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Fossil Bone Implements in the Industry of the Early Paleolithic Site Bogatyri/Sinyaya Balka (Taman Peninsula)

We describe three processed fossilized bones of sea mammals of the Miocene age, discovered in various years, but in similar stratigraphic and planigraphic contexts, at the Early Paleolithic site Bogatyri/Sinyaya Balka, on the northern coast of the Taman Peninsula. We provide information on the age, stratigraphy, and planigraphy of the site, interpreted as a place for butchering carcasses of elephants and rhinoceroses (elasmotheres). Results of traceological analysis suggest that two fossilized seal bones had been split by the counterstrike technique on soft (wooden or bone) anvils, while the third bone had been more thoroughly processed. All three specimens may have been collected from coastal deposits. Fossilized seal bones were evidently used as raw material along with rocks and animal bones of the Taman faunal complex. Small and inconvenient as they are, such bones provided the hardest isotropic material available at the site. That their use was not incidental is convincingly demonstrated by artifact No. 1, found in 2005. The point made on this bone is situated in the middle of an intentionally prepared blade, in a notch fashioned by shallow retouch. This bone tool is quite similar to other points in the Early Paleolithic industry of Bogatyri/Sinyaya Balka. Tools of that category differ in shape and size, but are similar because of a special morphological element—a point (bec, borer, etc.) shaped by a combination of retouch and small encoches at any suitable place in the blank such as jointing or spall.

Keywords: *Early Paleolithic, Northern Eurasia, Bogatyri/Sinyaya Balka, Paleolithic industries, fossilized bone artifacts, morphological and traceological analyzes.*

Introduction

The Early Paleolithic site of Bogatyri/Sinyaya Balka, which is part of the Taman Paleolithic complex (Fig. 1, 2), was discovered in 2002 at the paleontological locality Sinyaya Balka, a typical site of the Taman faunal complex (Gromov, 1948), in the course of its examination by members of the Ilskaya Paleolithic Expedition of

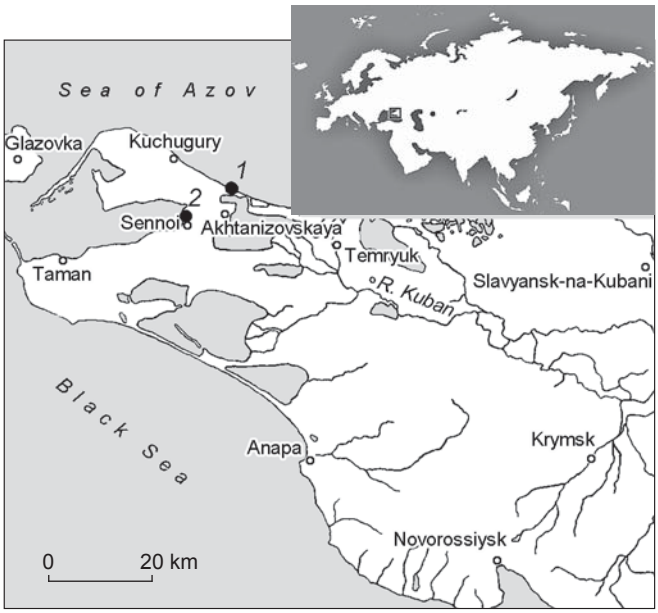


Fig. 1. Location of sites of the Taman Paleolithic complex.
1 – the Early Paleolithic sites of Bogatyri/Sinyaya Balka, Rodniki-1, -2, Kermek; *2* – Tsymbal locality.

the Institute for the History of Material Culture of RAS (Shchelinsky, Bozinski, Kulakov, 2003; Shchelinsky et al., 2004). Systematic excavations of the site, which began in 2003 (Kulakov, Shchelinsky, 2004), have been carried out (with interruptions) until today (Kulakov, 2018b; Kulakov, 2019b).

In 2007, during excavations in sq. 59/2, the processed bone of a marine animal was first found here. It was located in the lower part of layer 4, at the boundary with the sand layer. It must be admitted that as long as this artifact was the only one of its kind, we interpreted it with the utmost caution. In 2018, during excavations at Bogatyri/Sinyaya Balka in sq. 61/4, also at the boundary of the sands of layer 3 and the bone-bearing lens (layer 4), a second processed fossilized bone of a marine animal was discovered. In 2020, in Bogatyri/Sinyaya Balka excavation area 01, in sq. 60/4, also at the contact of layers 3 and 4, a third processed fossilized bone of a marine animal was found.

The discovery of such rare artifacts in the same excavation-area in the same stratigraphic and planigraphic context suggests that the skills of processing various raw materials had been developed already in the ancient, Oldowan, tool-making technologies.

General information about the site

The Early Paleolithic site of Bogatyri/Sinyaya Balka is a generally accepted evidence of the initial human dispersal from the African continent (Amirkhanov, 2016; Derevianko, 2009). Materials from studies conducted in 2003–2008, 2011, 2016, and 2018–2020 allow us to consider the site as a unique example of the adaptation of the most ancient collectives, presumably *Homo erectus*, to the specific conditions of the temperate zone of Northern Eurasia in the Early Pleistocene (Kulakov, 2018c).

The age of the site, as well as of the Taman faunal complex itself, is 1.2–0.8 million years (Trubikhin, Chepalyga, Kulakov, 2017; Kulakov, 2019b; Shchelinsky et al., 2010). However, in recent years, paleontologists have considered it possible to shift its lower boundary to 1.4–1.6 million years (Sablin, 2010; Titov, Tesakov, 2009).

Stratigraphy and planigraphy of Bogatyri/Sinyaya Balka (Fig. 3, 4) represent a clear picture of the processes

Fig. 2. Location of the Early Paleolithic sites on the northern coast of the Taman Peninsula.
1 – Bogatyri/Sinyaya Balka; *2* – Rodniki-1; *3* – Rodniki-2; *4* – Kermek.

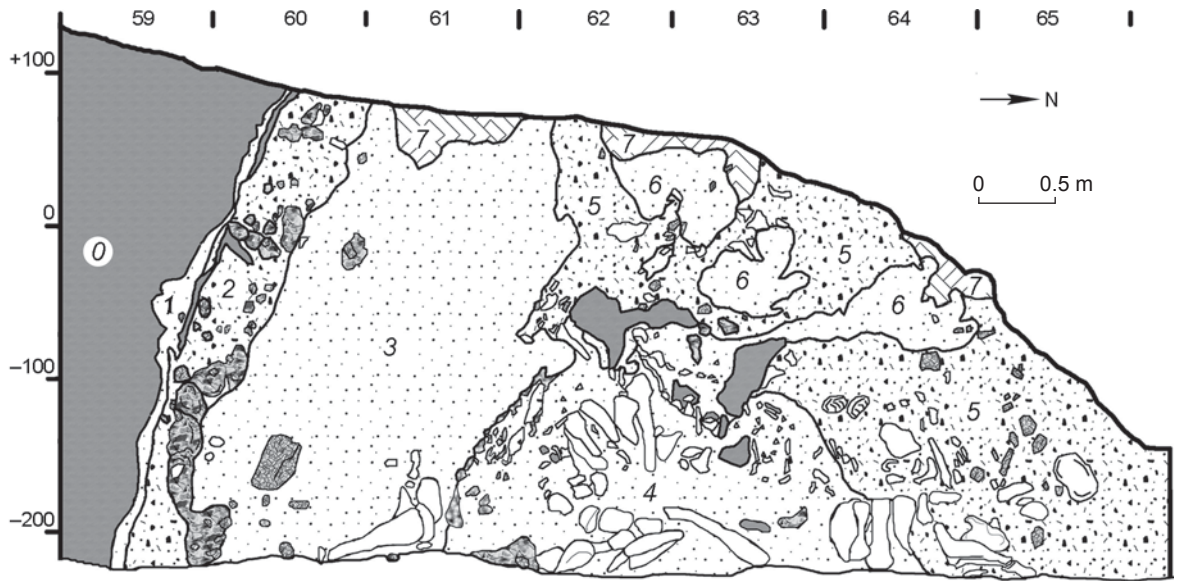


Fig. 3. The stratigraphic sequence on the western wall of the excavation at the Early Paleolithic site of Bogatyri/Sinyaya Balka. Numerals correspond to the numbers of layers.

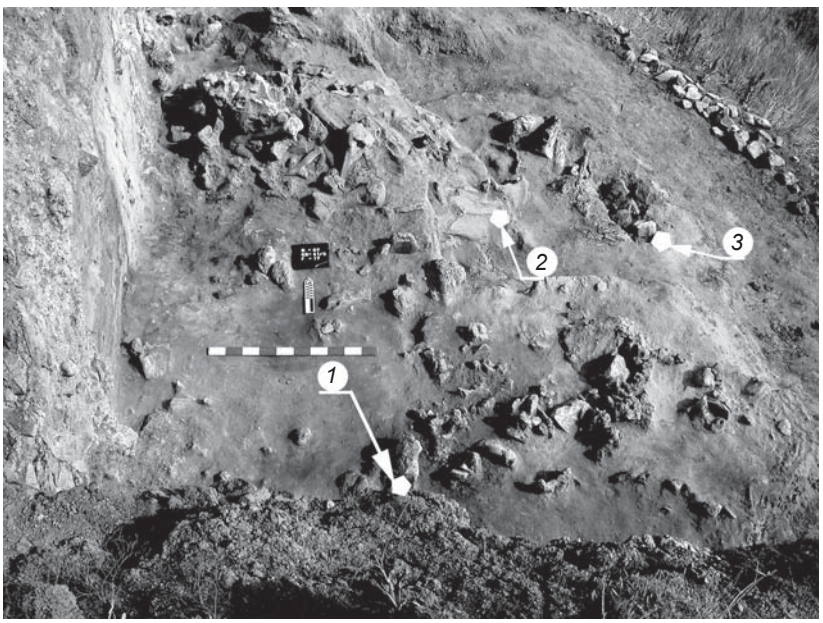


Fig. 4. Cultural layer of excavation 01 at the Early Paleolithic site of Bogatyri/Sinyaya Balka. Arrows indicate the places of discovery of the bone implements: *1* – No. 1 (2007); *2* – No. 2 (2018); *3* – No. 3 (2020).

of formation and accumulation of cultural deposits, as well as their post-depositional changes as a result of mud volcanic processes, tectonics, and coastal abrasion. All artifacts and faunal remains are concentrated only in dislocated, but not redeposited sand and gravel deposits of the Early Pleistocene uncovered during the excavation. According to modern concepts (Kulakov, 2012, 2018b, 2020a; Kulakov, Timonina, Titov, 2017), undisturbed sandy-gravel deposits directly overlie continental layer 0 of the "Kuyalnik" Pliocene clay (see Fig. 3). Layers 1 (marine beach sand layer) and 2 (towpath) cemented to breccia were formed directly in the beach zone of the reservoir. Layer 3 is a stratum of uneven-grained grayish-yellow and red sand containing artifacts and animal bones that do not form concentrations; this layer was also formed on the shore of the reservoir. Layer 4 is a "bone-bearing" stratum (a lens in the upper part of the sandy sediments of layer 3); it is clogged with fragments of various sizes,

small bone fragments and intact bones belonging only to elephants and rhinoceroses-elasmotheres. In this cluster of bones, artifacts were found that made up the main part of the site's collection. Detritus layers 5 (coarse gravel stratum) and 6 (fine gravel stratum) are traces of the activity of mud volcanoes; redeposited faunal remains and artifacts have been found here. Layer 7 is multi-temporal "enclosures"—blocks of various sizes, which appeared as a result of the destruction of coastal sediments in the area of the site, and gradually slipped into the sea; they belong to the period from the Pleistocene to the Holocene (Nesmeyanov, Kulakov, 2013). All cultural layers of the site were subject to such partial destruction; therefore, artifacts and faunal remains are sometimes found in these "enclosures".

The lithic industry of the site totals 514 specimens. All the artifacts are made of silicified dolomite; this is brittle, but splits well enough and produces fragments with sharp edges. This local raw material lies in layers in clay and sand in the form of blocks and tablets of various sizes. The toolkit includes 329 items or 63.5 % of the total collection, which may be due to the industry specialization. The rest of the collection consists mostly of flakes and their fragments (159 spec., 31 %), mainly primary; these are different in size; small spalls predominate absolutely. Among the 12 core-like products, only 2 specimens can indicate intentional flaking from cores. Analysis of this part of the collection gives good reason to believe that flaking of dolomites was carried out for the purpose of making choppers and coarse chopping tools; this category contains a series of "gigantoliths"—very large items weighing more than 2.5 kg (Kulakov, 2018a). Many spalls that appeared during the manufacture of large tools were used without special working or served as the basis for the manufacture of the so-called light-duty tools. The tool composition of the industry confirms this conclusion (see *Table*). Intentional tools—choppers—account for 30 %. The rest of the collection includes a variety of end-scrapers, points, side-scrapers, spalls, and fragments with utilization retouch. Thus, our analysis suggests that the Bogatyri/Sinyaya Balka lithic industry specialized in butchering the carcasses of large animals: thick skins were probably cut through with choppers, and flesh was cut off with side-scrapers, points, and end-scrapers.

In order to reconstruct the natural environment and the lifestyle of the primeval communities of the Bogatyri/Sinyaya Balka site, it is necessary to imagine the site during the period of human habitation, i.e. turn the western wall of the excavation counterclockwise by 90° (see Fig. 3, 4). Everything happened on the shore of a brackish reservoir. The watershed areas were dominated by forest-steppe vegetation; the region was inhabited by relatively heat-loving animals of the Taman faunal complex (Shchelinsky et al., 2010). The materials of layers 1 and 2 correspond to the first rare appearances of the most ancient humans on the beach at the very edge of the water. The presence of stone tools in the thick layered subaqueous sandy stratum (layer 3) indicates a long presence of human groups on the shore of the reservoir. This assumption is supported by the bone-bearing lens in layer 4; it was formed, probably, in the crater of lake depression of a mud volcano, which for a long time attracted both animals and ancient people. Then the time of cataclysms came: the swamp lake containing bones and artifacts flowed out onto the sands and was immediately covered by a thick layer of breccia from hills and slope deposits, which conserved the site. Tectonics and volcanism continued their destructive activities, which led to a tectonic fault—overturning "on the side" (by about 90°), to the northeast, of a huge block of the ancient coast, which included this multi-layered site (Shchelinsky et al., 2008; Nesmeyanov, Leonova, Voeikova, 2010; Kulakov, 2012, 2020a; Nesmeyanov, Kulakov, 2013; Izmailov, Gusakov, 2013; Izmailov, Shchelinsky, 2013).

On the basis of the derived data, the site is considered as an elephant and elasmotheres butchering place. Most likely, the Taman elephants *Archidiskodon meridionalis tamanensis* and the Caucasian elasmotheres *Elasmotherium caucasicum*, like modern elephants and rhinoceros, liked to take "mud baths". The caldera of the ancient mud volcano with a fresh-water lake in the middle and marshy shores was a popular place among

Distribution of stone tools at the Early Paleolithic site of Bogatyri/Sinyaya Balka by layers, spec.

Layers	Choppers	Coarse chopping tools	Side-scrapers	End-scrapers	Points	Notched-denticulate tools	Becs	Spalls with retouch	Fragments with retouch	*Total*
1, 2	3	–	1	1	–	–	–	–	–	5
3	24	2	7	16	17	3	1	1	14	85
4	29	2	18	25	17	2	4	3	16	116
5, 6	15	–	12	9	5	1	–	1	6	49
Talus	29	–	7	14	9	4	–	10	1	74
Total	100	4	45	65	48	10	5	15	37	329

elephants and elasmotheres. Submerging in mud, the big animals lost their mobility and could become the prey of large predators, such as saber-toothed felines and hyenas *Pachycrocuta*, and possibly the ancient *Homo*. Some of the elephants and rhinoceroses probably died, because they could not climb the swampy and steep banks (for young and broken animals these were a natural trap) or because of the toxic gases released by the mud volcano. Ancient people probably removed carcasses from the mud and butchered them to provide themselves with protein food. This assumption explains the occurrence of stone tools between the bones.

The prehistoric people most likely did not live directly at the butchering sites; they inhabited more convenient places in the nearest vicinity. Did *Homo* themselves actively hunt large mammals in the Taman Peninsula in the Early Pleistocene? There is no answer to this question yet, since no direct evidence of hunting has yet been found; the Bogatyri/Sinyaya Balka site has not yielded any remains of hunting weapons or traces of their use (Kulakov, 2018b, c, 2019a, 2020b).

Implements made of fossil bones from layer 3

Direct evidence of the active life of the most ancient *Homo* on the shore of one of the bays of a large Early Pleistocene reservoir are three fossilized bones of marine mammals, with signs of processing by ancient man, found in the undisturbed sediments of the site (see Fig. 4, 5).

In their state of preservation, these finds differ considerably from the numerous bones of elephants and elasmotherian rhinos from various layers of the site, which are characterized by extreme softness and friability. The differences are determined by the degree of fossilization—the substitution of siliceous rock for the bone-tissue. The bones of the marine mammals are much older than the bones of the Taman complex animals; during the formation of the cultural layers of the site, these bones were stones. Solitary remains of marine mammals (vertebrae and ribs of whales, dolphins, seals, etc.), whose state of preservation is typical of Miocene deposits, were found in various layers at Bogatyri/Sinyaya Balka. The remains of the Miocene marine mammals washed out from the older layers were often exposed on the shore of the ancient reservoir, and could have attracted the attention of ancient hominids by their appearance. At present, solitary bones of such animals occur in layers of sea sands and on the modern coast in the area of all the sites of the complex.

To determine the suitability of fossilized seal bones from the coastal deposits of the Sea of Azov for splitting, we carried out a series of experiments: the samples were used as cores for bipolar knapping (on an anvil). The results have shown that in all the fossils, the bone-fiber had been completely replaced by siliceous rock, relatively homogeneous, hard and brittle, producing step fracture.

The find No. 1 of 2007 is a well-preserved seal femur, silicified, with a missing distal end fractured at the level of the lower third of the diaphysis (Fig. 6). The length of the fragment is 48 mm, which is approximately 2/3 of the length of the whole bone. The color of the fossil is dark brown. By its size and morphology, the bone can be attributed to the species *Monachopsis pontica* (Eichwald, 1850), which is typical of Upper Sarmatian–Meotian deposits in the Black Sea region (Koretsky, 2001). Judging by its degree of fossilization and the nature of silicification, the bone was originally located in the Upper Miocene deposits, which were exposed in some places on the shores of the Taman Peninsula, on its northern coast in particular. Fossilization of the natural relief did not damage the surface of the seal bone; all the natural *in vivo* protrusions and depressions (from large to the smallest) are clearly visible on it. The natural surface shows traces of various kinds of changes that occurred in different periods of the "life" of the bone before and after its fossilization. Undoubtedly, traces of roots, as well as parallel, partially preserved grooves and scratches on the inner surface of the diaphysis in the left distal part, emerged before fossilization, but after the death of the animal (Fig. 7, *1*). We interpret them as the predator's gnawing-marks that emerged at the time when this bone still contained an organic component and its tissue was tenacious. Traces of such a change in the bone's surface were studied by the authors on the bones with ancient hyena gnawing-marks from Trlica Cave in Montenegro (excavations by M.V. Shunkov, determination by A.K. Agadjanyan) (Fig. 7, *2*). Traces of the plants' roots are presented in the classical form—thin winding and branching grooves (Fig. 7, *1*). Most likely, the ancient seal was washed ashore and eaten by a terrestrial predator, because animal bones and traces of roots appeared on the seal bone before fossilization, before the bone-fibers were replaced by siliceous rock.

The traces of the third group we associate with processing (Fig. 8, *1*). These emerged after the complete fossilization of the bone, when it acquired all the qualities of a brittle isotropic material producing a shell-like fracture. In this case, a solid siliceous substance was substituted for the bone-tissue; the negative scars of removals (flaking traces) were analyzed. Negative scars of small removals are observed; these have a conical and non-conical bulb and a stepped and/or loop-shaped ending as a rule. The negative scars are concentrated at the distal end of the bone; in fact, these are the result of the recurrent transverse splitting. Judging by the intact scars and those truncated by the subsequent flaking, at least seven removals were made. The concave ventral surface of the bone served as a striking platform. The relatively small

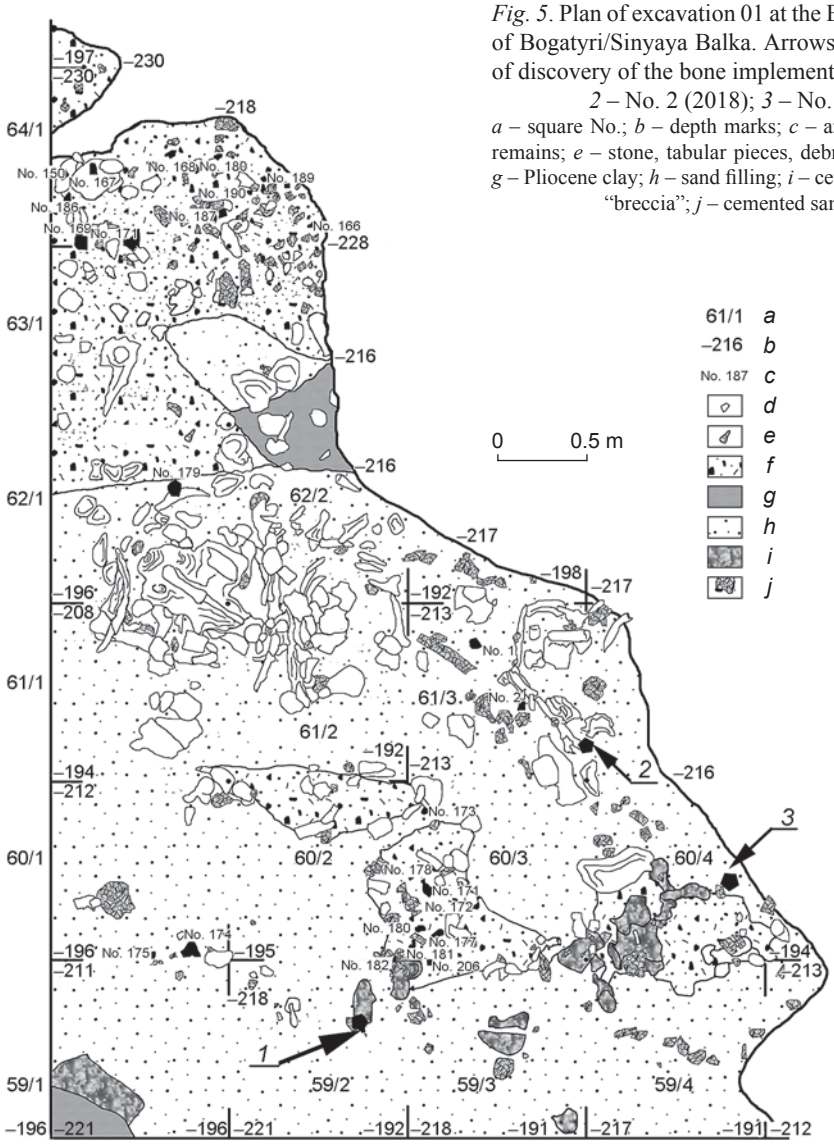


Fig. 5. Plan of excavation 01 at the Early Paleolithic site of Bogatyri/Sinyaya Balka. Arrows indicate the places of discovery of the bone implements: *1* – No. 1 (2007); *2* – No. 2 (2018); *3* – No. 3 (2020).
a – square No.; *b* – depth marks; *c* – artifact No.; *d* – faunal remains; *e* – stone, tabular pieces, debris; *f* – detrital filling; *g* – Pliocene clay; *h* – sand filling; *i* – cemented detrital filling, "breccia"; *j* – cemented sand filling.

