geographical location and history plays a significant role in the development of contacts between countries and cultures. Just as Hong Kong entrepreneurs actively developed business on the mainland, the professor successfully united the work of archaeologists from China, Japan, Europe, and America. He has held two dozen representative conferences and exhibitions with the participation of many leading scientists from different countries, attracting the necessary funds and sponsors. Thus, he has demonstrated his extraordinary talent as an organizer.

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*Tang Chung is the most familiar and widespread in Hong Kong (Xianggang) Yue pronunciation of his nominal characters 邓聪; Deng Cong is their standard (official) reading in the People's Republic of China.

Tang Chung was involved in the study of many Paleolithic sites in Japan and China, with particular attention afforded to microlithic tools; he led the excavations of the Neolithic/Early Metal Age site of Tai Wan on Lamma Island (Hong Kong) and a Neolithic workshop site for the production of stone rings and disks in Hac Sa (Macao); also he has headed the excavations in Vietnam. In recent years, he has been conducting field research in mainland China (the Neolithic settlement of Hamin in Inner Mongolia, etc.). Tang Chung has continually worked with archaeological finds kept in the collections of specialized institutes and museums in the provinces of Sichuan, Henan, Zhejiang, Liaoning, Heilongjiang, etc., and has prepared monographic publications of materials from excavations in Jinsha, collections of jade items relating to the cultures of Xinglongwa, Liangzhu, Erlitou.

One of the main objects of study for Tang Chung are products made from jade, which in Ancient China was considered the epitome of many virtues. The scholar has even advanced a hypothesis about it as a symbol of superiority in the Mongoloid peoples as opposed to the Caucasians, who preferred gold—an idea that is not indisputable, but conceptually very rich. Hence his interest in the earliest jewelry of Eurasia (for example, the chloritolite bracelet from Denisova Cave), which is associated with the origin of human activity not directly related to material production. He has also led an international project to study the origin and early use of turquoise in China. Use-wear analysis and experimental archaeological methods allowed Tang Chung to reconstruct a drilling and milling machine used by the Neolithic population of East Asia in manufacturing stone adornments, to restore the entire complex of ancient technologies, and to identify the earliest use of bearings. Eventually, he formulated the concept of two basic lines in jade processing in Eurasia.

Under the leadership of Tang Chung, several large projects have been carried out, which received financial support from the General Research Fund created by the government of the Hong Kong Special Administrative Region: "Archaeological Study of Bark-Cloth Beaters from the Territory of the Pearl River Delta, Vietnam, and Taiwan" (2000–2003), "Study of Slit Rings [*Jue* Type] in the Archaeology of East Asia" (2002–2006), "Techniques for String-Sawing Jade in Prehistoric East Asia" (2012–2014), "Functional Analysis of Prehistoric Stone Beaters in Southeast Asia in Archaeological and Ethnographic Aspects" (2013–2015), "Exchange of Raw Materials and Technologies of Jade Processing in Prehistoric Northeast Asia" (2015–2017), "Sources of Raw Materials and Manufacture Techniques of Turquoise Jewelry in Prehistoric China (the Case of Jiahu and Erlitou)" (2018–2020).

To interpret archaeological materials, Tang Chung has actively used ethnographic data, making expeditions to areas inhabited by peoples who preserve ancient way of life (in the provinces of Yunnan and Hainan of the People's Republic of China, in Vietnam, Indonesia, and the Philippines). He has produced several documentaries, showing the traditional methods of growing rice, beating bark-clothes, making and wearing jade jewelry; these data are compared with archaeological finds, revealing the meaning of the latter. Some of these materials are recorded on DVDs, and can be used as teaching aids. Professor Tang is also one of the most famous specialists in archaeological photography in the East Asian region; he has created a database that contains over 160 thousand photos of ancient sites and artifacts.

Tang Chung maintains close working contacts with Russian archaeologists, including joint projects. He has repeatedly come to Russia to study collections at the Institute of Archaeology and Ethnography SB RAS, Irkutsk State University, the Institute of History, Archaeology and Ethnography of the Peoples of the Far East FEB RAS; he has given lectures on the archaeology of East and Southeast Asia to students of Novosibirsk State University. The scientist's works has been published in Russian academic journals*. In 2021, "Selected Works of Tang Chung on Archaeology" (Deng Cong kaogu lunwen xuanji [鄧聰考古論文選集]. Hong Kong: Xianggang zhongwen daxue zhongguo kaogu yishu zhongxin)

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were published in four extensive volumes. But this publication was not an exhaustive collection of his scientific heritage, which constantly continues to grow. In the last three years alone, generalizing works on new finds in Erlitou, a monographic study of Jinsha evidence, etc. have been published.

The wise Confucius once said that at the age of 70 he could follow his heart-mind's desires (七十而从心所欲). We believe that Tang Chung has followed his generous heart throughout his whole life, well before his 70th birthday. Everyone who ever met him noted his exceptional openness and friendliness, desire and, more importantly, ability to provide the necessary help. These remarkable spiritual qualities, coupled with outstanding scientific achievements, have earned Professor Tang a well-deserved reputation among his many friends and colleagues. Let us wish him to continue following his chosen path!

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AN SSSR – USSR Academy of Sciences

CNRS – Centre National de la Recherche Scientifique

GAIMK – State Academy for the History of Material Culture (Moscow)

IA RAN – Institute of Archaeology, Russian Academy of Sciences (Moscow)

IAET SO RAN – Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences (Novosibirsk)

IIMK RAN – Institute for the History of Material Culture, Russian Academy of Sciences (St. Petersburg)

ION BNC SO RAN – Institute of Social Sciences of the Buryat Science Center, Siberian Branch, Russian Academy of Sciences (Ulan-Ude)

KhakNIIYALI – Khakass Research Institute of Language, Literature and History (Abakan)

KSIA – Brief Communications of the Institute of Archaeology, Russian Academy of Sciences

KSIIMK – Brief Communications of the Institute for the History of Material Culture

PNAS – Proceedings of the National Academy of Sciences

RGO – Russian Geographical Society

RGTEU – Plekhanov Russian University of Economics (Moscow)

SAI – Collection of Archaeological Sources

SVKNII DVO RAN – Shilo North-East Interdisciplinary Scientific Research Institute, Far East Branch, Russian Academy of Sciences (Magadan)

UfNC RAN – Ufa Scientific Center, Russian Academy of Sciences (Ufa)

UrO RAN – Ural Branch of the Russian Academy of Sciences

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