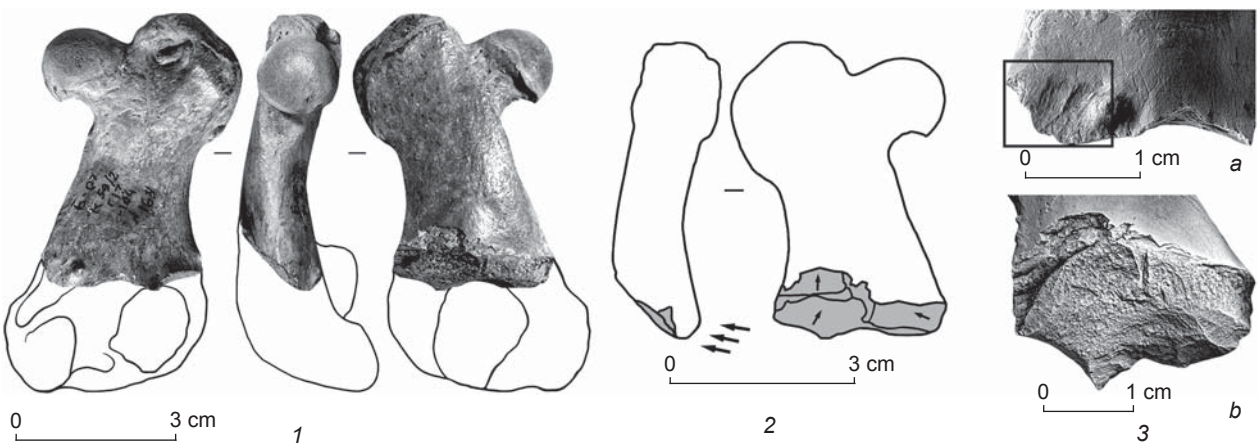
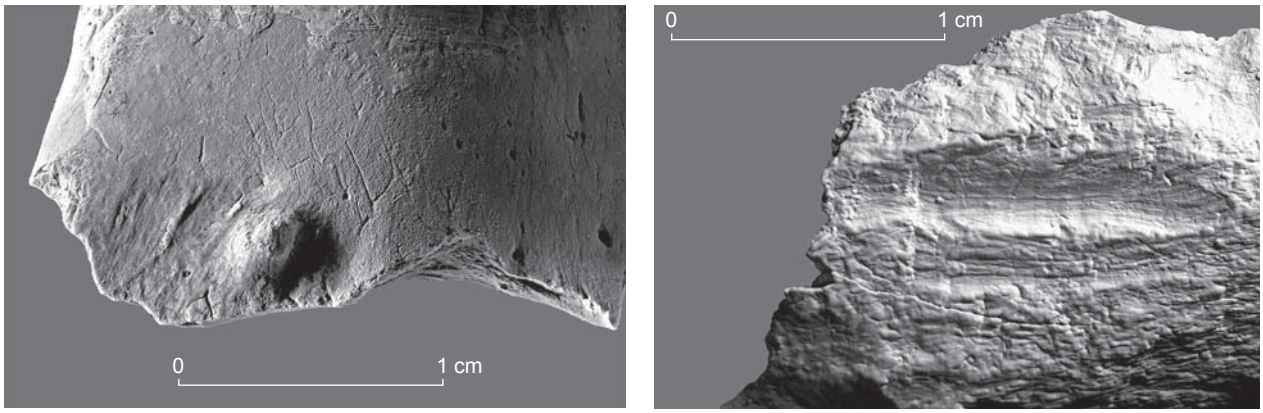


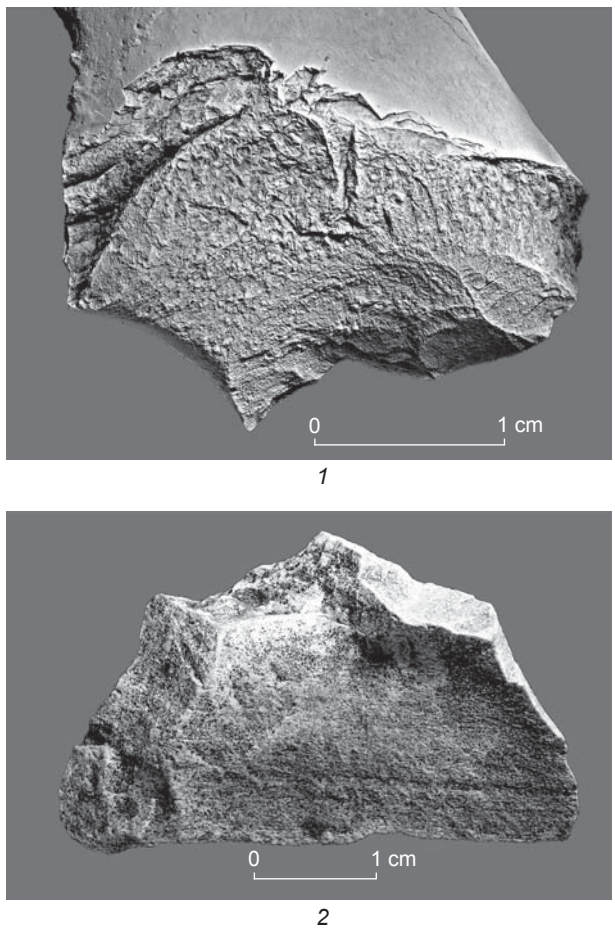
Fig. 6. Artifact made from fossilized bone No. 1 (2007) from the Early Paleolithic site of Bogatyri/Sinyaya Balka.
1 – general view; *2* – drawing of the treatment zones; *3* – macrophotographs of gnawing-marks (*a*) and traces of treatment (*b*). *Photos by E.Y. Girya, drawings by A.N. Trishkin.*



1 *2*

Fig. 7. Surface with traces of natural damage on bone implement No. 1 (2007) from the Early Paleolithic site of Bogatyri/Sinyaya Balka (*1*), traces of natural damage on the bone from Trlica Cave in Montenegro (*2*). *Photos by E.Y. Girya.*

Fig. 8. Bone point No. 1 (2007) (*1*), stone point (*2*) from the Early Paleolithic site of Bogatyri/Sinyaya Balka. *Photos by E.Y. Girya.*



1

2

size and mass of the nucleus suggest that the splitting was carried out on an anvil. Some angular item probably acted as a hammerstone, since the negative scar of one of the last spalls shows a very narrow, almost punctiform, conical bulb (see Fig. 7, *1*).

Despite the relatively good preservation of the spall's surfaces, no use-wear signs similar to those on a tool could be traced on this item. The presence of sharp protrusions on the retouched edge indicates clearly that the product was not used for processing any hard material. However, the working edge of the artifact is quite suitable for processing soft materials, so the possibility of its short-term use for cutting meat and/or skin cannot be excluded.

The absence of well-developed, well-marked traces of use-wear does not contradict the assumption about the intentional processing (splitting) of this fossil bone and its interpretation as a manifestation of the intelligent activity of the most ancient human ancestors.

The find No. 2 of 2018 is a right humerus with a missing distal end, broken off at the level of the lower third of the diaphysis (Fig. 9). The palmar-lateral (posterior-lateral) part of the proximal zone and diaphysis are also missing. The length of the fragment is 45.2 mm, the diameter of the bone's head is 30 mm. Judging by its size and morphology, the seal bone was assigned to the species *Cryptophoca maeotica* (Nordmann, 1860), typical of the deposits of the Middle Sarmatian in the Black Sea region (Ibid.).

The state of preservation of the antemortem (original) surfaces of this fossilized bone fragment fully corresponds to that of the fragment described above. No predator's gnawing-marks are recorded on the item; weak root traces are present. Hence, it can be concluded that both fragments of the fossil bones likely come from the same source—coastal deposits.

Unlike the previous one, this fragment of the fossilized seal humerus bears traces of longitudinal, rather than

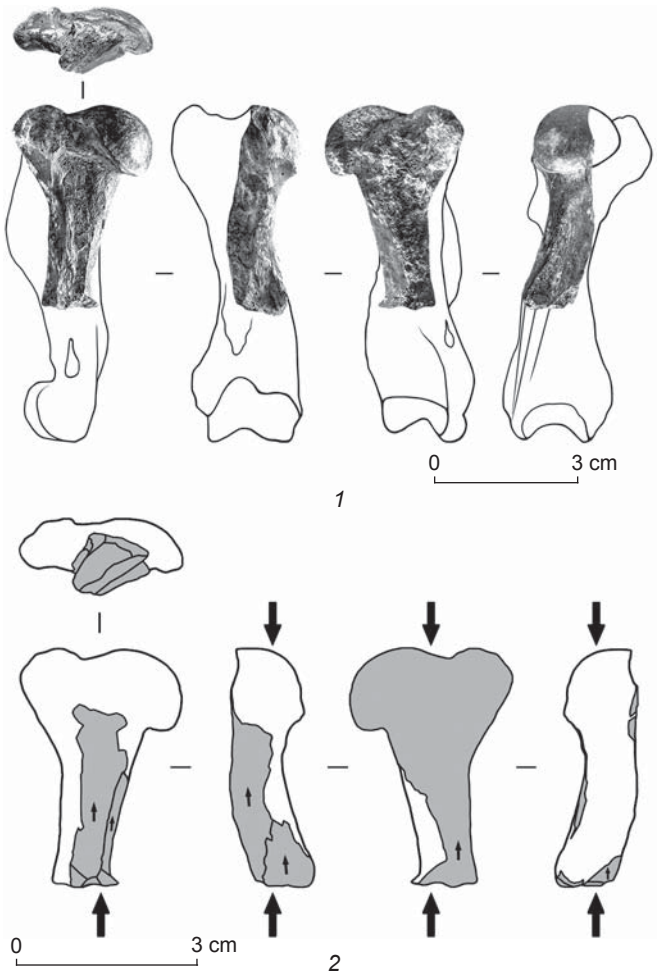


Fig. 9. Artifact made from fossilized bone No. 2 (2018) from excavation 01 at the Early Paleolithic site of Bogatyri/Sinyaya Balka. *Photos by E.Y. Girya, drawings by A.N. Trishkin.*
1 – general view; *2* – drawing of the treatment zones.

transverse, splitting. The size and orientation of the flaking scars, as well as the relatively small size and mass of the core itself, suggest that this item, like that described above, was split on an anvil. It is noteworthy that the counter-strike splitting of the fossilized bone, which served as a nucleus, was carried out in one direction—from the platform on the fracture of the diaphysis. The bone was cut almost to its full length vertically and was fragmented across. A few more elongated spalls were detached from the bone core during splitting from other sides. The platform was damaged in the same way as on all other counter-strike cores; and a sharp and uneven edge was formed (as in *pieces esquilles*). It is difficult to judge how many blows were delivered, since in counter-strike splitting, such fragmentation of the nucleus can occur as a result of one excessively strong blow. Noteworthy is the absence of traces of the same damage on the edge at the opposite side. A similar morphology is characteristic of counter-strike nuclei that were split on soft (wood, bone) anvils.

Find No. 3 of 2020 is the lower part of the diaphysis of the tibia of a small seal (Fig. 10). The proximal and distal ends are missing. This item represents the remains of a fairly long bone (about 1/4 of its total length). The smallest width of the diaphysis is 12.2 mm. The approximate dimensions and the slenderness index of the diaphysis allow us to make a preliminary identification of the bone as *Cryptophoca maeotica*.

The surface of this fragment of the diaphysis, as well as those described above, shows a very good state of preservation and similarity with the relief of

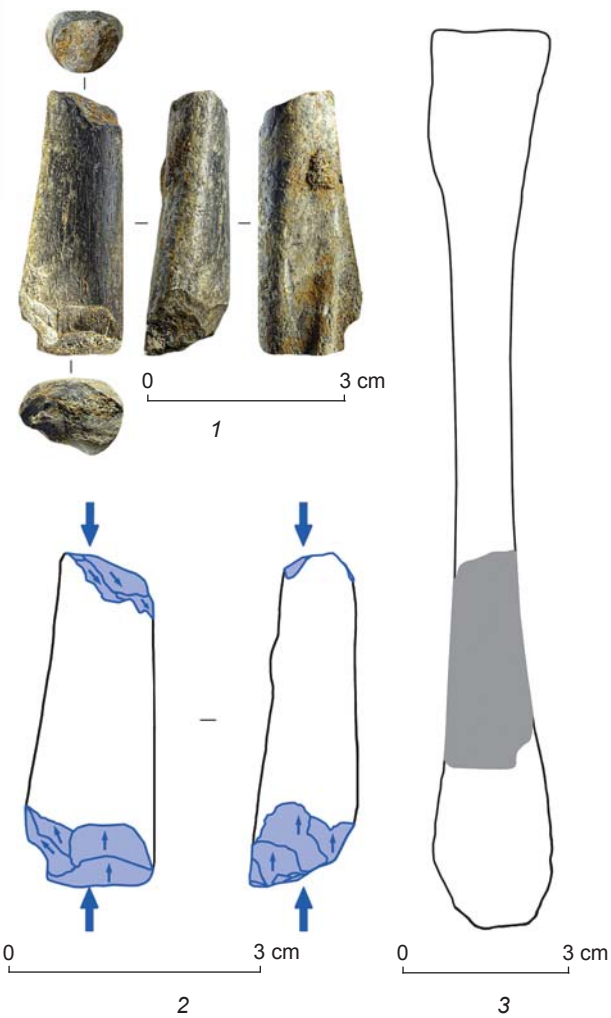


Fig. 10. Artifact made from fossilized bone No. 3 (2020) from excavation 01 at the Early Paleolithic site of Bogatyri/Sinyaya Balka. *Photos by E.Y. Girya, drawings by A.N. Trishkin.*
1 – general view; *2* – drawing of the treatment zones; *3* – drawing of location of the fragment.

the Miocene bone. No gnawing-marks or vegetation root tracks were found. There is no doubt that this fragment of fossil bone and the two fragments of seal humerus bones mentioned above were of common origin. Both ends of the product bear negative scars of flaking, the morphology of which corresponds to counter-strike flaking technique. One of the ends is formed by the negative scar of the transverse fracture, the other shows signs of bilateral linear damage, similar to that in *pieces esquilles*. That is, despite the distinctions in shape in general, this fragment of the fossil bone is similar in flaking pattern to the two items described above.

Thus, all three processed Miocene animal bones were found in the same stratigraphic and planigraphic context (see Figs. 4, 5). They occurred in sandy layer 3 in the zone of contact between the bone-bearing lens (layer 4) and the enclosing sands (see Fig. 3). All the artifacts (bones 1–3) were found in cultural deposits in association with stone tools, and bones of elephants and elasmotheres.

For all three bones, we exclude the possibility of appearance of traces of knapping as a result of their occurrence in the cultural layer. All surfaces of the negative scars are relatively "fresh", undamaged, and unrounded; there are also no traces of damage in the form of surface wear, grinding, or rounding of the ridges. The edges of the scars are sharp, without traces of damage and rounding.

Discussion

During the operation of this hunting camp or butchering site, it might not have been easy to find raw materials for the manufacture of stone tools. According to the results from many years of excavations, three types of raw materials were used. The main material was silicified dolomite represented by fragments of various shapes and sizes in coastal outcrops.

We have good reason to believe that bones of large animals, which became tools through knapping, were also used as raw materials at the site. Solitary fragments of diaphyses of tubular bones from the excavation show poorly preserved signs resembling the negative scars of bifacial working. N.K. Vereshchagin also reported processed bones of ungulates from the chronologically similar Tsimbal site (village of Sennoy, Taman Peninsula) (see Fig. 1), which contained numerous osteological remains of animals of the Taman faunal complex (Formozov, 1965). However, we believe that the available information is still insufficient for a convincing interpretation of the discussed items because of the very poor state of preservation of the bone-tissue, as well as the difficulty of clearing the bones and their fragments in the cemented deposits of the Bogatyri/Sinyaya Balka site.

The third type of raw material for the manufacture of tools was likely fossilized seal bones. It was small, awkwardly shaped, but also the hardest isotropic material available at the site. The small size of these implements is not something special in the industry in question. Along with massive and large tools, small products are also present (Kulakov, 2018a, b; Kulakov, Timonina, Titov, 2017; Kulakov, 2019b).

Prehistoric *Homo* picked up the fossilized seal bones on the shore and processed them like stones, with the help of various technical operations.

Bone No. 1 is the most interesting specimen; it was designed as a point. The artisan skillfully used the edge of the bone's fracture on the left side of the working edge. The right side was retouched more carefully than the left, possibly to make it even and give symmetry to the edge of the tool. At the final stage of processing, the working element—the point—was fashioned almost in the middle of the cutting edge with a small retouched notch (see Fig. 8, *1*). Apparently, such a treatment of fossilized bones was an intentional act. The lithic industry of the Bogatyri/Sinyaya Balka site contains a numerous category of points—one of the most important components of the set of so-called light-duty tools (see *Table*). Various types of stone points (side- and end-scrapers) dominate in the toolkit of the main cultural layers 3 and 4 (Kulakov, 2018b, c; Kulakov, Timonina, Titov, 2017; Kulakov, 2019b). The category of points in the Early Paleolithic "Bogatyri" industry comprises items of various morphology and size, the common feature of which is a special morphological element—a point (bec, borer, etc.), i.e. a sharp protrusion that was formed by a combination of retouch and small encoches, and was fashioned on any suitable area of the original blank (jointing, spall). Therefore, the points of the Bogatyri/Sinyaya Balka Early Paleolithic industry are not exactly what is meant by the point tool-type in the industries of the Upper Paleolithic, Mesolithic, and Neolithic (Vasiliev et al., 2007: 163–165). It would be interesting to analyze these morphological elements from the point of view of their purpose as "working elements" (Korobkov, Mansurov, 1972), but, unfortunately, it is almost impossible to conduct a microtraceological analysis of stone products from the Early Paleolithic Taman industries owing to the very poor state of preservation of their surfaces. As for the bone point in question, it seems that the situation was as follows: the artisan made a tool from a fossilized bone and, perhaps, even tried it, but the product did not suit him for some reason, and was discarded.

In terms of morphology, the point on a fossilized bone is quite similar to the lithic points from the collection: a stone point on a flake, found in sq. 63/3 in 2011, shows the same reduction sequence (see Fig. 8, *2*). The natural fracture surface was preserved on the right side of the transverse edge of the flake, while on the left half, a

notch was fashioned through a series of small removals and retouch, which formed a double point in the middle of the transverse edge and on the left corner of the blank.

Conclusions

Artifacts made from fossilized bones of Miocene marine animals found in layer 3 of the Early Paleolithic site Bogatyri/Sinyaya Balka may indicate that the ancient *Homo* used as raw materials not only stone (silicified dolomite), which is abundant in the area of the site, but also animal bones. It is quite probable that the ancient artisans processed and used the bones of contemporary animals. The availability of fossilized animal bones in the area made it possible for the ancient humans to master a new type of raw material in tool manufacturing.

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Paleoenvironmental Conditions of Neanderthal Habitation in the Altai: Chagyrskaya and Okladnikov Caves

We explore the environments of the Sibiryachikha Neanderthals, who had migrated to the Altai at the end of MIS 4. Given that the territory was already populated by Denisovans, the key question is whether the choice of habitat was random (i.e., the immigrants occupied vacant ecological niches) or motivated by other factors. On the basis of published results relating to the study of small-mammal fauna and pollen analysis, the environments of Chagyrskaya and Okladnikov Caves during the Neanderthal habitation are reconstructed. Species of small mammals are viewed as biome members. To reconstruct the episodic transfer of mammalian remains between stratigraphic units, we used ordination statistics and compared the results with those of micromorphological and stratigraphic analyses of Chagyrskaya Cave. It was found that late Neanderthals of the Altai lived in similar environments, dominated by steppe and forest steppe landscapes. The choice of caves for habitation depended on several factors, the key ones being the availability of game and high-quality raw material for manufacturing tools. On the basis of the statistical analysis of small-mammal fauna and the stratigraphic and micromorphological analyses, we conclude that post-sedimentation processes in caves can include vertical transfer of animal remains, affecting environmental reconstructions.

Keywords: *Altai, Paleolithic, statistical analysis, small mammals, environmental reconstruction.*

Introduction

In recent years, it has been proven that there were several waves of Neanderthal migration to the Altai in the Pleistocene. The late European Neanderthals migrated to the area at the end of MIS 4 and probably did not contact with first-wave Neanderthals. The late European Neanderthals practiced original material culture, which underwent almost no changes during the transcontinental migration (Slon et al., 2018;

Kolobova et al., 2020b; Vernot et al., 2021). New evidence suggests that the second-wave Neanderthals arrived to the territory inhabited by Denisovans, and occupied a certain ecological niche for about 20,000 years. In this context, issues concerning the subsistence strategies of new hominins in the settled area are of great relevance. Of particular importance are the issues of adaptation of the late European Neanderthals to the mosaic landscape and paleoecological conditions of the Altai Mountains.

Today, only two cave sites belonging to the Sibiryachikha techno-complex, which is the easternmost manifestation of the Micoquian, are known: Chagyrskaya and Okladnikov (Derevianko et al., 2013). Paleoecological reconstructions have already been made on the basis of the data on the Neanderthal environmental conditions in Chagyrskaya Cave; such data on the population from Okladnikov Cave are scarce.

This paper proposes comprehensive paleoreconstructions of the habitats of the late Altai Neanderthals from both caves, based on the data on small-mammal faunal communities and published results of biological analyses. Both caves are located in the low Altai Mountains. The same altitudinal belts are characterized by similar vegetation and faunal complexes, suggesting exploitation of the same range of natural resources by the late Neanderthals. Small mammals, in turn, reflect the paleoenvironments in the immediate vicinity of the sites; this provides the good ground for direct correlations between the sites under study.

The new results, on the one hand, complement the published data on the pollen analysis and the large fauna of Chagyrskaya Cave (Rudaya et al., 2017), but, on the other hand, reveal certain contradictions. For example, according to pollen analysis, landscapes near Chagyrskaya Cave, during the accumulation of layers 5 and 6, were characterized by formation of the steppe ecozone, while during the accumulation of layer 7, they were dominated by taiga. However, reconstructions based on theriological data do not confirm this. The ambiguity of the conclusions derived from various biological methods in the study of Chagyrskaya Cave requires a complex interpretation; so we involved data from detailed stratigraphic and micro-morphological analyses of the soft sediments of Chagyrskaya Cave, which showed the complexity of sedimentation and post-depositional processes in karst cavities, undoubtedly affecting the results of employed biological methods.

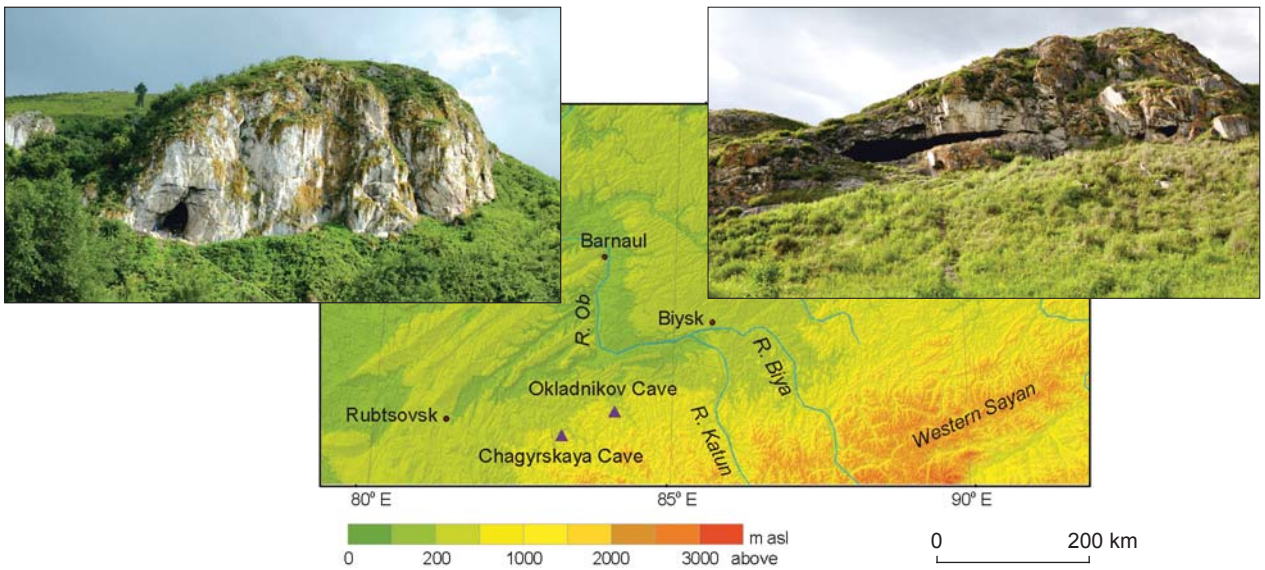
Material and methods

The osteological collection of Chagyrskaya Cave has been obtained using traditional methods. After being washed on sieves and dried, the bone remains were picked out from the small rock fraction. The material was identified with the aid of an MBS-10 binocular magnifying glass, using a micrometer eyepiece. For comparisons, collections of small mammals from the Borissiak Paleontological Institute of the Russian Academy of Sciences and the Zoological Museum of the Lomonosov Moscow State University were used. The derived data were processed in Excel. When analyzing the faunal composition, the percentage ratio for each species in the layer of the total amount of identifiable remains was determined; the minimum number of individuals was not determined, because it had been previously shown that when using these two techniques, the quantitative ratio between species in the layer is constant (Ivleva, 1990). In order to compare the fossil communities of small mammals from the two caves, ecological groups were identified: inhabitants of the open spaces—steppes, forest-steppes, semi-deserts; and inhabitants of closed spaces—forests; inter-zonal, semi-aquatic, and mountain-steppe species. The bats were not considered in this analysis by N.G. Ivleva. In order to make a correct comparison, they were also not taken into account in the paleoreconstructions.

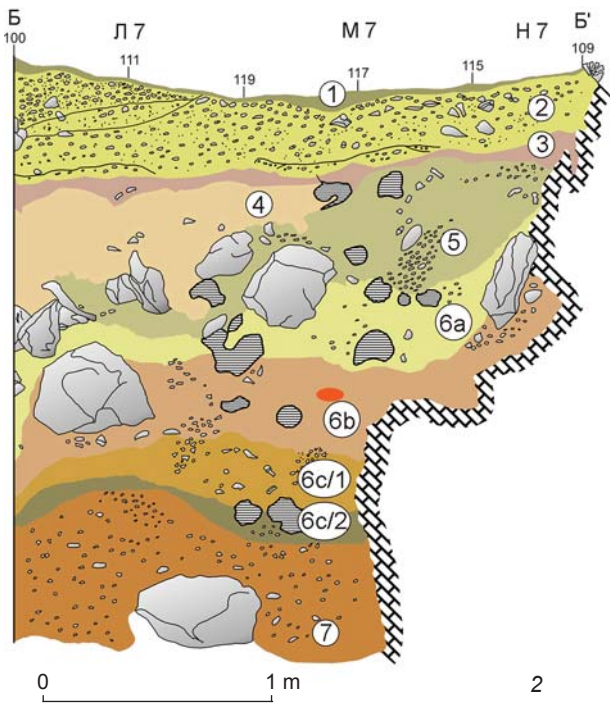
The composition of small-mammal communities from various stratigraphic units was studied using multivariate ordination methods. In cases where a significant number of variables were analyzed across multiple samples, non-metric multidimensional scaling (NMDS) was applied. In order to compare paleoecological conditions, biome compositions by biotope were determined through discriminant analysis (LDA). All statistical tests were performed in the PAST software (Hammer, Harper, Ryan, 2001).

Description of sites

Chagyrskaya Cave is situated on the left bank of the Charysh River, in the the Tigirek Ridge branch, in the northwestern Altai (Fig. 1, *1*). The cave faces north and is located 353 m above sea level and 19 m above the river. The cave is a key-site of the Sibiryachikha variant in the Altai Middle Paleolithic, which also includes Okladnikov Cave (Kolobova et al., 2019a). Chagyrskaya Cave is



1



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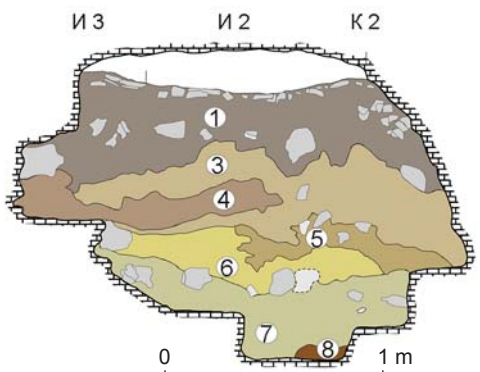


3

Fig. 1. Location (*1*) and stratigraphy of Chagyrskaya (*2*) and Okladnikov (*3*) Caves.

interpreted as a long-term camp of the Neanderthals for the consumption of hunting prey (Kolobova et al., 2019b). The hunting objects were bison and horse, which probably constituted the basis of the protein diet of the Neanderthals (Salazar-García et al., 2021). The artifacts found in the cave represent a practically complete cycle of lithic processing (Shalagina et al., 2020), as well as a complete chain of manufacturing various bone tools (Baumann et al., 2020); among which bone retouchers prevail (Kolobova et al., 2020a: 89).

Optically stimulated luminescence (OSL) dating technique, with measurement of single feldspar grains, allowed us to establish that the Neanderthals lived in the cave (layers 5–6d) for a relatively short period ranging from 59 to 49 ka BP. Layer 7, which shows no traces of ancient human habitation, is dated to 314 ka BP (Kolobova et al., 2020b).

Several stratigraphic units of loose sediments have been established at Chagyrskaya Cave. The layers are numbered from top to bottom of the profile, from the youngest to the oldest. The stratigraphy (Fig. 1, *2*) was described by M. Krajcarz, and is based on the published data (Kolobova et al., 2019a, 2020b). The stratigraphic sequence of Chagyrskaya Cave consists of eight layers, where layer 8 is red clay accumulated in depressions in the bed rock. Layers 1 to 4 have been attributed to the Holocene, layer 5 and below to the Pleistocene.

Layer 1 is gray and dark gray non-carbonate loamy sand, slightly compacted, with considerable inclusions of small river-pebbles. This layer is the top of layer 2, altered as a result of organic-matter influx and human trampling.

Layer 2 is yellowish-brown loamy sand, similar to layer 3; it contains large quantities of pebble material. Solifluction was the main sedimentation process.

Layer 3 is grayish-brown loamy sand with a large quantity of river-pebbles. Pebbles and sand were most likely shifted into the cavity through karst chimneys in the ceiling of the back chamber from ancient river-terraces on the slope above the cave by colluvial processes. Abundant Bronze Age artifacts and the remains of fireplaces in this layer indicate the cultural features of the deposits. Numerous rodent holes were noted during excavation; the holes contain sediments from layer 3, penetrating the underlying deposits (layers 4, 5) and the upper part of layer 6a. The sediments in the holes and the soft deposits of the layers containing these holes were excavated separately.

Layer 4 is a variation of layer 5a, with a more grayish color.

Layer 5 is yellowish carbonaceous silt-deposits. This is a complex of strata comprising two types of deposit: 5a is a colluvial filling consisting of loess-like silt, with occasional rounded pebbles and angular limestone rubble, deposited in erosional channels; 5b is coarse limestone debris, usually without loose filling, which indicates very rapid accumulation. Type 5b sediments are the result of seismic events preceded by intense mechanical weathering (frost impact).

Layers 6b and 6a are brown and orange carbonaceous silt with occasional coarse limestone fragments, bone fragments, stone artifacts, and river-pebbles. The layers were established during archaeological excavations in 2007–2015. These sediments form a complex colluvial series of more than two intervening sedimentary units. These should rather be regarded as lithological types within this series. Type 6a is more clayey, orange, similar to layer 7. Type 6b is more silty, slightly denser, less porous, grayish brown, and similar to sub-layer 6c/1. The lower boundary of the series is erosional.

Layer 6c is gray carbonaceous silty loam with occasional small fluvial rounded pebbles, numerous bone fragments, Middle Paleolithic artifacts, and few limestone fragments. The sub-layer has a complex structure, and can be subdivided into two smaller units, 6c/1 and 6c/2. The lower subdivision 6c/2 is loess-like sediment with traces of pedogenesis. The layer is cryoturbated. Cryoturbation occurred after the deposition of layer 6a (i.e. much later than occupation of the cave by the Neanderthals). The deposits of 6c and underlying layers were not mixed with those of the overlying layers. Sub-layer 6c/2 contains the greatest amount of remains of the Neanderthal material culture in Chagyrskaya Cave.

Layer 6d is reddish-brown loam with fine weathered limestone debris, few bones, and small river-pebbles. It contains sediments from layer 7 mixed with soil from layer 6c redeposited vertically due to permafrost processes.

Layer 7 is red-brown clayey loam with quartz grains and small, chemically weathered fragments of limestone and river-pebbles. The lenses of greenish silt have been noted. The red clay is typical residual sediment (terra rossa type) accumulated as a result of limestone-karst dissolution.

Remains of the Neanderthal material culture have been noted in the bottom of layer 5, as well as in layers 6a, 6b, 6c/1, and 6c/2. According to stratigraphic and micromorphological analyses, layers 6c/1 and 6c/2 are undisturbed. In the other layers, archaeological material has been redeposited as a result of colluvium shifting from sub-layers 6c/1 and 6c/2 in the rear part of the cave (Kolobova et al., 2020b).

Okladnikov Cave is located in the Anui River valley, on the left bank of the Sibiryachikha River (see Figure 1, *1*). It is located at an altitude of 368 m above sea level, and is a karst cavity with a system of branching galleries, grottoes, and chambers; stratigraphic sequences are specific for each area (Derevianko, Markin, 1992). All radiometric dates available for Okladnikov Cave (including dates of the youngest layer 1) are in the age range 37–44 ka BP, which corresponds to the Karga interstadial, or to MIS 3 according to the SPECMAP scale (Imbrie et al., 1984) and the refined stack scale from low latitude oceanic wells ODP 677+MD900963 (Bassinot et al., 1994).

The site was discovered by A.P. Derevianko and V.I. Molodin in 1984, and has been excavated by A.P. Derevianko and S.V. Markin for four years. The archaeological material was associated with stratigraphic units 1–3, 6, 7.

Nine layers have been identified in the cave, but the layers are discontinuous and have not been established in all galleries and chambers (Fig. 1, *3*). Layer 1 is loam saturated with limestone debris and solitary shale and sandstone pieces. Layer 2 under the rock-shelter includes single fragments of limestone, in gallery 2 fine debris. Layer 3 is brownish gray loam with varied clastic material in different parts of the

cave. Layer 4 contains solitary rounded fragments of limestone. Layer 5 contains large fragments of limestone. Layer 6 is dark brown loam; it was noted only in the grotto. Layer 7 is reddish brown loam with weathered and soft shale and sandstone. This layer contains rounded pieces of limestone, which were possibly transported with water during the sediment formation. Layer 8 consists of reddish-yellow clays; in the galleries it contains coarse pieces of shale, sandstone, and small quartz fragments. Layer 9 is a thin stratified stratum of sandy loam recorded over a small area under a rock-shelter.

There are no data on post-depositional processes in the cave, as no detailed stratigraphic and micromorphological studies have been carried out there.

Both caves were inhabited during the period from the late MIS 4 to the early MIS 3 by the Neanderthals genetically close to late European Neanderthals (Veront et al., 2021). This Neanderthal population produced the Micoquian lithic industry characterized by radial and orthogonal core reduction and plano-convex bifaces. The toolkit is dominated by side-scrapers including simple and convergent forms, retouched points, plano-convex bifacial side-scrapers, backed knives (Keilmesser), and truncated-faceted tools. The Neanderthals from both caves used almost identical sets of raw material (about 25 types), of which jasperoids of the Zasurye Formation were of the highest quality—they were used in manufacturing formal tools of the plano-convex biface type and convergent scrapers (Derevianko et al., 2015; Shalagina, Krivoshapkin, Kolobova, 2015).

Previous studies of Chagyrskaya and Okladnikov Caves make it possible to reconstruct the landscapes in this part of the Altai during the Pleistocene.

The Chagyrskaya fossil faunal collection, including bones of large (Vasiliev, 2013) and small mammals (Derevianko et al., 2013), has been analyzed; pollen analysis has been conducted (Rudaya et al., 2017). On the basis of the derived information, a detailed reconstruction of Pleistocene environments was proposed. Layer 5 was accumulated under the conditions of the aridization of climate; forest and forest-steppe stations with tundra elements prevailed. Judging by the reduction in the number of forest species and the increase in forest-steppe and steppe species, layer 6a was transitional between layers 5 and 6b, the latter being dominated exclusively by steppe taxons. Layer 6c was formed in an environment dominated by open biotopes, although arboreal vegetation occurred during the early periods of its accumulation. All subdivisions of layer 6 correspond to a moderately arid climate. The accumulation of layer 7 is associated with the spread of periglacial landscapes. Cold and severe climate is reconstructed for this layer.

The pollen, theriological, and malacological analytical data suggest the following paleoreconstruction for Okladnikov Cave. Layers 4 and 5 were not considered in the reconstruction, as they produce no biological objects. Layer 1 was formed in a humid and cold climate, with forest-steppe zones predominating among the landscapes. Layer 2 was characterized by a drier and warmer climate than during the formation of layer 1, and mountain-steppe and forest-steppe stations were common. For layer 3, warm and dry conditions were common, with steppe dominating everywhere. Layer 6 was characterized by steppe with forbs-wormwood vegetation, and the climate was dry and warm. Layer 7 was accumulated during the spread of mixed-grass-meadow steppe and forest-steppe ecozones under humid and warm climatic conditions.

Results

Over several field seasons (2008, 2009, 2015–2019, 2021), a rich collection of bones of the small vertebrates of Chagyrskaya Cave was assembled. In total, over 14,000 bone elements were identified, of which over 8000 fossils were identifiable as to genus and species. The osteological remains discovered in 2015–2021 do not contradict the previous data; they complement and confirm the assumptions made before.

Bones from Chagyrskaya Cave show varying degrees of preservation. Holocene remains are white or cream-colored, Pleistocene remains are light yellow and light brown. Among the Pleistocene finds, isolated light-colored bones and teeth occur; this was noted by S.K. Vasiliev (2013). Some of the bones show traces of gastric juice, indicating that it was included in the taphocoenosis composition from the pellets.

38 small mammals belonging to four orders (Chiroptera, Lipotiphla, Lagomorpha, and Rodentia) were identified up to species. In general, the composition of the Chagyrskaya small-mammal faunal remains is similar to that of the fossil faunal assemblages from other sites in the northwestern Altai.

A half of the small-mammal bones were recovered from the Holocene layers. Among the Pleistocene deposits, the greatest amount of bone remains were associated with layers 5 and 6a. Layers 6b and 6c

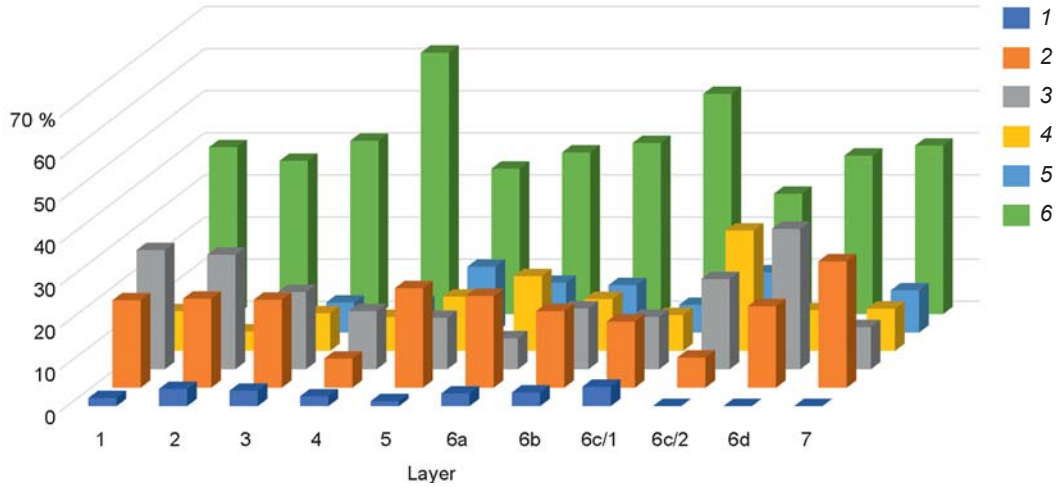


Fig. 2. Ratio of ecological groups of small mammals of Chagyrskaya Cave by layers.
1 – semi-aquatic; *2* – mountain-steppe; *3* – forest; *4* – steppe; *5* – semi-desert; *6* – forest-steppe.

produced ten times less bones, which may be due to the periodicity of human habitation in the cave. Layers 6b and 6c yielded the greatest amount of stone tools and Neanderthal fossils (Vernot et al., 2021). The large-mammal fossil collections show differences in the taphonomy of these layers (Vasiliev, 2013; Mezhdistsiplinarnyie issledovaniya…, 2018; Rudaya et al., 2017). The distribution of materials by ecological groups shows that the fauna of Chagyrskaya Cave is dominated by species typical for open spaces—steppe, forest-steppe, and meadows, while the number of forest species is insignificant (Fig. 2, 3). Occurrences of mountain-steppe species (rock-voles and pikas) indicate the formation of a specific mosaic fauna associated with latitudinal zones and vertical zonality.

The analysis of the fossils from Chagyrskaya Cave was made earlier (Ivleva, 1990). It has been shown that open spaces expanded upwards the profile, from layer 7 to layer 1 (Fig. 4). Throughout the whole sequence, a mosaic type of landscape with a decrease in the afforested area and a predominance of the forest-steppe zone is observed (Ibid.: 92). The semi-aquatic species (beaver and water vole) indicate the humidity level of climate; fluctuations of their population point to climatic changes. Layers 2 and 6 were the "driest" (Ibid.).

In the Pleistocene layers of Chagyrskaya Cave, few identifiable bone remains were found. According to stratigraphic and

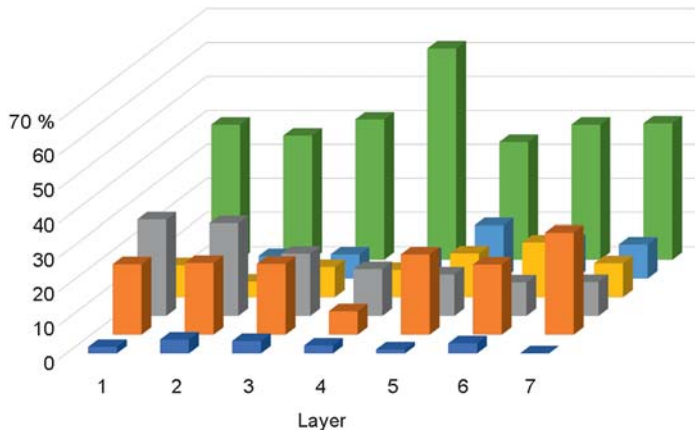


Fig. 3. The ratio of ecological groups of small mammals of Chagyrskaya Cave by layers (layers 6a–6c/2 combined into one). Legend same as on Fig. 2.

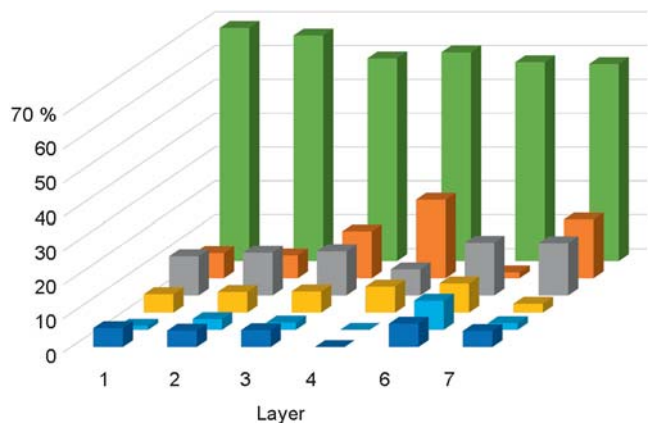


Fig. 4. Ratio of ecological groups of small mammals of Okladnikov Cave by layers. Legend same as on Fig. 2.

micromorphological analytical data, layer 6c/1 is considered undisturbed and contains faunal material; hence, its animal fossil composition was regarded as a reference for reconstructing the paleoecological conditions and the impact of post-sedimentary processes.

The small-mammal compositions of the Holocene, Late Pleistocene, and Middle Pleistocene stratigraphic units of Chagyrskaya (Table 1) and Okladnikov (Table 2) caves have been compared. First of all, the faunal composition from layers 6c/1 and 6c/2 of Chagyrskaya Cave was considered, as the least disturbed by post-sedimentation processes. In addition, the likelihood of shifting small-mammal bone remains from one layer to another as a result of colluvial and permafrost processes was assessed.

Statistical ordination methods were used to test the assumption that the composition of small mammals reflected the relevant paleoenviroments. Because the available data include a great number of variables (31) and a small number of samples (17), non-metric multidimensional scaling was conducted. The scaling results are shown on the diagram (Fig. 5, stress level 0.02).

Table 1. **Bone remains of mammals of various species in the deposits of Chagyrskaya Cave, spec.**

Biotopes	Таксон	Layer										
		1	2	3	5	6	6a	6b	6c/1	6c/2	6d	7
Semi-desert	*Alactagulus* sp.	–	–	–	1	–	1	–	–	–	–	–
	Allactaga sp.	–	1	2	1	–	5	–	–	–	–	–
	Ellobius talpinus	–	–	2	2	–	2	–	–	–	–	1
	Lagurus lagurus	–	51	83	184	1	112	3	–	–	7	1
	Eolagurus luteus	–	7	8	19	–	24	1	–	–	–	–
Steppe	*Lepus* sp.	1	4	33	20	–	15	–	–	–	–	–
	Spermophilus sp.	3	25	72	125	–	190	6	–	–	7	2
	Marmota sp.	–	1	2	8	–	15	–	–	–	–	–
	Cricetulus migratorius	–	5	7	20	–	20	–	–	–	2	–
	Allocricetulus eversmanni	1	6	5	4	1	1	–	–	–	–	–
Forest-steppe	*Myospalax myospalax*	7	98	83	126	3	206	4	4	1	5	1
	Cricetus cricetus	3	51	48	3	–	4	1	–	–	–	–
	Lasiopodomys gregalis	6	103	311	210	–	242	11	8	–	22	3
	Microtus oeconomus	2	45	76	72	–	25	2	2	–	7	1
	Microtus arvalis	3	20	19	4	–	4	–	–	–	1	1
	Sicista sp.	–	7	2	1	–	–	–	–	–	–	–
Forest	*Asioscalops altaica*	–	13	29	28	1	65	5	–	–	10	1
	Crocidura sp.	1	7		1	–	–	–	–	–	–	–
	Sorex sp.	2	32	17	10	–	–	1	–	–	1	1
	Sciurus vulgaris	–	1	–	4	–	2	–	–	–	–	1
	Eutamias sibiricus	1	–	–	–	–	–	–	–	–	–	–
	Pteromys volans	–	–	–	–	–	–	1	–	–	–	–
	Apodemus sp.	2	14	7	4	–	–	–	–	–	–	–
	Clethrionomys sp.	9	162	176	116	–	19	7	1	3	17	–
	Myopus/*Lemmus*	–	1	3	5	–	1	–	–	–	–	1
	Microtus agrestis	–	12	15	2	–	–	1	–	–	3	–
Semi-aquatic	*Arvicola terrestris*	1	36	49	14	–	36	2	1	–	–	1
Mountain-steppe	*Alticola* sp.	11	177	237	320	–	267	15	4	–	15	4
	Ochotona sp.	–	11	47	15	–	19	2	1	–	3	–

Table 2. **Bone remains of mammals of various species in the deposits of Chagyrskaya Cave, spec. (Ivleva, 1990)**

Biotopes	Taxon	Layer					
		1	2	3	4	6	7
Semi-desert	*Erinacea* sp.	0	0	1	0	0	0
	Allactaga sp.	1	1	3	0	0	2
	Ellobius sp.	5	10	19	0	1	2
	Eolagurus sp.	3	4	10	0	4	9
Steppe	*Lepus tolai*	1	0	3	0	0	2
	Spermophilus sp.	16	16	43	0	3	9
	Marmota sp.	10	4	14	0	1	3
	Cricetulus sp.	14	9	37	1	1	3
Forest-steppe	*Myospalax myospalax*	197	44	136	4	12	31
	Cricetus cricetus	169	32	69	2	3	19
	Lasiopodomys gregalis	26	109	257	0	9	132
	Microtus oeconomus	40	44	218	2	7	137
	Microtus arvalis-agrestis	85	87	245	0	3	62
Forest	*Asioscalops altaica*	12	7	47	0	1	8
	Sorex sp.	15	10	15	0	3	9
	Crocidura sp.	14	7	22	0	0	4
	Pteromys volans	3	2	2	0	0	0
	Clethrionomys	24	20	90	1	4	52
	Myopus sp.	1	0	3	0	0	0
	Microtus agrestis	18	14	23	0	1	28
Inter-zonal	*Castor fiber*	2	3	1	0	0	1
Semi-aquatic	*Arvicola terrestris*	40	20	76	0	4	30
Mountain-steppe	*Alticola* sp.	42	25	169	2	0	99
	Ochotona sp.	14	7	45	1	1	14

The composition of small-mammal bones varies from layer to layer. The layers with the highest biodiversity are located in the right portion of the graph, the layers with the lowest biodiversity are in the left part. The latter cluster includes the smallest complexes from modern layer 1 and layer 4 of Chagyrskaya Cave. The composition of small mammals from layer 7 of this cave, corresponding to the Middle Pleistocene and tundra landscapes, almost completely coincides with that from overlying layers 6c/2 and 6c/1. This may be due to shifting the faunal remains through frost processes and the poor preservation of the material inside the layer. Excavations in layer 7 revealed only bones of large mammals from overlying layer 6c/2.

The composition of small mammals from layer 6d, which was formed due to freeze fracturing of the sediments in layers 6c/2 and 7, almost completely corresponds to that of layer 6c/2. This confirms the conclusions drawn from the composition of the bone material from layer 7: it was shifted from layer 6c/2 and contained poorly preserved remains. The sparse composition of small mammals from undisturbed layers 6c/2 and 6c/1 can be a result of the taphonomic processes in these stratigraphic units. Nevertheless, the similarities that have been identified between these layers suggest that the deposits were formed under similar paleoenvironmental conditions and that materials were transferred from these layers to neighboring ones.

The similarity in the composition of small mammals from layer 6b of colluvial genesis and from undisturbed layers 6c/2 and 6c/1 indicates that the remains of small mammals were transferred from these layers.

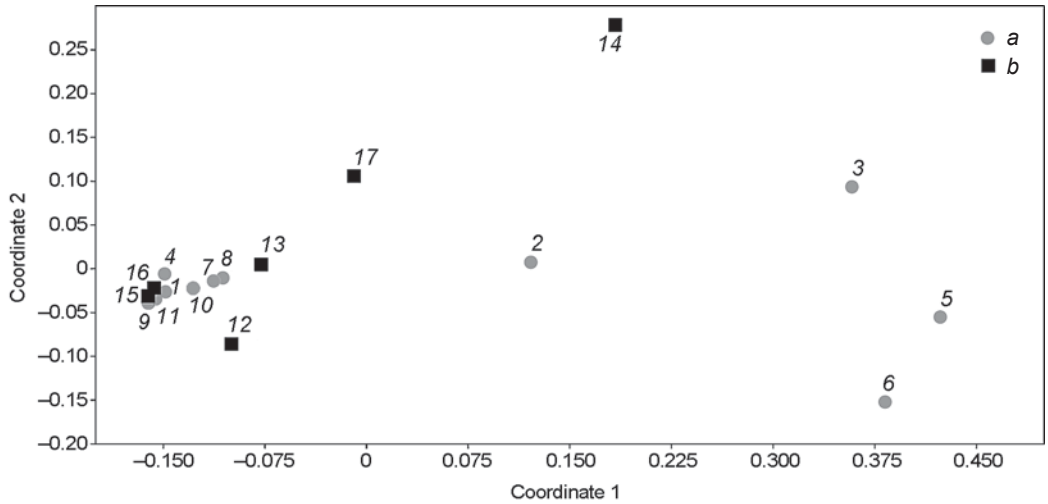
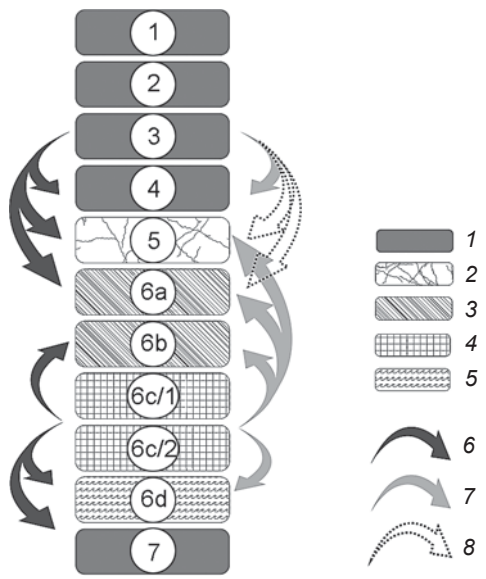


Fig. 5. Non-metric multidimensional scaling of the small fauna composition from stratigraphic sequences of Chagyrskaya (*a*) and Okladnikov (*b*) Caves.
1 – layer 1; *2* – layer 2; *3* – layer 3; *4* – layer 4; *5* – layer 5; *6* – layer 6a; *7* – layer 6b; *8* – layer 6c/1; *9* – layer 6c/2; *10* – layer 6d; *11* – layer 7; *12* – layer 1; *13* – layer 2; *14* – layer 3; *15* – layer 4; *16* – layer 6; *17* – layer 7.

The situation in Pleistocene layers 6a (colluvial genesis) and 5 (complex genesis including seismic and colluvial processes of varying degrees of intensity) is completely different. Forest-steppe environment was reconstructed for layer 5, and dry arid steppe landscapes were typical for layer 6a. The small-mammal faunal assemblages from these layers are similar in composition, but differ significantly from the bone collection of the underlying layers (6c/2, 6c/1, 6b). Layers 5 and 6a contain remains of great biodiversity, which brings them closer in composition to Holocene layer 3 containing material remains of the Bronze Age Afanasyevo culture.



The great part of small-mammal remains may have been transferred to layer 6a from overlying layers 3 and 5, rather than from underlying layers 6c/2, 6c/1, as compared to the case with layer 6b. A small proportion of small-mammal remains may nevertheless have been transferred from the underlying layers together with the remains of the artifacts of late Neanderthals. These assumptions are supported by the high degree of biodiversity of the mammal composition and the similarity of the composition of Holocene layer 3 with that of layers 5 and 6a.

Okladnikov Cave shows significant biodiversity in Pleistocene layers 2, 3, and 7. However, the composition of the small-mammal remains from layers 4 and 6 is almost identical to that from layers 6c/2 and 6c/1 of Chagyrskaya Cave.

A diagram was constructed on the basis of the results of statistical analysis of the composition of small-mammal fauna from the stratigraphic units of Chagyrskaya Cave and the results of stratigraphic and micro-morphological analyses. The directions of transfer of bone remains correspond almost entirely with those of soft sediments (Fig. 6).

In order to ordinate and correlate the paleoenvironments of Altai Neanderthals, a

Fig. 6. Scheme of transfer of archaeological and osteological materials in the deposits of Chagyrskaya Cave.
1 – lithological layer; *2* – lithological layer of colluvial and seismic genesis; *3* – lithological layer of colluvial genesis; *4* – lithological layer *in situ*; *5* – lithological layer of permafrost genesis; *6* – movement of small fauna; *7* – movement of Neanderthal material-culture remains; *8* – movement of loose deposits as a result of rodent activities.

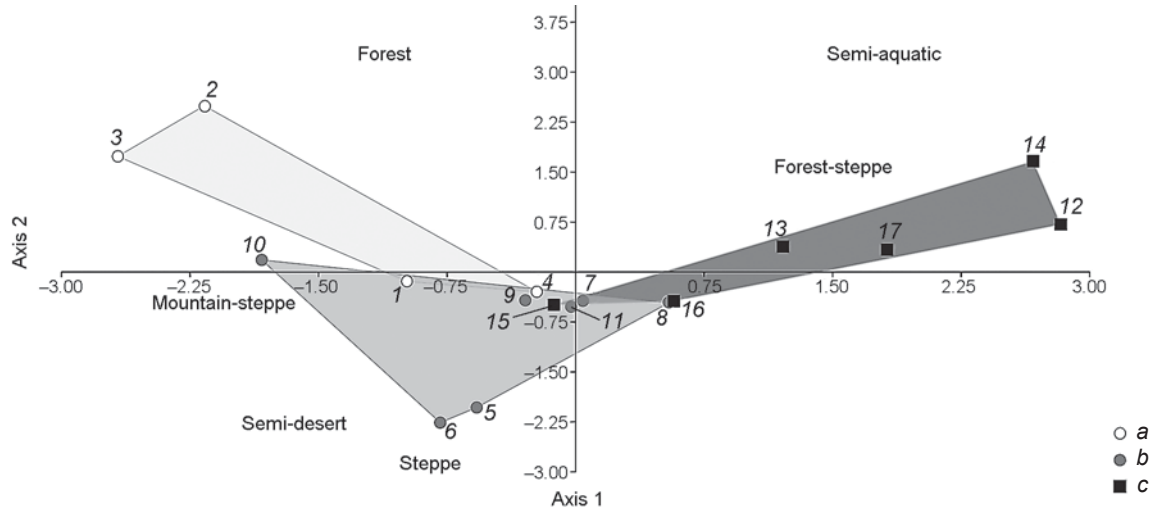


Fig. 7. Discriminant analysis of the small fauna composition in biotopes from the Holocene (*a*) and Pleistocene (*b*) deposits of Chagyrskaya Cave and Pleistocene deposits (*c*) of Okladnikov Cave.

discriminant analysis based on biotope data was carried out. To reduce variables, the remains of small mammals were grouped by biotopes (see Tables 1, 2). For the analysis, the samples were subdivided into three groups, which included the Pleistocene and Holocene layers of Chagyrskaya Cave and the lithological layers of Okladnikov Cave.

The discriminant graph, which establishes correlations of various Middle Paleolithic layers belonging to different biotopes and interrelations between layer complexes, shows that the Pleistocene deposits of Chagyrskaya Cave were accumulated under the conditions of predominance of steppe-forest-steppe landscapes, and the Holocene deposits under the conditions dominated by forest-steppe-forest landscapes (Fig. 7). Soft sediments in Okladnikov Cave were formed under the conditions dominated by forest-steppe and semi-aquatic fauna.

Discussion

The Holocene layers of Chagyrskaya Cave are characterized by a high concentration of the remains of chiropterans. Six species were identified: *Eptesicus nilssonii* northern bat, *Myotis brandtii* Brandt's bat, *Myotis dasycneme* pond bat, *Myotis blythii* lesser mouse-eared bat, *Plecotus ognevi* Siberian long-eared bat, and *Murina leucogaster* greater tube-nosed bat. In the Pleistocene layers, the amount of remains is significantly lower than in the Holocene layers. In layers 6b and 6c/1, only two teeth were found. This can be explained by the fact that bat bones are fragile and poorly preserved; besides, during the period of human occupation of the cave, the chiropterans may have not used the cave for denning or wintering (Agadjanian, Serdyuk, 2005). The fauna of chiropterans is not analyzed in this article, and its use for paleoreconstructions is difficult, because, first, bats represent a rather mobile group of small mammals, and, second, the number of their remains is small. Rodent remains are the most abundant in the cave deposits, with over 30 species. Among insectivores, at least five species have been identified. The remains of duplicidentates have also been identified. For each layer of Chagyrskaya Cave, the following composition of small mammals has been determined.

Layer 1. Characterized by species occurring in the present-day Altai; no exotic species were found. The tooth morphology of the background vole species is close to that of the modern one. The overall faunal composition of this layer suggests the distribution of forest-steppe stations.

Layer 2. The faunal composition is the same as in layer 1, but includes *Lagurus lagurus* steppe lemming, *Eolagurus luteus* yellow steppe lemming, and a lemming of the *Lemmus* genus. The first two species inhabit steppes and semi-deserts, while the third is characteristic of tundra associations. All the three species are markers of "mixed" faunas (Vangengeim, 1977; Gromov, 1948; Markov et al., 1965; Chersky, 1891). Holocene refugia of large mammals are well known (Kovacs, 2011; Vartanyan, 2004; Stuart et al., 2004; Vereshchagin, 1988); small mammals, unlike large ones, are more resistant to environmental changes

(Popova, 2014). During the accumulation of layer 2, a tundra-steppe biocoenosis may have persisted for some time in the vicinity of the cave. The pollen spectrum is dominated by synanthropic plant species.

Layer 3. The faunal composition is the same as in layer 2. The forest-steppe formations dominate, but there are representatives of "mixed" periglacial faunas and wood-shrub biotopes (*Sicista* birch mouse, and forest mice of *Apodemus* genus), and *Allactaga* jerboa, which prefers semi-desert habitats. According to our statistical calculations, layer 3 is close to layers 5 and 6a in terms of biodiversity. Partial transfer of materials between layers is possible. Large mammals are represented by bison, a typical inhabitant of vast open landscapes from forest-steppe to tundra steppe (Mezhdistsiplinarnyie issledovaniya…, 2018). The occurrence of remains of this artiodactyl in the area of Chagyrskaya Cave suggests that the area was a refugium for mammoth fauna in the Holocene. The pollen data for this layer indicate forest-steppe with arboreal components, which is consistent with the composition of small mammals.

Layer 4. The amount of bones is very low for the Holocene layer, the animal community is dominated by voles (narrow-skulled, common, and tundra one), while other species are rare. Judging by the composition of the small-mammal bone collection, the layer may be a buried rodent hole containing pellets of a predator (Shalabaev, 2011).

Layer 5. The small-mammal fauna is the most abundant for the Pleistocene deposits of Chagyrskaya Cave. It indicates the steppe and semi-desert biotopes during the formation of the layer. There are remains of *Allactaga* marmot and *Alactagulus* tarbagan inhabiting takyrs with dense clayey soil. Steppe lemming and *Eolagurus luteus* yellow steppe lemming are also common in such semi-deserts. Layer 5 was apparently formed under periglacial cold steppe conditions; this is evidenced by the remains of *Lemmus sibiricus* lemming. Pollen data indicate a taiga biome for this layer. Typical taiga small-mammal species are represented by few teeth and bones of squirrels; no bones of other typical forest-dwelling species were found. Squirrel remains may be associated with small forests along riverbanks, which did not play a significant role (Mezhdistsiplinarnyie issledovaniya…, 2018). The remains of forest mice attest to arboreal and shrub vegetation. Large mammals were dominated by steppe and forest-steppe species. As shown earlier, cave hyenas were involved in the formation of the large-mammal taphocoenosis (Kolobova et al., 2019b); these animals are rightfully considered unique collectors, they pick up the remains of almost the full range of medium and large-mammal fauna in their hunting territory. It is likely that humans visited the cave infrequently at this time; hence, it was also attractive to predators gathering small fauna, such as birds of prey or small polecats. In the context of our study, it is important that large predators probably dug the cave soil while making dens and thus caused some movement of the archaeological material, which may partially penetrated into the overlying or underlying layers.

Layer 6a. Like the previous layer, it reveals a large amount of bone remains. The layer is characterized by a greater number of desert and semi-desert small-mammal species than layer 5. The Siberian lemming was noted. Layers 5 and 6a were formed under different conditions. In the fauna of large mammals, the number of forest-steppe species in layer 6a is lower than in layer 5. The pollen data for this layer suggest a transition from "taiga" (layer 5) to "steppe" (layer 6b). The small-mammal fauna does not show a clear "transition". As no obvious taiga fauna was recorded in layer 5, layer 6a shows neither a reduction in the number of forest species, nor an increase in the number of steppe species. In general, the period of formation of layers 6 coincided with the period of human habitation in the cave. This explains the small number of small mammals remains: wild animals and birds avoided close proximity to humans.

Layer 6b. The amount of small-mammal remains is sparse. Neither jerboa nor wood-shrub dweller remains occurred in the layer. The fauna includes representatives of meadow and meadow-steppe biotopes (gopher, mole rat, common vole, and root vole), while the number of steppe species is insignificant. The large-mammal fauna is dominated by steppe species. The pollen data indicate an increase in cereal pollen, which is inconsistent with the data on small mammals. This can be explained by the small amount of material or other taphonomic features.

Layers 6c/1 and 6c/2. The amount of small-mammal remains is also low. The species composition is almost identical to that of layer 6b. According to statistical and micro-morphological analyses, layer 6c is the source of the formation of the taphocoenosis of layer 6b. A partial transfer of archaeological materials from the layer is possible owing to human economic activity in the cave at that time. The fauna is dominated by the remains of meadow-steppe stations; few osteological remains have been associated with the rocky habitats. Large-mammal community is dominated by steppe species. The pollen data show the reduction in the number of cereals.

Layer 6d. Small-mammal community of this layer is dominated by grey voles. The composition of the microfauna, almost entirely corresponding to that of layer 6c/2, supports geological definition that the layer was formed due to permafrost processes.

Layer 7. The amount of materials for biological analysis from this layer is negligible. Among small mammals, representatives of "mixed" periglacial fauna are noted; remains of mole vole avoiding feather-grass and sagebrush steppe were recorded. There are also species of mountain-steppe and grassland habitats. According to the mentioned data, the climate was arid. Large-mammal community is dominated by steppe species. Pollen samples attest to the taiga, steppe, and tundra biomes; these data do not correlate with the paleotheriological facts. This discrepancy is explainable by ingression of the overlying sediments, which does not contradict the results of the statistical analysis.

Data of the microtheriological analysis of finds from Okladnikov Cave indicate a predominance of forest-steppe biotopes in the cave area and warming of the climate closely before the Holocene. Remains of inhabitants of the "mixed" periglacial landscapes were also found in the cave. Four teeth of the forest lemming of *Myopus* genus were discovered (Ivleva, 1990). These lemmings inhabited various forests—spruce, fir, cedar, and mixed forests, i.e. their biotopic allocation was not the same as that of the tundra lemming. According to recent data, forest lemmings differ from the tundra ones in the third upper molar and the morphometric characteristics of other teeth (Ponomarev et al., 2011). Probably, a revision of the lemming material from Okladnikov Cave is needed to confirm or refute the occurrences of tundra components in the Okladnikov Cave area in the Pleistocene.

Discriminant analysis confirmed the results of both microtheriological analysis and multidimensional scaling, and revealed statistically significant similarities in the composition of the small-mammal fauna (Chagyrskaya Cave – layers 6c/1, 6c/2, 6b, Okladnikov Cave – layer 6). According to the results of discriminant analysis, the late Altai Neanderthals, whose traces of habitation were found in both caves, lived predominantly in forest-steppe landscapes. The significant presence of semi-aquatic species in the sediments of Okladnikov Cave may be due to the shorter distance to the river as compared to the distance from Chagyrskaya Cave to the river.

In general, the data on small mammals from the two caves indicate similar landscapes and conditions in the Karga period. According to the microtherological records, forest-steppe ecozone dominated in the low Altai Mountains for almost the entire period of sedimentation.

Conclusions

This study has shown that in the Altai in the final MIS 4–early MIS 3, late Neanderthals lived in similar paleoenvironments dominated by steppe-forest-steppe landscapes. The high proportion of semi-aquatic species in the faunal complexes of Okladnikov Cave probably attests to different hydrological regimes of the Sibiryachikha and the Charysh Rivers in the Pleistocene. Perhaps the Charysh was not as full then as it is now.

Despite the small sample-size of the two sites, it can be assumed that the choice of the late Altai Neanderthals (inhabitants of two caves in similar paleoecological conditions) could have hardly been accidental. The Neanderthals from the Micoquian populations of Central and Eastern Europe hunted a wide range of large mammals, which included almost all representatives of the mammoth fauna (Richter, 2006). In the complexes of the geographically closest Caucasus and Crimea, Neanderthals hunted predominantly large herbivores (bison, Pleistocene donkey, etc.) (Uthmeier, Chabai, 2010; Golovanova et al., 2018; Ramírez-Pedraza et al., 2020). The Sibiryachikha Neanderthals, who hunted bison and horse, likely occupied the most suitable ecological niches for this activity—caves in river valleys, which served as transit corridors for seasonal migrations of large herbivores. A similar dependence of ancient hominin adaptation strategies on habitats and migrations of Pleistocene animals has already been documented in several areas of Central and North Asia (Agadjanian, Shunkov, 2018; Khatsenovich et al., 2021; Zavala et al., 2021).

Another reason for settling in these karst cavities was probably the possibility of extracting jasperoids of the Zasurye formation and chalcedony—high-quality lithic raw materials used for making tools typical of the Sibiryachikha industries (plano-convex bifaces and convergent scrapers). The Chagyrskaya and Okladnikov Caves are the only Middle Paleolithic sites in the region that are located on outcrops of these rocks (Derevianko et al., 2015; Kolobova et al., 2019b). The dependence of choice of human settlement on the availability of high-quality lithic materials been noted exclusively for the Upper Paleolithic sites in North and Central Asia (Rybin et al., 2020).

The statistical study of the composition of the fauna of small vertebrates proved useful for comparing

complexes containing dozens of species; statistical data make it possible to draw the conclusions about post-sedimentary processes, which do not contradict the stratigraphic and micromorphological data, but complement them. It has been determined that the faunal composition of the individual layers of Chagyrskaya Cave is influenced by the state preservation of organic materials within the layer. For example, in layer 7, to which pollen data suggest taiga/tundra conditions during the sedimentation period, small mammals from the overlying stratigraphic units (layer 6c/2) were recorded, with compositions corresponding to steppe-forest-steppe landscapes. The fauna of small mammals from the colluvial layers (6b) largely coincides with that of the source layer of redeposition, confirming the assumption about transportation of not only Neanderthal cultural remains, but also fauna. The faunal composition also depends on various disturbances of the layers, especially rodent burrows from the overlying layers, even though the excavations were carried out in the up-to-day way. Layer 6a, for example, showed greater impact from the overlying layers (3 and 5) than from the undisturbed stratigraphic unit containing numerous archaeological materials and large animal bones.

Small-mammal fauna data combined with the results of stratigraphic, micromorphological, and pollen studies can be used in the reconstruction of post-sedimentation processes in karst sites. In Chagyrskaya Cave, the recorded transfer of small-mammal remains between layers is almost entirely consistent with post-sedimentary processes.

Paleoreconstructions based on the small-mammal fauna and pollen are usually carried out apart from detailed stratigraphic reconstructions that take into account episodes of displacement or redeposition of stratigraphic units. Assemblages of each layer are considered as discrete units reflecting the sequential development of paleolandscapes from the bottom to the top of the sections, which may not completely correspond to the sedimentation processes. The study of Chagyrskaya Cave complexes revealed the complexity of stratigraphic processes in karst cavities, their impact on the composition of the small-mammal fauna and, ultimately, on paleoreconstructions.

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Komudvany—a Final Paleolithic Site in the Lower Ob Valley: Geomorphology, Paleontology, Archaeology

This article is devoted to the preliminary results of multidisciplinary studies at Komudvany—a site located within a "mammoth cemetery" in the Lower Ob basin. We present the excavation history, geomorphological characteristics, results of radiocarbon analysis, and descriptions of archaeological and faunal remains. According to geological and geomorphological criteria, three parts of the site are distinguished: the terrace, the promontory, and the floodplain. The radiocarbon analyses of bones show the chronological heterogeneity of floodplain finds. Finds from the promontory and the terrace most likely represent a single episode of habitation and butchering or collecting bones and tusks. The mammoth "cemetery" was dated to 20–12 cal ka BP. At least one episode of habitation and human activities has been registered and dated to 15–14 cal ka BP. Archaeological finds and series of radiocarbon dates suggest the attribution of Komudvany to the Final Paleolithic. It is the northernmost site of that period in the West Siberian Plain and, along with Lugovskoye, is a reference object for studying the early human habitation in the northern regions of Asia.

Keywords: *Western Siberia, Final Paleolithic, geology, geomorphology, paleontology, radiocarbon dating.*

Introduction

According to the modern paleogeographic data, the earliest episodes of peopling of the northern part of the West Siberian Plain are younger than 50 ka BP, since the existence of a continuous continental glaciation in the second half of the Late Pleistocene and, accordingly, of the Mansiysk glacial-dammed lake (Arkhipov, Volkova, 1994) are not confirmed by the recent research results (Svendsen et al., 2004; Astakhov, Nazarov, 2010; Zolnikov et al., 2021). Discoveries of archaeological sites in the circumpolar zone also suggest the start of colonization of the northern regions of Asia during the Early Upper Paleolithic, or possibly even earlier. The most striking examples of this are Mamontovaya Kurya on the Pechora River and the Yanskaya site on the Yana River (Svendsen, Pavlov, 2003; Pitulko et al., 2004).

The available data suggest that there were several stages of human dispersal in the circumpolar regions of Eurasia in the Upper Paleolithic (Pavlov, 2016; Pitulko, 2016; Zolnikov et al., 2020). At present, there are quite few Paleolithic sites known on this territory; these sites are located at a significant distance from one another and belong to various chronological periods (Velichko et al., 2014). The Paleolithic of the northwestern Siberia is still a poorly researched theme, even as compared to the generally poor knowledge of this period in the northern regions of Asia. A definite breakthrough in this area occurred after the discovery in 1998 of the Lugovskoye site located at latitude 61° N (Pavlov, Mashchenko, 2001; Zenin et al., 2006), and the subsequent discovery of bones of *Homo sapiens sapiens* aged to ca 40 ka BP near the mouth of the Ishim River (58° N) (Fu et al., 2014). The next step that shifted the boundary of the known Paleolithic ecumene in the region to 63° N was the discovery of the Komudvany site in 2016 (Makarov, Rezvyi, Gorelik, 2018). This article introduces the materials from this Final Paleolithic site, the northernmost one in the Ob basin.

Fig. 1. Location of the Komudvany site and other main Paleolithic sites in the West Siberian Plain.
1 – Komudvany; *2* – Lugovskoye; *3* – Gary; *4* – Ust-Ishim; *5* – Shikaevka-2; *6* – Cherno-Ozerye-2; *7* – Volchya Griva; *8* – Tomskaya site; *9* – Mogochino; *10* – Krasnoyarskaya Kurya; *11* – Shestakovo; *12* – Achinskaya.

General information and history of the study of the Komudvany site

The site of Komudvany (63°18′18.1″ N; 65°27′27.6″ E) is situated in the Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra, approximately 400 m from the confluence of the Manya and the Bolshaya Ob rivers (Fig. 1, 2). The site was named after the abandoned village of Komudvanovskiye, located 5 km to the southwest of the site, on the left bank of the Bolshaya Ob River. The artifacts were found in the uppermost portion of the soft sediments of the terrace-like bench about 7 m high over the Ob low-water level (~4 m over the Manya water level and ~20 asl).

In 2015, a team from the Museum of Nature and Man (Khanty-Mansiysk) carried out a survey of the banks of the Manya River's mouth area and discovered an accumulation of the Pleistocene faunal remains. In that year, paleontological material was collected (about 500 spec.) and two test profiles were made on terrace-like ledges, one of which contained a bone-bearing layer.

Field studies were continued in 2016, and paleofaunal remains were recorded in the upper part of the sediments on the terrace. In addition to the paleontological materials—mainly the mammoth remains (*Mammuthus primigenius* Blum.)—two stone flakes were found. Additional test pits were made on a small promontory located ~50 m upstream of the Manya, where another bone-bearing horizon and several quartz shatters were found. Thus, within the paleontological locality, a Paleolithic site was recorded. The studies were continued in 2017, 2020, and 2021 by the joint team of specialists from the Museum of Nature

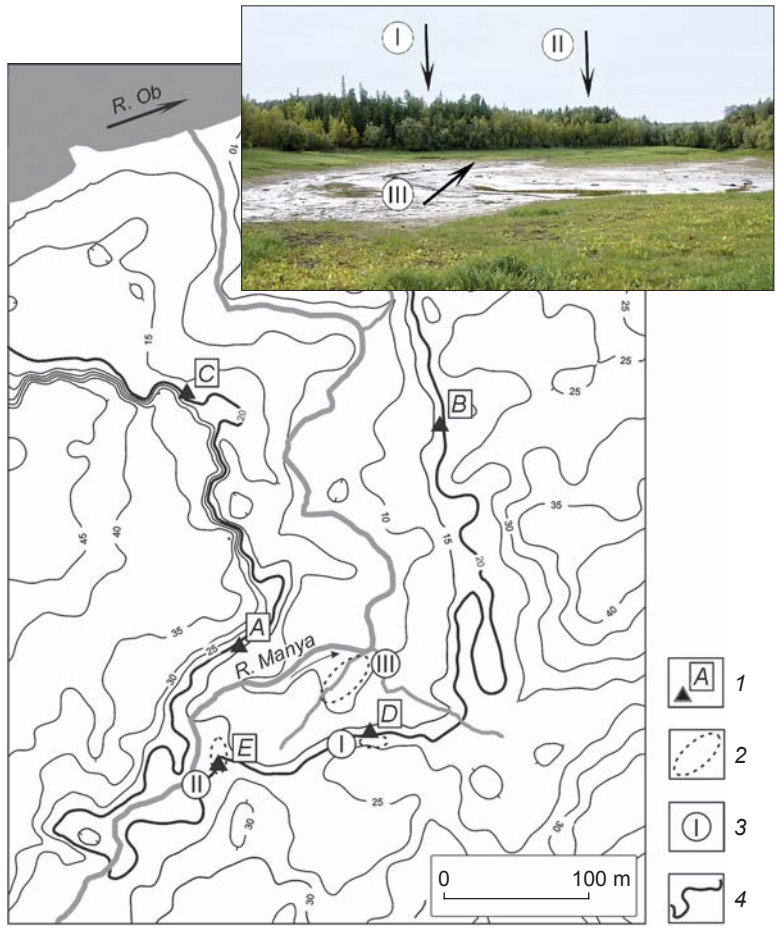

Fig. 2. Layout plan of the Komudvany site.
I – terrace area; II – promontory area; III – floodplain area.
1 – main profiles (see Fig. 3); *2* – site areas; *3* – site area numbers; *4* – the level of the coastal ledge of the terrace area.

and Man, the Institute of Archaeology and Ethnography SB RAS, Tomsk State University, and the Sobolev Institute of Geology and Mineralogy SB RAS (Makarov, Rezvyi, Gorelik, 2018).

The site contained three areas with archaeological finds: terrace, promontory, and floodplain (Fig. 2). The first two areas yielded lithic artifacts and faunal remains. The floodplain area didn't contain lithic artifacts, but the paleontological collection included a mammoth-tusk spatula (or shaft) with signs of working. To date, the site includes a trench, a main excavation area, 11 test pits (excavated area totals 50 m^2), and six profiles at the banks. The conducted field studies have shown three bone-bearing horizons on the terrace; the archaeological material is associated with the upper one.

Geological and geomorphological characteristics of the study area

The study area is located at the northwestern margin of the Belogorskaya Upland, which is composed mainly of Middle Quaternary glacial and water-glacial deposits overlain by the Upper Quaternary subaerial cover. The right bank of the Ob is steep and rises several tens of meters above the water edge. The mouth area of the Manya valley is located within the lower relief of the ancient bend of the paleo-Ob, which probably corresponds to fluvial terrace I, with the height of the edges of this elevated plain not exceeding 4–5 m above the low-water level in the Manya. This terrace adjoins elevated remnants resting on the Middle Quaternary base. Test profile 3 was established in a coastal cliff 10.2 m high above the edge of the towpath on the left bank of the Manya (Fig. 3, *A*), and produced the general idea of the stratigraphy. The modern soil, 0.1 m thick (layer 1), is underlain by a subaerial cover ~2.0 m thick composed of unstratified eolian sand (layer 2) and diluvium (layers 3, 4). Below is a dense diamicton (layer 5) containing sandy siltstone with rare ice blocks of boulder-pebble size, the visible thickness is ~2.0 m; this layer is the main Middle Pleistocene moraine.

Profile 2 was established on the right bank of the Manya, on a terrace 4 m high above the towpath (Fig. 3, *B*). Here, under modern soil 0.1 m thick (layer 1), there is a subaerial cover 1.0 m thick (layer 2) represented by diluvium (alternating sand and silt sand). Small frost wedges were recorded in its bottom portion. Below, there are parallel-layered (layer 3) and cross-layered (layer 4) alluvial sands with pebbles of a total thickness of 2.1 m. Beneath the alluvium, diamicton was uncovered, comprising a non-layered sand-aleuropelite with rare boulder-pebble ice blocks and grus (layer 5)—the main mid-Quaternary moraine. The moraine is underlain by sands with a visible thickness of 0.55 m. At their contact, there is a gneissic texture ~0.2 m thick (glaciomelange), in the moraine itself there are rare small flat outliers of the underlying sand. This outcrop is remarkable in that the alluvial deposits are exposed above the Middle Pleistocene base of the profile, with the alluvium being most likely the subaquatic part of Ob's fluvial terrace I, the height of which in this area is 4 m above the towpath edge. Profile 5 was established at

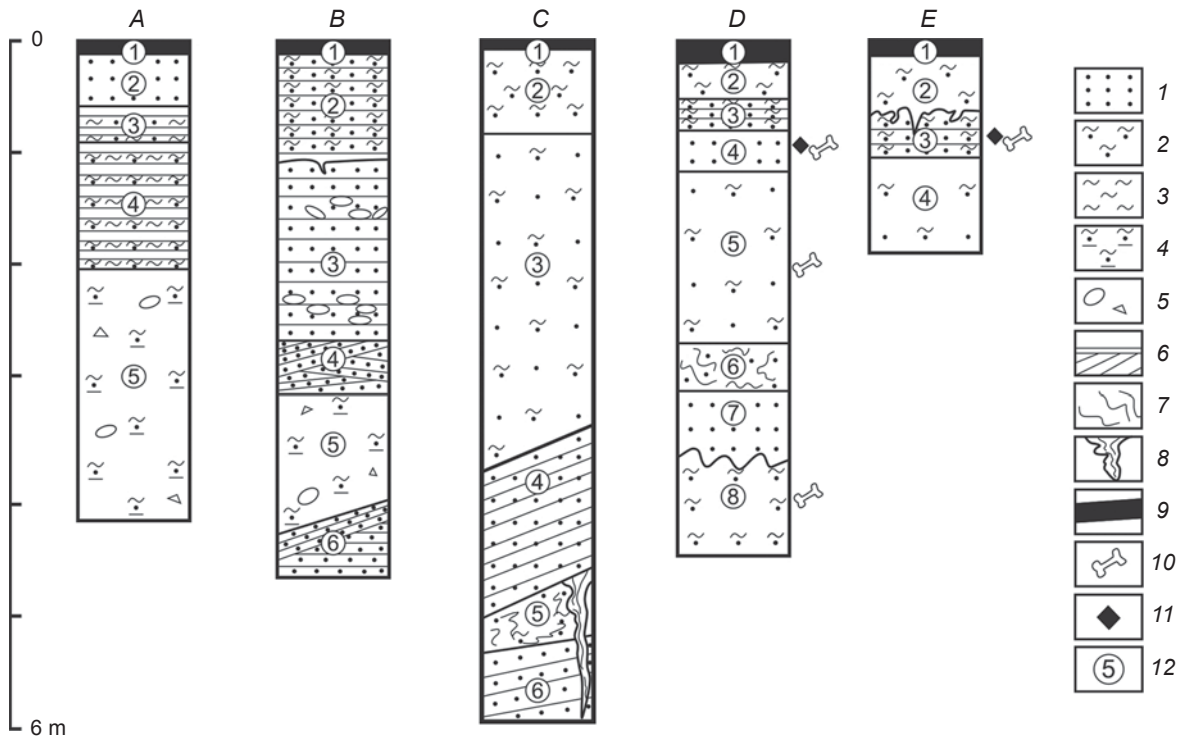

Fig. 3. Stratigraphic columns of the main profiles of the mouth area of the Manya.
A – test profile *3*; *B* – test profile *2*; *C* – test profile *5*; *D* – excavation of 2021*; E* – test pit 5.
1 – sand; *2* – silty sand; *3* – silt; *4* – sand-aleuropelite; *5* – grus and boulders; *6* – oblique bedding; *7* – gneissic textures; *8* – frost wedges; *9* – modern soil; *10* – megafaunal remains; *11* – lithic artifacts; *12* – numbers of layers.

this terrace at a height of ~5.0 m above the towpath on the left bank of the Manya (Fig. 3, *C*). Modern soil 0.1 m thick (layer 1) was underlain by a subaerial cover 5.4 m thick comprising unstratified eolian sands and silty sands (layers 2 and 3), sandy deluvium layered parallel to the modern slope of the terrace surface (layer 4), and sandy soliflux (layer 5) with wedges from the top layer to a depth of up to 1.5 m. Below are parallel-layered alluvial sands with a visible thickness of up to 0.8 m.

Deposits containing remains of megafauna and archaeological finds were uncovered on the right bank of the Manya, on the terrace area of the site. The excavation 2021 was laid in the central part of the site, 3 m from the terrace edge (Fig. 3, *D*; 4). The modern soil, 0.2 m thick (layer 1), was underlain by a subaerial cover 3.8 m thick containing the following stratigraphic layers: non-layered eolian silty sand (layer 2); diluvium (alternating sand and silt sand) layered parallel to the slope (layer 3); non-layered eolian sand ~0.2 m thick (layer 4), whose 0.1 m thick top portion was associated with the mammoth bones and lithic artifacts (upper bone-bearing level and culture-bearing layer); non-stratified eolian silty sand, sporadically saturated with silty fraction forming silty sand (layer 5) and containing reindeer remains in the middle part, at a depth of ~2.0 and 2.2 m (middle bone-bearing level); sandy patchy-banded soliflux (layer 6); and non-stratified eolian sand with rodent casts and rare small humus lenses (layer 7). The subaerial complex of sediments was underlain by lacustrine-marsh sediments (perhaps these are the sediments of a floodplain lake) of unstratified pale blue silty sand with rare small black spots of organic matter and a marsh smell (layer 8); the apparent thickness is up to 0.7 m. The contact between these two layers is uneven and deformed by solifluction. Faunal remains were found 0.4 m from the top of layer 8 (lower bone-bearing level) (Makarov, Rezvyi, Gorelik, 2018).

On the promontory area of the site, at a height of ~2.0 m above the towpath, test pit 5 was established. It revealed a bone-bearing level with archaeological finds (see Fig. 3, *E*). Under the modern soil 0.15 m thick (layer 1), there is a subaerial cover 1.8 m thick containing non-layered eolian silt sand (layer 2), and diluvium (alternating sand and silt sand) layered parallel to the slope (layer 3), with wedges and solifluction deformations in its top part. This last layer yielded lithic artifacts and paleofaunal remains. Further below, there is a layer of unstratified aeolian silty sand and silt sand in some places (layer 4).

The daylight surface of the terrace and promontory sections does not form a flat area elevated to a common hypsometric level. It is gently segmented by stream

and deluvial erosion, and possibly by deflationary processes.

The greater thickness of the diluvium at the promontory area (see Fig. 3, *E*, layer 3) as compared to the terrace area (see Fig. 3, *D*, layer 3) and the absence in the promontory area of a clearly expressed layer of unstratified aeolian sand recorded in the terrace area (see Fig. 3, *D*, layer 4), as well as the discovery of archaeological and paleontological materials in these layers, suggest the influence of local planar erosion of the eolian layer by deluvial processes on the formation of layer 3 in the promontory area. Thus, the finds from layer 3 of trench 5 and from layer 4 of the 2021 excavation are probably of the same age.

The upper bone-bearing level (layer 4) was studied in the terraced area over 12 m^2 (trench, excavation and pits) and in two test profiles; the middle bone-bearing level (layer 5) was studied over an area of 2 m^2 in the excavation of 2021; the lower one (layer 8) over 1 m^2 in test profile 1. In the promontory area, the bone-bearing level lying in sediments of subaerial genesis, with signs of diluvial transport (layer 3), was studied over an area of 2 m^2.

The two upper bone-bearing levels, the upper of which contains lithic artifacts, are associated with the subaerial cover with a total thickness of up to 3.8 m. This cover, in all likelihood, was formed when the Ob's alluvial terrace I emerged into a floodplain position, approximately 15 thousand years ago. Lacustrine-marsh blue silts at the base of the terrace area may be coastal deposits on the drained floodplain, completing the formation of the alluvial stage of this terrace. This interpretation is not contradicted by radiocarbon dates (~20,000 cal BP) generated on bones from layer 8 (see *Table*). Below, deposits of the Middle Quaternary glaciocomplex occur, which are typical for the northwestern margin of the Belogorskaya Upland in the lower reaches of the Ob. The height of fluvial terrace I ranges from 3 to 7 m above the low-water level in the Ob, which is due to the different thickness of the subaerial cover in its various parts, as well as to the uneven erosional (stream) and planar (diluvial and deflationary) denudation.

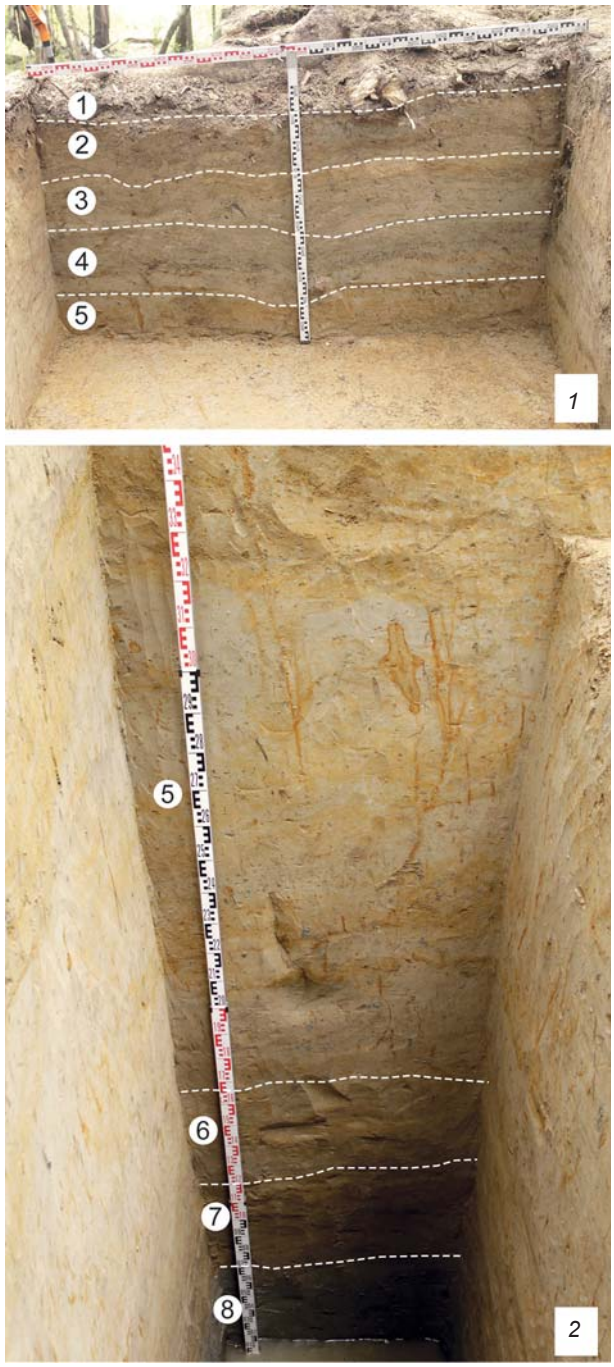

Fig. 4. The northwestern wall in the excavation of 2021. *1* – upper part; *2* – lower part. Geological layers are marked with figures.

Paleontological finds

The remains of large mammals are distributed over the entire surface of the mouth area of the Manya floodplain. The highest concentration was recorded on the right bank of a small stream flowing into the Manya River (floodplain area) (see Fig. 2). In the surface collections, mammoth remains (*Mammuthus primigenius* Blum.) predominate (*n*=567, which is 97.7 % of all identifiable finds (≥13 individuals)). Bones of woolly rhinoceros (*Coelodonta antiquitatis* Blum.), reindeer (*Rangifer tarandus* L.), horse (*Equus* sp.), and bison (*Bison* sp.) were also found. These finds are a mixed complex, which is confirmed by the great range of the radiocarbon dates obtained as compared to other parts of the site (see *Table*).

Paleontological materials from the upper bone-bearing level (layer 4) in the terrace area include

Results of dating of the fossil faunal remains

Place of deposition	Taxon	Method	Radiocarbon date, BP	Calendar age, BP	Lab code
Lower bone-bearing level (layer 8)	Mammal	AMS	17,060 ± 90	20,853–20,420	NUTA2-25794
		"	17,040 ± 60	20,795–20,444	NUTA2-25451
	"	"	16,810 ± 40	20,468–20,020	UGAMS-40953
Upper bone-bearing level (layer 4)	Woolly mammoth	^{14}C	12,567±150	15,331–14,117	SPb-2672
	"	AMS	12,320 ± 35	14,809–14,104	UGAMS-40954
Floodplain area (surface collections)	Woolly rhinoceros	"	14,750 ± 50	18,222–17,907	NUTA2-25450
		"	14,540 ± 90	18,089–17,415	NUTA2-25793
	Reindeer	^{14}C	12,243 ± 120	14,847–13,810	SPb-2673
	Woolly mammoth	"	10,622 ± 110	12,765–12,103	SPb-2298
	"	"	10,565 ± 100	12,740–12,102	SPb-2297

155 specimens. All identifiable bones were attributed to mammoth (≥3 individuals). In the anatomical composition of the finds, there are no skull bones; the vertebrae are represented only by fragments of neural arches (2.6 %); there are also epiphyses of bones of the anterior (4.5 %) and hind (7.7 %) limbs, fragments of ribs (37.7 %), phalanges (5.2 %) and small unidentifiable bone fragments (42.3 %).

Paleontological materials from the middle bone-bearing level (layer 5) in the terrace area are represented by fragments of tubular reindeer bones (5 spec.). The finds were collected over an area of 0.2 × 0.2 m, which may indicate that they belonged to one individual. The surfaces of the bones are covered with traces of plant-roots. Within the lower bone-bearing level (layer 8), in the area of the same size, fragments of the mammal's ribs (3 spec.) were recorded; the ribs were tentatively assigned to one individual. The bones are dark brown, resembling the state of preservation of the bones from the surface collections.

Paleontological materials from the promontory area (11 spec.) form a single bone-bearing level (layer 3). The poor preservation of the bones, which may be due to redeposition, did not allow for species identification.

Results of the radiocarbon dating

In total, ten radiocarbon dates were generated on the bones from surface collections in the floodplain area and from the upper and lower bone-bearing levels of the terrace area (see *Table*)*. Calendar age was determined using the OxCal, v. 4.4.4., according to the IntCal20 calibration curve (Muscheler et al., 2020), with a reliability of 95.4 %.

The dates of the bones from the floodplain show a wide range (~18–12 cal ka BP) in comparison with samples from the upper (~15–14 cal ka BP) or lower (~21–20 cal ka BP) bone-bearing levels. Thereby, the paleontological segment of the Komudvany site was formed in the interval from ~21 to 12 cal ka BP, and the presence of Paleolithic man in this place can be associated with a single habitation stage, during the formation of the upper bone-bearing level, ~15–14 cal ka BP.

Lithic artifacts

Lithic artifacts were recorded *in situ* in the upper bone-bearing level (layer 4) in three test pits, trench, and excavation area (terrace and promontory areas). Washing and sieving the deposits of the floodplain area did not reveal any lithics, although paleontological material was found. At present, all the lithic artifacts (28 spec.) are assigned to the single complex, and include a laminar flake, flakes (9 spec.), shatters (17 spec.), and a chip. No core-like forms have been found. The tool collection (5 spec.) included a retouched flake (point ?), flakes, and a shatter with traces of utilization retouch (Fig. 5).

The following raw materials of the lithic artifacts were identified visually: quartz/quartzite – 71.5 % (20 spec.), sandstone – 25.0 % (7 spec.), agate (?) – 3.5 % (1 spec.). Four flakes and the chip retained pebble crust over some parts of the surface. Most likely, the source of raw material were pebbles >5 cm in size from perluvium deposits of the Middle Quaternary moraines in the immediate vicinity of the site.

*The bones from the promontory area of the site were not used for radiocarbon dating owing to their poor state of preservation.

The parallel flaking was the most characteristic technique of primary knapping; however, one spall shows bidirectional flaking of the edges of the dorsal surface. All the spalls are small, not more than 5 cm long. The striking platforms are plain and straight (one punctiform platform was noted), prepared through one removal. One flake shows the use of the overhang rejuvenation technique.

Noteworthy is the flake with convergent lateral sides, one of which, in its distal part, was additionally fashioned with marginal dorsal retouch (Fig. 5, *4*). This artifact can be interpreted as a small pointed form. The distal end of the bladelet flake bears small notches, which can be considered as utilization retouch (Fig. 5, *3*). A similar retouch was noted on the laterals of two more flakes (Fig. 5, *1*, *2*) and on a shatter (Fig. 5, *5*).

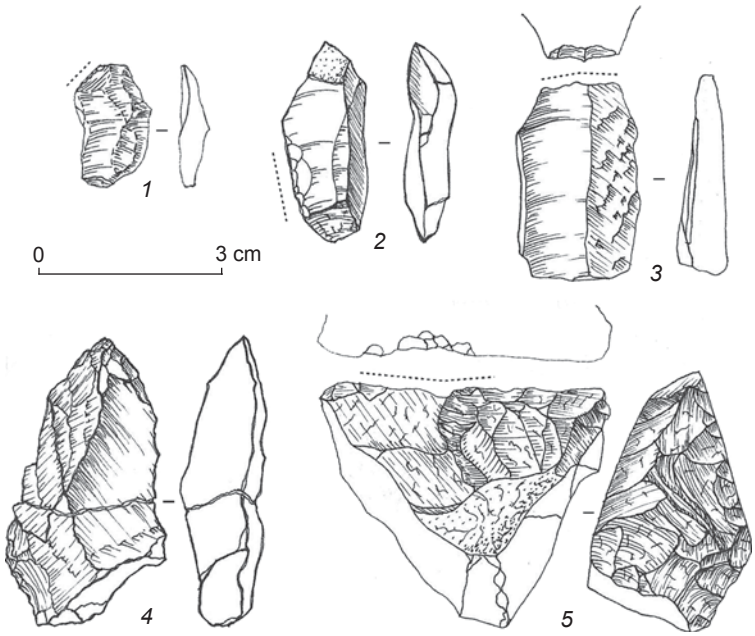

Fig. 5. Lithic artifacts from terrace area (layer 4).
1–3 – flakes with utilization retouch; *4* – retouched flake (point ?); *5* – shutter with utilization retouch.

Artifacts of mammoth tusk

A fragment of mammoth tusk (29.2 × 6.1 to 5.1 × × 5.0 cm), bearing traces of longitudinal splitting ("breaking" in G.A. Khlopachev's and E.Y. Giria's terminology (2010: 29)), was found *in situ* in layer 4 in the terrace area. Its surface shows a partially preserved cement layer, negative scars of longitudinal flaking, and a zone of severely cracked dentin. The ends of the tusk fragment are broken off. The cement layer is associated with two planes of longitudinal splitting, which are oriented tangentially to the structure of the tusk and extend over the entire length of the fragment. The negative scars partially overlap one another, indicating the sequence of operations. The rest of the tusk's surface shows growth cones delaminated and cracked to various depths. This fragment can be interpreted as a core for producing tusk rods or blades (Pitulko, Pavlova, Nikolsky, 2015).

A spatula (or shaft) made from a mammoth tusk (80.7 × 17.6 × 5.0 mm) (Fig. 6, *1*) was collected from the floodplain. It is rectangular in shape, with a slightly concave ventral surface, a curved dorsal surface, and a slightly twisted (propeller-like) profile. One end was truncated; the opposite end had been sharpened with several cuts. The concave surface of the blade is natural, with traces of stratification of dentin, while the convex surface bears numerous long, shallow, and subparallel scratches. One lateral side is pointed, the other is flatter and resembles an artificially fashioned back. The back shows six parallel notches located at approximately the same distance from each other.

Discussion

Komudvany occupies almost the entire mouth area of the Manya River, but the bones are concentrated mainly in the floodplain along the right bank, in the immediate vicinity of the terrace area. The proximity of the upper bone-bearing level to the edge of the terrace-like ledge, as well as a significant number of paleontological finds in the adjacent floodplain area, suggest the destruction of a greater part of the original site as a result of erosion. Distinctions revealed in the anatomical composition of paleontological surface collections and those deposited *in situ* may indicate also the anthropogenic factor in the formation of the upper bone-bearing level. The predominance of bones with a low nutritional value index (distal parts of the limbs and ribs) (Kasparov, Nekhoroshev, 2018) allows us to consider the studied part of the upper bone-bearing layer as a possible butchering zone. Several subparallel cut marks noted on the rib (Fig. 6, *2*), as well as the *in situ* co-occurrence of stone flakes and faunal remains, support this assumption.

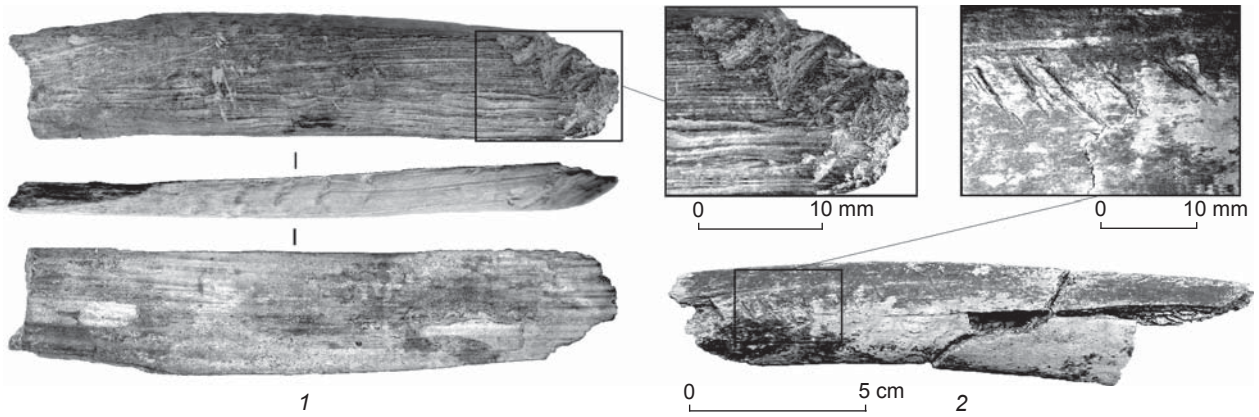

Fig. 6. Faunal remains with traces of anthropogenic impact.
1 – bladelet of mammoth tusk (floodplain area, surface collection); *2* – rib-fragment with cut marks (terrace area, layer 4).

Lithic artifacts are not numerous at the site; the collection does not contain cores; formal tools are extremely rare. Spalls are represented exclusively by flakes, one of which is bladed. Four specimens have traces of use-wear retouch, suggesting their use as situational tools. All the spalls are <5 cm in length, which can be explained by the rarity of high-quality raw materials in the area of the site and by the use of small pebbles of quartz and quartzite from the Ob towpath in the immediate vicinity of the site, which are unsuitable for knapping.

Fragments of mammoth tusks from Komudvany, with traces of working, are common finds for many Late Paleolithic sites (Anikovich, 1992; Khlopachev, Girya, 2010: 7; Pitulko, Pavlova, Nikolsky, 2015), including the sites in the West Siberian Plain (Petrin, 1986: 102–109; Derevianko et al., 2003: 132–136; Seuru et al., 2017). Solitary tools, the presence of a series of spalls with utilization retouch and the small size of the artifacts, along with the association to the mammoth fauna, make the Komudvany complex close to the majority of Paleolithic sites in Western Siberia: Lugovskoye, Gary, Shikaevka-2, Volchya Griva, Shestakovo, Krasnoyarskaya Kurya, the Tomskaya site, etc. (Kashchenko, 1901: 28–30; Petrin, 1986: 21–99; Derevianko et al., 2000; Zenin et al., 2006; Serikov, 2007: 96–106; Seuru et al., 2017; Leshchinskiy, Zenin, Bukharova, 2021); however, a more accurate attribution of finds is still difficult.

Conclusions

The Komudvany site is situated at the megafaunal locality dominated by the mammoth remains. The excavations have shown that the deposits in the terrace area (probably, fluvial terrace I) began to accumulate prior to 20 cal ka BP, and ~14 cal ka BP the sedimentation was subaerial. Radiocarbon dating of fossil faunal remains indicates the formation of a paleontological locality during several thousand years.

The site includes three areas: the terrace area yielding three levels of *in situ* occurrence of bones, with lithic artifacts in the upper level; the promontory area yielding one bone-bearing level with archaeological finds; and the floodplain area with the surface occurrence of paleontological and archaeological materials. Eolian, deluvial, and erosional processes had an effect on the formation of deposits containing archaeological finds.

The available data suggest at least one episode of human habitation between 15 and 14 cal ka BP. The people were likely attracted by a large number of faunal remains providing local, easily accessible supply. Animal bones and tusks could have been an additional valuable resource used in production of tools or non-utilitarian items. The composition of the bones and cut marks on their surfaces, as well as lithic artifacts, indicate the anthropogenic factor in the formation of the upper bone-bearing level, which allows us to interpret the Komudvany site tentatively as a temporary camp associated with the mammoth faunal locality, where bone and tusk raw materials could be collected and animal carcasses could be butchered.

Though the collection of lithic artifacts was small, the site is important. It is the northernmost archaeological site of the terminal Late Paleolithic in the West Siberian Plain. A representative series of radiocarbon dates and *in situ* occurrences of archaeological and paleontological materials make it possible to consider Komudvany, along with the

Lugovskoye site, as a reference object for studying the processes of early human habitation in the northern regions of Asia.

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On the Cultural Geography of the Eastern Caucasus and Southern Caspian in the Mesolithic

This study focuses on the geography of the Mesolithic cultures of the eastern Caucasus and the current approaches to this topic. In the 1970s, the Caucasian Mesolithic was considered an amalgam of several archaeological cultures evolving in parallel. In the eastern part of that region, two archaeological cultures were described: Chokh and Trialeti. While no one questioned their marked specificity vis-à-vis the cultures of western Caucasus, the similarities and differences between them have not been specifically addressed. In the 1990s, S.K. Kozłowski proposed merging Chokh and Trialeti with other Mesolithic cultures of the northern Zagros, Anatolia, the western Caucasus, the Crimea, the southern and eastern Caspian, and possibly the Central Iranian Plateau, into a single industry, which he termed "Trialetien". This idea was based on approaches different from those used in establishing archaeological cultures. Therefore, the notion of the Trialetien was likewise novel. I believe that the former typological criteria underlying the typology of the southern part of the circum-Caspian area (Chokh, Trialeti, Balakhan) are still valid. Likewise plausible is the idea that in addition to the cultures mentioned above, the Southern Caspian archaeological culture must be established. All those local units, including Trialeti (in the traditional sense), are a group of related cultures, which I previously included in the "Southern Caspian Mesolithic area".

Keywords: *Mesolithic, eastern Caucasus, Chokh culture, Trialeti culture, Southern Caspian cultural area, "Trialetien".*

Introduction

At a time when Soviet Paleolithic experts were searching for specific features in the material remains of the Stone Age (1960s–1970s), in the eastern Caucasus the Chokh and Trialeti Mesolithic cultures were identified. These paleo-cultural studies aimed at the identification of groups of sites that would meet the notion of "archaeological culture" as a typological structure corresponding to the upper level of the triad: attribute–type–culture. Identification of a particular archaeological culture was generally recognized as proven if groups of products of specific types, or even of a single cultural form, were identified for a certain set of sites.

It should be admitted that the identification of the Stone Age cultures has in practice very often outstripped the methodological relevance of the research procedure. Even when the attribution of sites to one community seemed justified, questions were raised as to whether the entity in question was an archaeological culture (a narrow local unity), a cultural community (a group of related cultures) or a community made up of different sites that shared

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a common developmental pattern. Addressing these issues was hampered by the difficulty of achieving the goal of typological analysis, namely the identification of ideal types (not replaceable by subtypes, supra-types, categories, etc.), which would be used for the comparative analysis of materials.

In the past, archaeological cultures were usually identified not on the basis of clearly defined typological characteristics, but often by intuition. In this way, most of the Upper Paleolithic and Mesolithic cultures of the Caucasus were identified (Bader, Tsereteli, 1989)—the Imereti, Chokh, Trialeti, Black Sea, and Gubs.

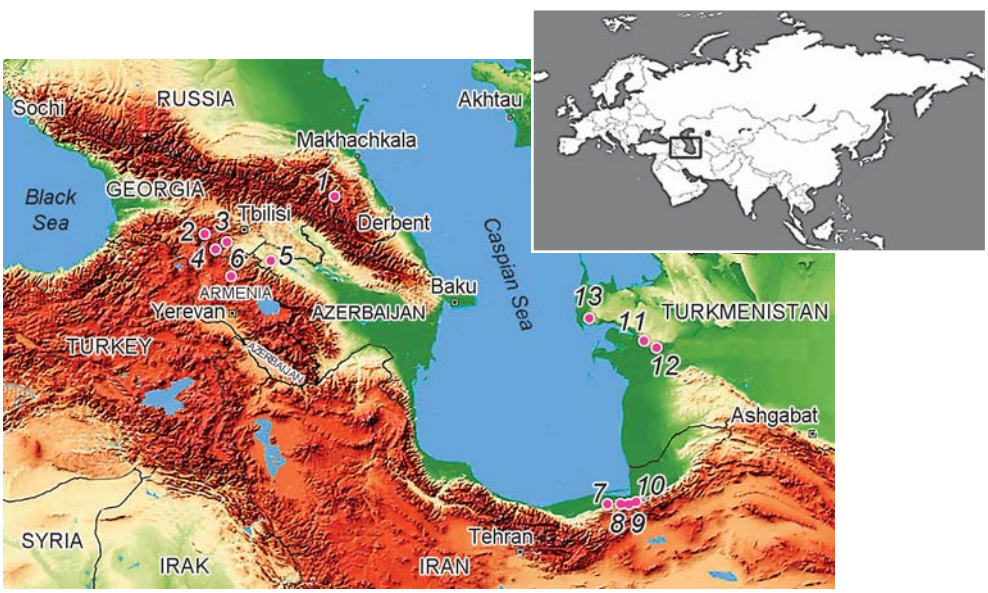
The Trialeti culture according to Soviet (Georgian and Russian) researchers

The Trialeti Mesolithic archaeological culture was identified in the 1970s by Georgian researcher M.K. Gabunia from the materials of two cave sites (more precisely, on the grounds under rock-shelters): Edzani and Zurtaketi, located in the southern spurs of the Trialeti Range (Gabunia, 1976; Gabunia, Tsereteli, 1977) (see *Figure*). The area of the culture's distribution was determined to be approximately within the territory of Eastern Georgia.

The lithic industry at the Edzani rock-shelter site consists of 21,628 items, of which 1910 show signs of secondary working. The Zurtaketi lithic assemblage is much more modest—386 items, 21 of them with traces of secondary working.

The materials of the culture under consideration were not dated until the last decade. Recently, the dates have been obtained for the Bavra Ablari rock-shelter site (Georgia) and for the Mesolithic layer of Damjili Cave (Azerbaijan). Both sites are located in the area of the Trialeti culture. Four radiocarbon dates for the Mesolithic deposits of Bavra Ablari correspond to a range of 9500–8700 cal BP (Varoutsikos et al., 2017: 243). The Mesolithic layer of Damjili Cave is dated to 6400–6000 cal BP (Nishiaki et al., 2019). With these dates, the chronological range of the culture can be estimated as from 9500 to the end of 7000 cal BP.

As for the two sites from which the Trialeti culture was originally identified, their age was estimated purely on the basis of a comparison of typological features. The reliability of these relative dates raises significant doubt. As is known, M.K. Gabunia attributed the Zurtaketi site to the Early Mesolithic, and Edzani to the Late Mesolithic (Gabunia, 1976). This conclusion was based on the fact that Edzani, in contrast to Zurtaketi, yielded elongated asymmetrical triangles and Gravettoid points, as well as numerous backed bladelets. That is, morphological groups of items that, according to the modern approach, should belong to the Early Mesolithic were chosen



Map of the sites mentioned in the article.
1 – Chokh; *2* – Bavra Ablari; *3* – Edzani; *4* – Zurtaketi; *5* – Damjili; *6* – Kmlo-2; *7* – Komishan; *8* – Hotu; *9* – Kamarband; *10* – Ali Tepe; *11* – Dam-Dam-Cheshme; *12* – Djebel; *13* – Kaskyr Bulak.

as elements indicating the relatively late age of the site within the Mesolithic. This is the case with the cultures identified in the northeastern Caucasus (Amirkhanov, 1987), and the southern and northern slopes of the western Caucasus (Tsereteli, 1973; Leonova, 2015, 2019; Aleksandrova, Leonova, 2017; Bar-Oz et al., 2009).

The materials from the Edzani site do indeed show features indicating the Late Mesolithic. These probably include the small size of such items as segments and trapezoids. The tools fashioned with distributed retouch and isolated symmetrically stemmed points can be classified as distinctly late. The indisputable evidence of Neolithic material in the collection is a core for pressure-flaking using a lever (see (Gabunia, 1976: Pl. XV)).

Giving the typological description of the Edzani toolset, the researcher points to the "abundance of such tools as geometric microliths (among these, noteworthy are the large series of asymmetric triangular inserts, rather developed forms of segments and trapezoids, segments with blunted arcs, and trapezoids with blunted upper bases), tools resembling arrowheads, numerous various perfectly worked insert-bladelets; micro-endscrapers on bladelets; and rounded endscrapers on microflakes, etc." (Gabunia, Tsereteli, 1977: 34).

When considering the composition of the Edzani collection from the point of view of modern science, it should be noted that typologically it is heterogeneous, and includes various diachronous components. Similar observations have also been made by other researchers (Kozłowski, 1999). The bulk of this collection relates to the Mesolithic; it reveals features that distinguish this industry from other Mesolithic industries of the western Caucasus. Specific to the Trialeti complex are small cores with flattened flaking-surfaces, sometimes showing disk-form (along with prismatic and conical nuclei) and, consequently, the great importance of flakes serving as blanks for tool manufacture. Peculiar are such distinctive tools as trapezoids (these are close to carinated pieces). The implements in the form of a blade, semicircular in plan view, with a solid, flat, thinning inverse retouch on one or both ends, from the Edzani assemblage, have long remained in the background (Gabunia, 1976: Pl. XI, *28*). Most likely, it was a product of this type that was identified by modern researchers under the name of "Damjili-type tool" during the recent studies of the Mesolithic layer of the eponymous cave in Western Azerbaijan (Nichiaki et al., 2019).

Considering the Trialeti culture, Gabunia points to the absence of signs of the use of pressure technique for the production of blanks in it. However, this feature cannot be treated as culture-specific, because this technique is not typical of the Mesolithic of the whole eastern Caucasus.

In general, the above typological description of the Trialeti culture can hardly be regarded as complete enough to serve as a basis for unambiguous attribution of a certain site to this cultural formation. Judging by this characteristic, this formation can include the materials from a variety of Mesolithic sites on a huge territory. This is precisely what happened later with the transformation of Gabunia's "Trialeti Mesolithic culture" into Kozłowski's "Trialetien".

Trialeti industry according to S.K. Kozłowski

S.K. Kozłowski repeatedly referred to the issue of the Trialeti culture (Kozłowski, 1994, 1996, 1999; Kozłowski, Aurenche, 2005) in connection with the study of the Early Holocene cultural geography in the area of the Fertile Crescent and adjacent regions. He drew conclusions about the cultural phenomenon in question on the basis of study (mostly according to the literature) of the materials of Edzani (Gabunia, 1976), Hallan Çemi (Turkey) (Rosenberg, 1994), Ali Tepe (Iran) (McBurney, 1968), Kamarband (Belt), layers 28–11 (Iran) (Coon, 1957), Chokh, layers E–C (Amirkhanov, 1987), Dam-Dam-Cheshme II, layers 7–3 (Korobkova, 1977), and Nevalı Çori (Turkey) (Schmidt, 1994).

To denote cultural formations spread in the Middle East to the north of the Zagros Mountains, in the Taurus Mountains and in the Caucasus, Kozłowski uses the concepts with different meanings in terms of scope: "Trialetien industry" (Trialetien in the broad sense), "typical Trialetien" (Trialetien in the narrow sense), and "Caucasian-Caspian cultural area". These concepts do not imply clear attributes and are not organized into a strict scheme with hierarchical levels—although the idea of hierarchy is present here, even if not clearly.

According to Kozłowski, the Trialetien in the broad sense is a Late Pleistocene–Early Holocene industry common to populations who are not engaged in a production economy, and provide for their needs mainly through hunting. This industry is generally contemporaneous with the proto-Neolithic and pre-

pottery (Early Neolithic) cultures of the Taurus, Zagros, and Mesopotamia, such as Mlefaatian, Nemrikien and partly PPNB (Pre-Pottery Neolithic B). All these cultures date back to between 11 and 7 ka BC. The north-south boundary of their area of distribution runs from the southern Greater Caucasus to the main ridge of the Zagros Mountains, while the east-west line runs from the Eastern Taurus to the Kopetdag and Nebitdag. In this vast territory, there is an area where the industry in question is represented in its typical form. This is a region that includes Southern Georgia (Edzani site), and the southern and western coast of the Caspian Sea (Ali Tepe, Kamarband, Dam-Dam-Cheshme II sites)* (Kozłowski, 1996).

In the area of distribution of the Trialetien, the Caucasian-Caspian cultural province is identified, which includes the territories of the Imereti, Black Sea, and Shan-Koba Mesolithic cultures** (Ibid.). The researcher writes that "with high probability, the Trialetien was an industry of hunter-gatherers in the forested territories of the Caucasus, Elbrus, Kopetdag, Nebitdag, Eastern Taurus, and the northern slopes of Zagros; possibly, it was spread on the Iranian Plateau" (Ibid.: 163).

In the Trialetien industry, primary flaking consisted of prismatic, sub-conical, and cube-like cores, which are designed to produce both blades and flakes. Discoidal cores on small chips or concretions, as well as on large flakes, regularly occur. Core-flaking was carried out using a punch technique.

According to Kozłowski, geometric microliths form a great part of the retouched tools in this industry. They are predominantly large in size (over 15 mm long), often made on blades or fragments thereof, but not on bladelets. The collections of sites of this type contain numerous "para-Gravettes" and long, narrow, and ordinary (small) segments; there are also elongated asymmetric triangles and isosceles triangles, as well as large asymmetric and symmetric trapezoids.

The beginning of the development of the Trialetien industry in its typical form—not later than 10.5 ka BC—is established by the materials of the southern Caspian region (Ali Tepe site). The second phase of the industry's development—9 ka BC—is determined as the phase of the widespread use of trapezoids. The third phase, dated to 8–7 ka BC (Edzani, Hallan-Chemi stage), is distinguished by a significant decrease in the proportion of trapezoids in the toolset.

In the west and north of the common area of distribution of the Trialetien, the destiny of the culture is thought to have developed differently. Kozłowski writes: "In the Kura River valley [rough error in localization. – **H.A.**], the Chokh variant of the Trialetien is represented in somewhat modified technological form with pottery, while in the southeast of Turkey the Trialetien is transformed to the local variant of PPNB, probably as early as the beginning of 7 ka BC (Çatalhöyük, early stage)" (Ibid.).

Chokh culture

The most representative site of this culture is the Chokh site, located in the central (mid-mountain) part of Dagestan (northeast of the Greater Caucasus), with cultural deposits from the Mesolithic, Neolithic, and the Bronze Age. The notion of the "Chokh archaeological culture" emerged in the mid-1960s with the replacement of the "stadiality" approach in explaining the Upper Paleolithic of the Caucasus by the concept of culturalism (Bader, 1965). Initially, the Chokh culture was perceived as mainly Late Paleolithic. Four of the lower six layers of the site were wrongly dated to the Upper Paleolithic (Kotovich, 1964). Almost 30 years after the first excavations, it has become clear that the upper layers of the site are Neolithic (layer C) and Bronze Age deposits (horizon C1), while the two lower lithological layers (layers D, E) contain Mesolithic archaeological materials (Amirkhanov, 1987). Then, the features of primary working techniques, flint tools of specific types, and groups of implements were revealed, that have been recorded in such a combination only at this site and (almost) nowhere else.

The most peculiar Chokh features were recognized to be the following implements: points (arrowheads) of the Chokh type (in four variants), knives with distal retouched backs, low elongated asymmetrical triangles, and cores of archaic shapes (discoidal, similar to Levallois), which occur in the materials of all stages of the Chokh culture development.

*The area where the listed sites and the Chokh site are located was earlier identified by us as the Southern Caspian Mesolithic area (Amirkhanov, 1987).

**It is strange that the Shan-Koba culture of the Crimea is included in this province, but the Chokh and the Trialeti cultures of the Caucasus are not listed. In 1999, Kozłowski excluded the Crimea from this area (Kozłowski, 1999) and did not subsequently change his opinion on this issue (Kozłowski, Aurenche, 2005).

A distinctive component of this culture is trapezoidal pieces—always carinated, sometimes asymmetrical, with straight or slightly concave sides. It was noted that the flint tools from the Chokh site and their working technique were changing from the lower Mesolithic layer to the upper one very gradually, so that one cannot conclude about qualitative transformations. In the goods from the Neolithic layer, there appeared pottery, brand-new types of tools (harvesting-knives and grinders), and items indicating the start of house-building and the formation of new subsistence patterns.

Notably, the significant changes accompanying the introduction of Neolithic innovations, at a certain developmental stage of the Chokh culture, had almost no effect on the flint industry's typology. The Neolithic layer's assemblage shows continuity with the materials of the underlying (Mesolithic) layers. This is reflected in the basic types of culture-specific flint tools: Chokh-type points, knives with retouched distal slanted backs, elongated asymmetrical triangles, and certain varieties of carinated trapezoids. Cultural ties with the industries of the underlying Mesolithic layers are evidenced by the presence of sub-Levallois cores, which were also in use during the Neolithic. These forms differ from their archaic analogues, first, in their size (at the Chokh site, these are always small), and second, in their trend for production of small flakes to make arrowheads (mainly of the Chokh type). In other respects, the described cores correspond to the morphology and characteristics of almost all well-known (Lyubin, 1965) variants of pieces of this Middle Paleolithic category, including varieties with a faceted (in some cores from the Chokh site, faceting is replaced by a retouch) edge of the working part of the striking platform. Discoidal cores also occur sporadically in the Neolithic layer.

Among the typical elements of the lithic evolution of the Chokh culture, mostly important is the appearance, in the Neolithic layer of the site, of signs of the use of manual pressure technique for the production of blanks in the form of micro-bladelets.

The area of distribution of the Chokh culture, according to the modern data, includes the mountainous part of Dagestan, or the central part of the northeastern Caucasus.

One radiocarbon date was obtained for each Mesolithic layer of the site: layer D, excavations 1957, charcoal ($IGAN_{AMS}$ 6313), σ 68.3 % 12,830–12,959 cal BP; 2σ 95.4 % 12,784–13,010 cal BP; averaged date 10,341 BC; layer E, excavations 1980, bone ($IGAN_{AMS}$ 8112), σ 68.3 % 12,830–12,959 cal BP; 2σ 95.4 % 12,784–13,010 cal BP; averaged date 10,872 BC. Judging by these dates, the Chokh culture dates back to the Late Dryas (ca 11,000 cal BC). Its Mesolithic phase probably lasted until the beginning of the Atlantic (late 7th millennium BC). This assumption requires confirmation by absolute dates. Research in this direction is ongoing, and will hopefully yield more definite results in the near future.

Discussion

The above-mentioned expert in the Late Stone Age archaeology, S.K. Kozłowski, studied and interpreted many Mesolithic materials of the eastern Caucasus. Especially noteworthy is his contribution to the study of the geography of the Near Eastern Caucasian cultures: in particular, relations between the Mesolithic cultures of the Caucasus and the cultures of Zagros, Taurus, Anatolia, southern Caspian region, Central Asia, and Iranian Plateau (Kozłowski, 1994, 1996, 1999; Kozłowski, Aurenche, 2005). Nevertheless, these works show certain factual errors and are unconnected with specific materials. For example, in the description of the Chokh variant of the Trialetien, he points to the Kura River valley in the southern Caucasus as the area of its distribution rather than the northeast of the Greater Caucasus (Kozłowski, Aurenche, 2005: 52). Another example: the Mesolithic culture of the western Caucasus is perceived by Kozłowski as identical to the Shan-Koba culture of the Crimea (Ibid.). The issue of the typological features bringing together the Mesolithic materials of the Crimea and Caucasus was also studied by other researchers (Bader, 1961); probably, these are the works that Kozłowski relies on. It is important to note that the researcher's predecessors see the origin of this proximity in a single line of development of the cultures in the compared regions. It is not quite clear why Kozłowski, being a supporter of the concept of multilevel (four levels) manifestations of similarity between industries, has not adopted this point of view (Kozłowski, Aurenche, 2005).

The notion of Trialetien, proposed by Kozłowski, had attracted almost no attention from Russian researchers of the Caucasian Mesolithic, nor from their Southern Caucasian colleagues. Meanwhile, it

deserves a thorough analysis. First, noteworthy is a lack of clarity in the methodological justification of the cultural community called the "Trialetien" and the extensiveness of its area of distribution. The typological justification for the Trialetien proposed by Kozłowski seems vague: the area of distribution of this industry included the whole Caucasus, part of Southeastern Europe (the Crimea), the Anatolian and Iranian highlands, Northern Mesopotamia, the southern Caspian region, and the western part of Central Asia (at least Kopetdag, Nebitdag). The excessive size of this area was evident to Kozłowski himself; in his 1996 work, the Crimea was excluded (Kozłowski, 1996).

Notably, the northern slopes of the eastern Greater Caucasus are not mentioned among the territories of the Trialeti industry (Trialetien). As noted above, this is due to the fact that Kozłowski erroneously believed the Chokh site (one of the principal sites of that industry) to be situated in the Kura Valley in the southern Caucasus. In fact, this site was situated in the northern part of the Greater Caucasus Range, and its typical landscape was not a river valley in the Caspian lowlands, but a mountain steppe on a plateau-like upland with absolute heights of 1700–1800 m above sea level.

If we analyze the technical-typological features of the Trialetien listed by Kozłowski in his publications of different years, we should note their almost complete coincidence with the features that we used to define the Chokh Mesolithic culture (Amirkhanov, 1987). According to Kozłowski, in the typological set of the Trialetien, only the Chokh-type points are absent. In terms of methodology, this fact is very indicative. The Chokh-type points are a culture-defining type; they form the basis of the specificity of the Chokh culture. To acknowledge this means to agree that the Chokh culture has a special place in the Trialetien. From this alone it follows that there is a need to structure the materials included in the broad concept of "Trialetien industry" and to justify this cultural community (if it really existed) as a multi-layered and multi-component entity.

Earlier, the items similar in their typological status to Chokh-type points (in fact, culturally diagnostic forms) served as a basis for identifying archaeological cultures in the Mesolithic of the Caucasus. It is precisely because of this kind of diagnostic material that the Chokh culture was never considered analogous to the Trialeti. The common feature of the two cultures was that they had practically the same features that differentiated them from the Mesolithic materials of the western Caucasus. If this kind of cultural similarity between the Trialeti and the Chokh cultures has not been described in the literature, it is only because it was perceived as obvious and not challenged by anyone. Another reason was, as noted above, a certain ambiguity in the typological justifications for the identification of the Trialeti culture.

In view of the above, it is surprising to note the complete absence of any mention in Kozłowski's works of the Chokh archaeological culture as a separate cultural entity in the region under study. This is despite the fact that the Caucasian culture has much more material and typological references than any other Mesolithic or Neolithic culture of that region. For example, there is a specific type of piece with the eponym "point (arrowhead) of the Chokh type".

This lack of attention to the methodological aspect of the distinction between the notions of "typical Trialetien" and "Trialetien industry" could not but affect the identification of their place in the hierarchy of notions and the boundaries of the areas of cultural communities. The typological content of the first notion is more definite than that of the second. As for the typical Trialetien, according to Kozłowski, the list of the relevant sites, *stricto sensu,* curious as it may seem, lacks the Trialeti sites themselves, if we perceive the Trialeti culture as it was originally identified (Gabunia, 1976) and repeatedly described in the literature.

It is noteworthy that the notion of "typical Trialetien" (i.e. Trialetien *stricto sensu*), according to Kozłowski, corresponds to the sites of the southeastern Caspian Sea coast (Kamarband, Hotu, Ali Tepe, etc.), the eastern Caspian region (Dam-Dam-Cheshme II, Djebel), and the northeastern Caucasus (Chokh). Notably, we have already identified exactly this group of sites as a certain broad community forming the "Southern Caspian Mesolithic area" (Amirkhanov, 1987: 202–203). We regarded it as a unity of related archaeological cultures, which have deep genetic roots and differ from those of the Northern Caspian Mesolithic area.

Now, almost 40 years after the publication of this point of view, representatives of the new generation of Iranian archaeologists have given the culture of the above region a slightly modified, but essentially similar name—"Caspian Mesolithic" (Jayez, Nasab, 2016). In this variant, the cultural entity in question is associated with the territory of the southeastern

Caspian coast within the north and northeast of modern Iran. In addition, the sites of this region were rather categorically excluded from the relatively narrow cultural entity classified by Kozłowski as the Caucasian-Caspian community within the Trialetien, but also from the Trialetien in its broadest sense. In the newer concept, the sites of the eastern Caspian region (Dam-Dam-Cheshme II, Djebel, Kaylu) are considered as cultural analogues of the Iranian sites of the southeastern Caspian region (Ibid.).

The Chokh site, located in the mountains that fringe the Caspian Sea from the west, was not included by the Iranian researchers in the Caspian Mesolithic area. This can be explained by ignorance of the Chokh materials. As noted above, Kozłowski handled the Chokh materials by relying on generalizations of the authors, most of whom had not seen the Chokh materials themselves. New researchers of the sites in northeastern Iran already use in their developments the third-level generalizations made by Kozłowski. This explains the uncertainty, in particular, about the boundaries of the "left wing" of the "Caspian Mesolithic". In cases where these researchers have full knowledge of cultural formations, they are extremely precise in determining their localization. For example, they consider the central part of the Iranian Plateau (at least its eastern regions) as a region whose neolithicization was influenced by Zagros cultural impulses, but in no way by the Trialetien (Nasab, Solange, Shirvani, 2019).

Among the South Caspian Mesolithic sites, the closest to the Chokh site is Ali Tepe, the earliest in the specified group. Typologically, their similarity is expressed in the materials of both sites by the presence of elongated segment-like points, knives with distal retouched backs, asymmetrical triangles, and single carinated trapezoids. Individually, these implements are typical of both the Final Paleolithic and the Early Mesolithic of the Caucasus; but together in one toolkit they occur rarely, especially in combination with a flat core with a straight flaking surface. Each of the sites under consideration shows its own specific types of hunting-weapon: at the Chokh site, these are points (arrowheads) of the Chokh type, and at Ali Tepe the stemmed forms of arrowhead (with lateral and symmetrical marginal notches). Later on, in the southern Caspian region, the latter are replaced by large asymmetrical trapezoids, each with a notch on one lateral side, which might be called beveled points (arrowheads) with notches in their bases.

Notably, the materials of the Lower Mesolithic layer of the Chokh site and those of the Early Mesolithic of Ali Tepe are chronologically correlated.

Conclusions

The use of the notion of "Trialetien" proposed by Kozłowski in its broad meaning is feasible only to distinguish the "barbaric" Mesolithic hunter-gatherer cultures that spread north of the Taurus and Zagros mountains from the Early Neolithic cultures of the Fertile Crescent with production economies, which appeared there no later than the late 9th millennium BC.

Technologically, the "Trialetien" sites are united by the absence of any signs of the manufacture of stone blanks by pressure technique. This undoubtedly adds flavor to the industry, but is not enough to distinguish a specific cultural-chronological entity on this basis. After all, this feature is inherent in any cultural community that was not familiar with the lithic reduction-technique in question.

The present state of research on specific archaeological materials and issues of the Mesolithic in both the eastern Caucasus and the circum-Caspian area does not require any substantial revision of long-standing general assessments and descriptions of the cultural geography of the region in question at the turn of the Pleistocene-Holocene. Techno-typological analysis of specific materials allows the identification (in the eastern Caucasus, the southern Caspian Sea coast, and the eastern Caspian region) of a unity of related but at the same time independent archaeological cultures. These include such cultures as the Chokh in the northeastern Caucasus (Amirkhanov, 1987), possibly the Trialeti in the southern Caucasus (Gabunia, 1976), the Southern Caspian in the north and northeast of Iran (Jayez, Nasab, 2016), and the Balakhan in the eastern Caspian region (Korobkova, 1970). The community of these cultures has been previously substantiated, and the area of their distribution has been determined as the Southern Caspian cultural area (Amirkhanov, 1987).

Thus, the notion of "Trialetien", introduced by Kozłowski at the end of the last century, but not very well established in the literature, seems redundant for the following reasons. Above all, a culture with this name (Trialeti) had previously been identified by another researcher on different grounds and in a

different territory. Moreover, the introduction of a new concept adds nothing to the understanding of the cultural geography of the territories in question during the Mesolithic. The inclusion of the Trialeti archaeological culture in its traditional sense into the above-mentioned broad Southern Caspian cultural area can be regarded as a novelty. We can agree with this assumption, although Iranian researchers (Jayez, Nasab, 2016) deny the connection of the Mesolithic industry of the southern Caspian region (Komishan Cave) they study with the Trialeti culture. In our opinion, there are differences between the industries of these areas at the level of archaeological cultures, but this does not invalidate the similarities between the materials in question at the super-cultural level, i.e. at the level of a group of related cultures. This is what we had in mind when we proposed the notion of "Southern Caspian cultural area". This view of the situation seems to correspond to the state of archaeological realities today.

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Ornaments Made from *Unio* Shells in a Neolithic Burial at Ust-Aleika-5, Barnaul, Southwestern Siberia

The search for a Mongolian era cemetery at Ust-Aleika, Kalmansky District, Altai Territory, in 1982 revealed a Neolithic child burial, which was excavated. The funerary items included over 300 artifacts made of organic and inorganic materials, among them more than a hundred pendants made from fossil Pleistocene shells of Unio mollusks, which do not occur in the Ob basin at present. These thick-walled shells had been procured from the Kalistratikha I exposure on the left bank of the Ob. The pendants had been made according to a hitherto unknown technique: they are irregularly ellipsoid with segment-shaped longitudinal and transverse sections. The thickness of the shells allowed the artisans to use relief, which is difficult or impossible with shells of modern bivalves from the Upper Ob basin. Burial 2 at Ust-Aleika-2 dates to the middle or late 4th millennium BC. It belongs to the same cultural and chronological group as burials 1 and 5–9 at Solontsy-5, and a double burial at Bolshoi Mys (Itkul), excavated by V.I. Molodin in 1976.

Keywords: *Child burial, Neolithic, Barnaul area, Ob basin, ornaments, Unio shells.*

Introduction

The Ust-Aleika-5 site was discovered in 1981 in Ust-Aleika village, Kalmansky District, Altai Territory (Fig. 1). At that time, during the power line's construction works, a Mongolian era burial 1 was destroyed. The cemetery is located on a small promontory formed by the left side of the River Alei valley in its mouth zone, where the old Alei riverbed joins the Ob floodplain. The promontory is crossed by Partizanskaya Street. In 1982, during the search for a cemetery of the Mongolian era, a Neolithic burial 2 was discovered and excavated—a single vertical burial of a small child with abundant grave goods. The grave was 0.6–0.7 m deep in the virgin land and ca 0.3 m in diameter.

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The anthropological materials recovered from burial 2 at Ust-Aleika-5 cemetery were explored in the 1980s at the Department of Human Anatomy of the Altai State Medical Institute (postcranial skeleton, identified by A.I. Sterlin) and in the Anthropology Department of the Tomsk State University (fragments of the skull, identified by V.A. Dremov). On the basis of osteometric data on the long bones, the age of the buried child was determined as in the interval of 18–20 months; and according to the morphological features of the skull and teeth eruption, in the range of 2–3 years.

As a result of work with the fragments of the child's skull (Inv. No. 3305), kept in the Anthropology Department of Tomsk State University, it was possible to restore its shape (Fig. 2) and obtain important craniometric characteristics, as well as data on odontological features. The use of modern anthropological methods made it possible to clarify the age of the child on the basis of the size of tooth germs and the degree of formation of their roots. The age of an individual from the Neolithic burial is determined as in the range of 1.5–2 years.

The reason for the extraordinary set of grave goods and the funeral rite in general could be the pathological status of the buried. An unclosed anterior fontanel on the skull of a 1.5–2-year-old child, and its significant area, as well as the horizontal and circumferential dimensions of the braincase, which are very large for this age, with the normal size of the facial region, indicate macrocephaly, probably due to hydrocephalus.

The reconstructed "adult" dimensions of the child's skull suggest the male sex for the buried. The derived craniometric and odontological parameters suggest the attribution of the individual to the anthropological stratum of the autochthonous population of the central regions of Eurasia, represented in particular by craniological series of the Neolithic period from the cemeteries of the Barnaul-Biya-Ob region, the northern foothills of the Altai, the Middle Irtysh region, and the Aral Sea region.

In total, 328 artifacts from the collection of burial 2 at Ust-Aleika-5 were passed on to the Museum of Altai

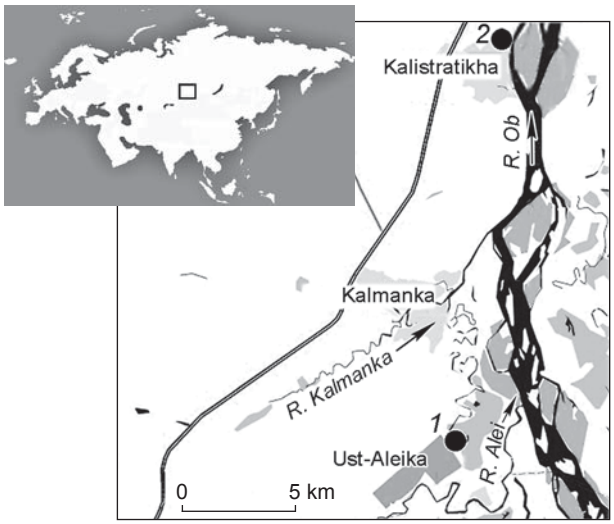

Fig. 1. Location of the Ust-Aleika-5 site (*1*) and the Pleistocene deposits exposure at Kalistratikha I (*2*).

Archaeology of Altai State University, including 124 mother-of-pearl pendants. This collection also includes 129 drop-shaped pendants made from thin polished bone (horn?) (Fig. 3, *1–3*), and 25 items made from red-deer incisors (Fig. 3, *4–6*); each item has a small hole for hanging. Some show the traces of a strap (grooved structures with soft smoothed edges) 3.5–4.0 mm wide (Fig. 3, *5*).

In total, 49 lithic artifacts were found in the grave, including six intact bifaces (Fig. 3, *7*) and nine fragments, three tools on siliceous shale plates, four tool fragments, an axe with polishing signs (Fig. 3, *8*), four arrowheads, an abrader with a longitudinal groove, a scraper, and two retouched flakes. Production waste (17 spec.) consists of flakes, fragments, and a spall from a polished tool. Quite interesting is a small piece of trapezoidal hematite with numerous scratches and traces of smoothing. A horn point was also found. Three marmot mandibles (identified by N.D. Ovodov) were found in the grave; and also 23 marsh

Fig. 2. Neolithic child's skull from burial 2.

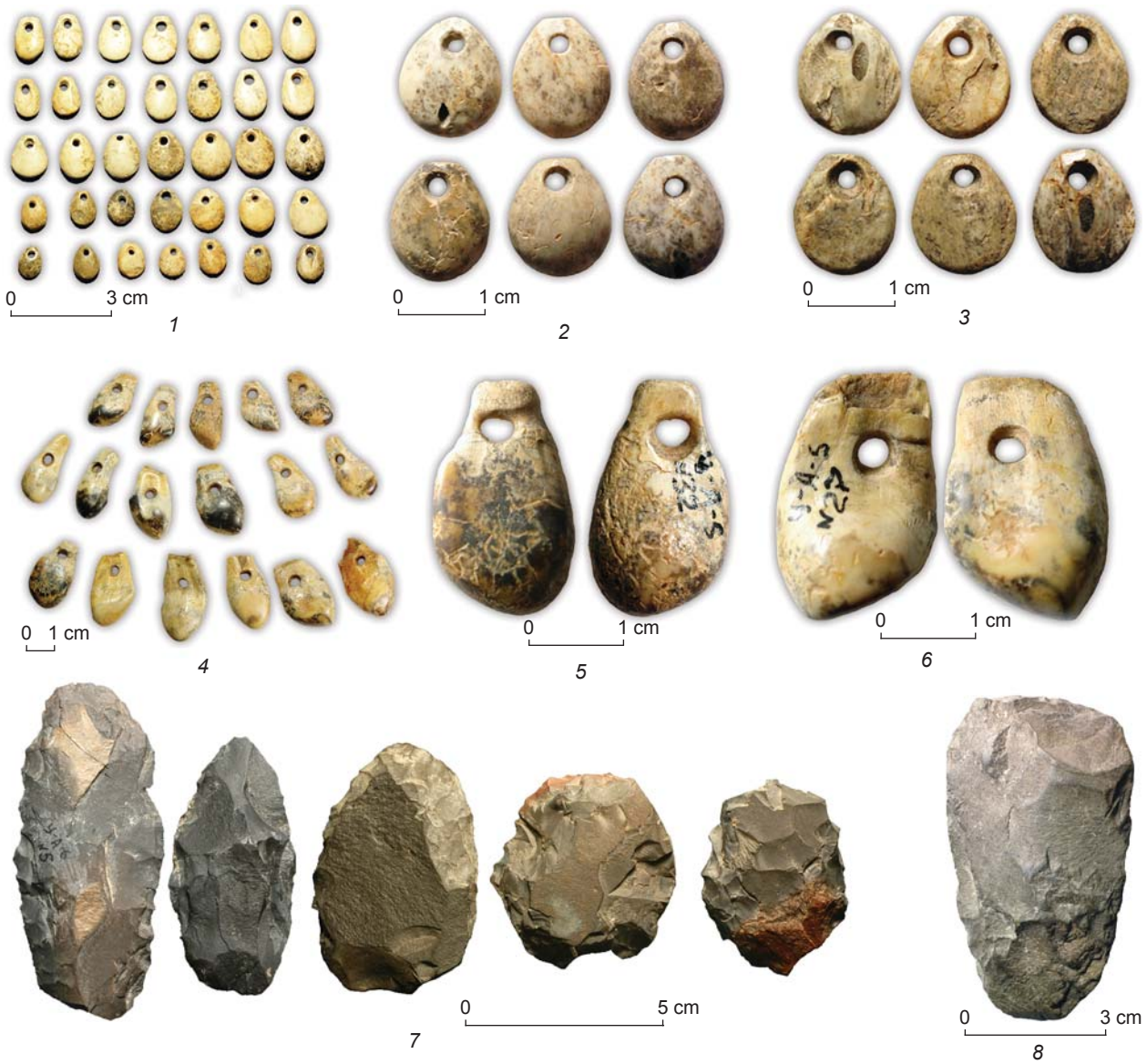

Fig. 3. Grave goods.
1–3 – drop-shaped pendants from bone and horn (*1*, *2* – obverse, *3* – reverse); *4–6* – pendants from red deer incisors; *7* – bifaces; *8* – an axe.

harrier bones, all from a single individual (identified by N.V. Martynovich).

Infant burial 2 at Ust-Aleika-5 is atypical among contemporaneous sites of the Altai and adjacent regions. The mother-of-pearl ornaments from the shells of large bivalve mollusks from this burial are very unusual. Such items are relatively rare in the burials of the region under consideration. Since the sources of raw materials suitable for their manufacture (reservoirs with the relevant types of mollusks or localities of fossil shells) are often known, such finds make it possible to reconstruct the area of movements and/or the cultural ties of the local population (Kiryushin Y.F., Kiryushin K.Y., Schmidt et al., 2011; Kiryushin Y.F., Kiryushin K.Y., Demin et al., 2012). Certain artifacts made from mollusk shells from the Chalcolithic–Bronze Age burials of the Ob region and the foothills of the Altai proved to originate from rather remote regions (Ibid.). In this regard, all finds of this kind are of considerable interest.

Study results

Mother-of-pearl pendants are 1.0–1.5 cm long and 0.8–1.0 cm wide, their average thickness is 2.0–2.2 mm (the largest is 3.0 mm). The state of the products' preservation is poor. The mother-of-pearl layer crumbles heavily. Most of the pendants are heavily damaged, but some of the items are quite well preserved (Fig. 4–7), and some items even show a characteristic mother-of-pearl sheen

Fig. 4. Mother-of-pearl pendant of irregular ellipsoid shape.
1 – obverse; *2* – its fragment.

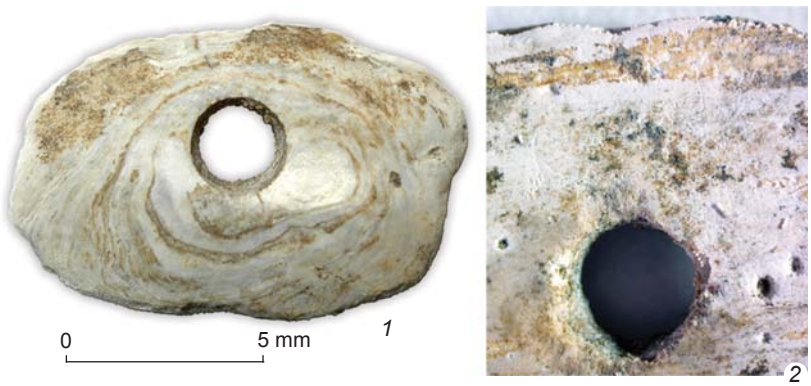

Fig. 5. Mother-of-pearl pendant of subrectangular shape.
1 – obverse; *2* – reverse fragment.

Fig. 6. Mother-of-pearl pendants.
1 – obverse; *2* – reverse.

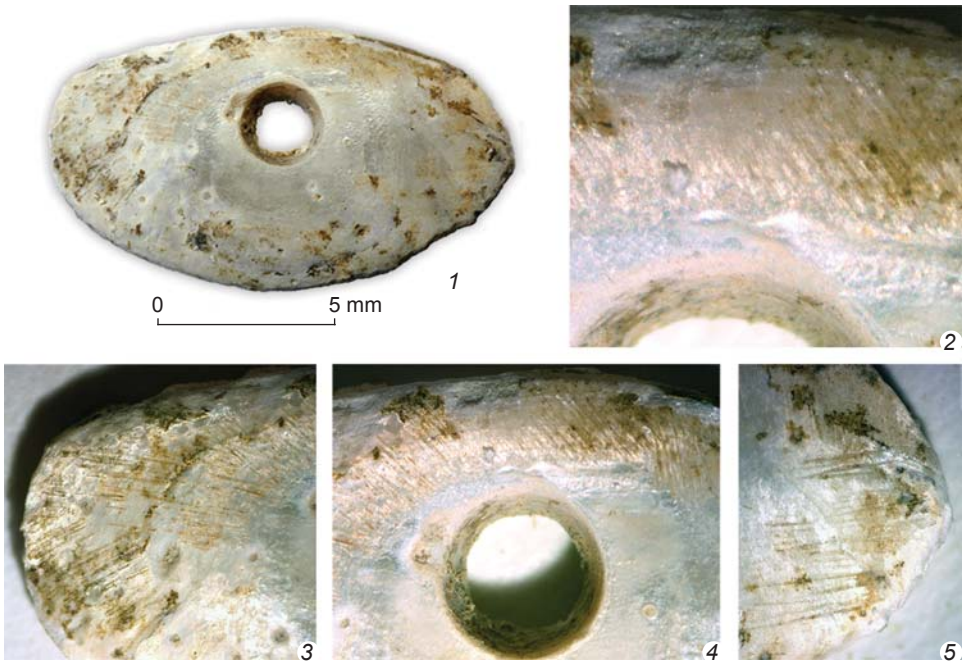

Fig. 7. Mother-of-pearl pendant.
1 – obverse; *2–5* – its fragments.

(see Fig. 4; 6, *B*; 7). Most of the ornaments have an irregular ellipsoidal shape (see Fig. 4), but there are also subrectangular ones (see Fig. 5).

All the pendants have conical holes, the diameters of which are smaller on the reverse side of the product than on the obverse side. In most of the pendants, the hole is located closer to the upper edge (see Fig. 4; 6, *B*; 7), but some of them bear the hole almost in the center (see Fig. 5; 6, *A*). In most cases, the hole's edge is polished from the reverse (see Fig. 5, *2*; 6, *A*, *2*; *B*, *2*).

Several pendants show traces of fastening (grooved marks with smoothed edges) 0.15–0.18 mm wide on the obverse (see Fig. 4). On some items, these marks are recorded on the reverse, but they are rather vague (see Fig. 5, *2*). These are the characteristic traces of attaching an item to clothing. There is no doubt that the mother-of-pearl items were used as pendants, each of which was individually attached to the outfit. These ornaments looked quite impressive, showing the brilliance and play of mother-of-pearl.

On the reverses of the pendants, growth lines of shell valves are visible (see Fig. 6, *A*, *2*; *B*, *2*). The affiliation of these artifacts to mollusk shells is also proved by the remains of the horny (periostracal) layer on the obverse of some specimens (see Fig. 4, *1*).

All pendants show a segment-shaped cross-section in the longitudinal and transverse views; the reverse being almost flat, while the obverse is convex. Owing to removal of material through grinding, the shells' growth lines in the central parts of the pendants, on their outer sides, became concentric. The reverse of the products was processed on a rather coarse abrader, traces of which are visible to a certain degree on all pendants. The obverse of almost all products is carefully polished. Grinding marks formed in the course of pendant shaping are found only on a few items (see Fig. 4, *1*; 7, *2–5*). Radial scratches, sometimes deep, are traced mainly along the edge, and are absent in the medial part (see Fig. 7, *2–5*). In most cases, they are smoothed through subsequent careful polishing of the obverse of the products. It can be concluded that during the manufacture of a pendant, the reverse of the shell became the obverse of the item, and the obverse became the reverse side.

As noted above, thickness of the pendants is 2.0–2.2 mm on average (the largest is 3.0 mm). Taking into account that the items were polished, the initial thickness of the original shell valves should have been at least 2.5–3.5 mm. At the same time, the relative position of growth lines indicates shell sizes of approximately 10–15 cm.

As noted above, the pendants are 2.0–2.2 mm thick on average (the thickest is 3.0 mm). The items were polished, hence, the initial thickness of the shell valves from which they were made should have been at least 2.5–3.5 mm. At the same time, the relative position of growth lines indicates shell sizes of approximately 10–15 cm.

In the continental regions of Northern Eurasia, there is only one group of bivalves with similar thick-walled shells. This is the genus *Unio*, pearl shell, which does not occur in the modern fauna of the Upper Ob region (Kuzmenkin, 2013). Swan mussel of the genus *Anodonta*

(*Colletopterum*), which is similar in shell size and widespread in the region, has rather fragile thin-walled shells (Starobogatov et al., 2004). The largest modern swan mussels in the Upper Ob region have the valves with a maximum thickness of 2.4 mm (in their joint area), but their average thickness is much less, in the range of 0.7–1.0 mm. These are the reliable grounds for attribution of the mollusks, from the shells of which these ornaments were made, to the genus *Unio*.

The Kalistratikha I exposure of the Pleistocene deposits was established on the bank of the channel of the Ob near the northern outskirts of Kalistratikha village, Kalmansky District, Altai Territory (see Fig. 1), approximately 18 km north of Ust-Aleika-5. The stratigraphic sequence of the section was subjected to paleontological analysis, and was attributed to the Middle to Late Pleistocene (Zudin, Panychev, 1968; Razrez…, 1978: 42–43; Stratigrafiya…, 1977: 20–21). The Kalistratikha exposure contained numerous faunal remains (bones of large and small mammals, mollusk-shells, micro- and macro-plant remains) (Razrez…, 1978: 42).

The reliable habitats of *Unio* bivalve mollusks that are closest to the study area are currently located in the basin of the Tobol River and Bukhtarma Reservoir. However, these mollusks appeared there relatively recently, presumably as a result of human activities that contributed to their dispersal from the nearby areas of the Volga-Kama basin, or during the introduction of commercial fish (Babushkin et al., 2021: 3). The only *Unio* population in the region with a presumably relict aboriginal origin inhabits the Cherny Irtysh River in the vicinity to the Kazakhstan border with China (Ibid.: 8). Thus, the areas of the modern habitation of *Unio* are rather far away from the Ust-Aleika-5 cemetery. The area of distribution of this group of mollusks in the 5th–4th millennium BC hardly differed significantly from the modern one. However, fossil Pleistocene *Unio* mollusks are fairly typical for the Upper Ob region (Maloletko, 1972: 67, 81).

To test the hypothesis on the possible use of fossil material in the manufacture of ornaments, Pleistocene mollusk shells from Kalistratikha I were studied. The exposure was inspected and samples were collected in October 2021. Numerous fragments and whole valves (Fig. 8) of *Unio aff. tumidus* pearl shell were recovered from a Pleistocene layer of bluish-gray clays, ca 3 m above the river level. The shells have also been noted on the beach downstream. The remains of *Unio* shells (mostly small fragments, very rarely whole valves) also occur upstream from the indicated place, for about 5 km. Intact valves are oblong-oval in shape and 8–15 cm long. Their thickness varies from 2.1 to 4.0 mm. The corneous layers of the shells extracted from the deposits crumble quickly; their fragments remain only along the growth lines. The general state of preservation of the valves seems to be sufficient for the manufacture of small items.

The features of the state of preservation of the artifacts under discussion indicate fossilization of the raw material; the samples of Pleistocene shells collected at Kalistratikha I in the fall of 2021 demonstrate the same state of preservation. This fact, and the proximity of the section to Ust-Aleika-5, make it possible to conclude that it was the material from this exposure that was used to manufacture the ornaments.

Discussion

Categories of artifacts from burial 2 at Ust-Aleika-5 are widely represented in the Neolithic and Chalcolithic materials from the Barnaul Region of the Ob and adjacent territories. It is generally accepted in the scientific literature that some of them (drop-shaped pendants made of bone or horn) were widespread "in the cultures of the Neolithic and Early Bronze Age of Eurasia, and it makes no sense to provide parallels to them" (Molodin, 1999: 44). Therefore, to determine the cultural and chronological position of the burial under discussion, it is necessary to consider the available absolute dates.

Radiocarbon dating of the bone samples (drop-shaped pendants) from burial 2 at the Ust-Aleika-5 flat-grave

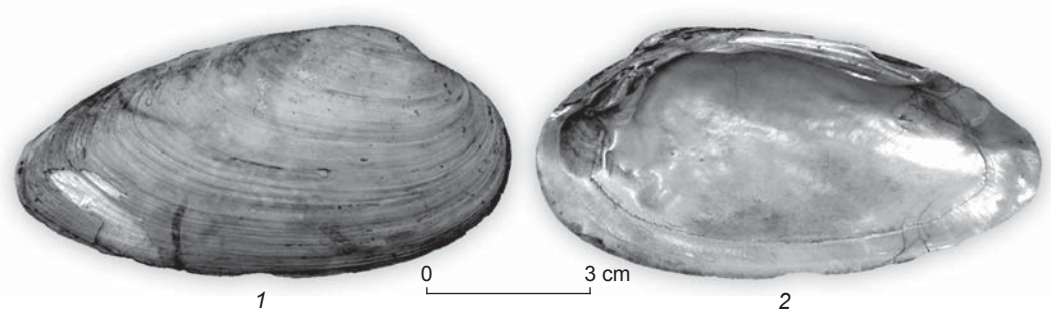

Fig. 8. Unio aff. tumidus fossil shell from Kalistratikha I exposure.
1 – obverse; *2* – reverse.

burial ground was carried out at the Center for Collective Use "Laboratory of Radiocarbon Dating and Electron Microscopy" of the Institute of Geography RAS, in the Center for Applied Isotope Studies at the University of Georgia, USA (outsourcing), and at the Budker Institute of Nuclear Physics SB RAS. Two AMS-dates have been derived: 5550 ± 25 BP (IGAN-5829) and 5219 ± 86 BP (NSKA-01941). The intervals of calendar age determined through calibration show a small scatter for the first date (4445–4415, 4400–4380, 4375–4350 BC by 1σ, and 4450–4340 BC by 2σ) and a very significant scatter for the second one (4230–4190, 4170–4090, 4080–3950 BC by 1σ, and 4350–3800 BC by 2σ). It is noteworthy that there is a small overlapping of these intervals: the lower value by 2σ 4350 BC (NSKA-01941) and the upper by 2σ 4340 BC (IGAN-5829).

The closest parallels to the drop-shaped bone and horn pendants, deer incisor ornaments, and lithic artifacts found in burial 2 at Ust-Aleika 5 have been recorded in the materials of the Solontsy-5 flat-grave burial ground (Kungurova, 2005: 14–17). Burial 1 of this burial ground revealed a man of 35–40 years old and a child of ca 1.5 years old, with rich grave goods (Ibid.: 14–15). The length of the child's skeleton is 0.70–0.75 m; the skull is crushed (Ibid.). In the child burial, there were a side-bladed dagger, eleven stone arrowheads and their fragments, four stone flakes, "a piece of hematite (red mineral paint)", tusks of a musk deer, teeth of a roe deer, and three round valves of large shells (Ibid.). Unfortunately, N.Y. Kungurova did not mention the species of the shells found. In the analysis of the grave goods of the burials at Solontsy-5, the author noted that "shells" and "twisted snail shells" with "thin walls" were found in the female burials, and "shells of a different type; shell valves of *Glycymeris sp. (Anodonta sp. Corbicula fluminalis)* in male burials" (Ibid.: 33). The relevant drawings (Ibid.: 111, fig. 31, *4*) suggest that in burial 1, shells of *Glycymeris* bivalve mollusks were found.

Thus, comparative analysis of the burials with sets of grave goods similar in contents and size (Ust-Aleika-5 and Solontsy-5) has shown the coincidence in the age of the buried children, and also in the availability of stone arrowheads and flakes, as well as pieces of hematite. In addition, one of the graves yielded fossil shells, the other fossil shell ornaments. The similarities look even more significant if we take into account that the grave of a man from the same burial included ornaments made of deer incisors and drop-shaped pendants made of bone or horn (Ibid.: 106, fig. 26, *16–22*, *35*), which are almost identical to those found in burial 2 at Ust-Aleika-5, as well as stone axes and bifaces (Ibid.: 98–106, fig. 18, *26*). Burials 6–9 at Solontsy-5 revealed drop-shaped pendants made of bone or horn, round pendants made of mother-of-pearl, deer teeth, and pieces of "paint of ferriferous rock" (Ibid.: 16–17). The radiocarbon dates of 5485 ± 85 (SOAN-4627) and 5325 ± 45 (SOAN-4628) BP were obtained for burials 1 and 7 at Solontsy-5 (Ibid.: 57).

Drop-shaped bone ornaments and round mother-of-pearl sewn-on decorations were found in a double burial at the Bolshoi Mys (Itkul) cemetery, excavated by V.I. Molodin in 1976 (Molodin, 1999). Drop-shaped pendants made of bone were found in burial 5 at this cemetery (Kiryushin, Kungurova, Kadikov, 2000: 111, fig. 18). In the burials at the Ust-Isha cemetery, drop-shaped bone ornaments (burials 8, 9, and 12), pendants made of red-deer incisors, and round mother-of-pearl sewn-on decorations (burials 8 and 12) were found (Ibid.: 80, fig. 15; 89, fig. 4). Burial 12 yielded pieces of hematite (Ibid.: 14, 91, fig. 26, *4*); burial 8 contained *Corbicula* (?) shells (Ibid.: 13, fig. 15).

Drop-shaped bone ornaments and round mother-of-pearl sewn-on decorations were found in a female Neolithic burial in Kaminnaya Cave (Markin, 2000). The dates of 5320 ± 90 (SOAN-3401) and 5300 ± 150 (AECV-2040 C) BP were generated on charcoal from the grave-pit filling just above the skeleton. (Ibid.: 63).

The results of radiocarbon dating point to a contemporaneous proximity of the considered child burial to burials 1 and 7 at Solontsy-5 and the Kaminnaya Cave burial. Comparative analysis of the materials suggests that it constitutes a single cultural and chronological group with burials 1, 5–9 at Solontsy-5 (Kungurova, 2005: 14–17) and a double burial at Bolshoi Mys (Itkul), studied by Molodin in 1976 (Molodin, 1999). The currently available series of radiocarbon dates for the complexes under study was generated on various materials (animal bone and horn, human bone, charcoal from the grave-pit filling) in different laboratories, using different methods (AMS and LSC), and it can hardly be considered representative. At the present stage of the study, the available dates suggest attribution of this group of burials to the middle–late 4th millennium BC. In all likelihood, as soon as new dates become available, the chronology will be corrected. The group will probably be expanded by the inclusion of burial 5 of Bolshoi Mys (Itkul) and burials 8, 9, and 12 of Ust-Isha (Kiryushin, Kungurova, Kadikov, 2000: 12–14).

Summing up, it is worth noting that mother-of-pearl pendants of irregular ellipsoid shape from burial 2 at Ust-Aleika-5 have no direct parallels in the materials of the Neolithic-Chalcolithic sites of the Altai and adjacent territories, where only round-shaped mother-of-pearl ornaments are known. The original raw material (thickness of shells) allowed the ancient artisan to produce artifacts in relief, which would be impossible or very difficult with the modern forms of bivalve mollusk from the Upper Ob region. This issue is discussed in comparatively few papers; but the collections from the

Tavdinsky grotto (Volkov et al., 2006) and the Tuzovskiye Bugry-1 cemetery (Kiryushin Y.F., Kiryushin K.Y., Schmidt et al., 2011) suggest that the materials from burial 2 of Ust-Aleika-5 present the technology of making ornaments from mother-of-pearl, which was atypical of the region.

The mother-of-pearl pendants from the Tavdinsky grotto were made from fragments of shells; judging by their thickness and degree of preservation, these were swan mussels (*Anodonta* sp.), which inhabited the lower reaches of the Katun during the Chalcolithic. The products were from 1.0 to 2.4 mm thick (1.5–1.7 mm on average), which corresponds to the original thickness of the valves, since no signs of special processing were noted either on their reverse and obverse sides.

Traceological study of 29 mother-of-pearl pendants from the Chalcolithic horizon of the Tavdinsky grotto revealed a series of characteristic traces of grinding, polishing, drilling, etc. (Volkov et al., 2006: 253). On the basis of a cumulative analysis of products, the main technological stages of their manufacture have been established. At first, flattened fragments of shells were given the outlines rounded in plan view by rough removal of protruding outer edges (Ibid.). Then, the product was ground on a wide fine-grained abrader with a flexible base. Then, a hole was made in the central part of the product. In some cases, drilling was stopped—probably because of the risk of destruction of the mother-of-pearl plate, i.e. in the cases when the blank was relatively thin (Ibid.: 254)—and continued from the opposite side. The final stage of work was polishing the ends of the products. Their surfaces do not bear traces of special grinding or polishing. Only solitary areas showed polishing overlapping, as if "concealing", the traces of unintentional destruction (picking out) of the mother-of-pearl layer, which were produced during the previous stages (Ibid.: 255).

The process of making the Ust-Aleika-5 pendants (shaping the product and subsequent polishing) required more labor costs than other ornaments from the Tavdinsky Grotto. Apparently, in the Neolithic and Chalcolithic burial complexes of the Altai, the technological (and possibly cultural and chronological) tradition of producing round mother-of-pearl pendants can be traced, similar or very close to that of the Tavdinsky Grotto materials. This technology was adapted to the local raw materials (swan mussel shells) and was less labor-intense.

Conclusions

In the course of the research, it was found that mother-of-pearl pendants from burial 2 at Ust-Aleika-5 were made of fossil Pleistocene shells *Unio aff. tumidus*. The raw material's provenance was also established; it was the Kalistratikha I exposure on the left bank of the Ob River, 18 km north of the Ust-Aleika-5 cemetery.

The derived AMS-dates of 5550 ± 25 years BP (IGAN-5829) and 5219 ± 86 years BP (NSKA-01941) suggest the attribution of the burial to the middle–late 4th millennium BC. It has been concluded that burial 2 at Ust-Aleika-5 is chronologically close to burials 1, 5–9 of the flat-grave burial ground of Solontsy-5 and the double burial at Bolshoi Mys (Itkul) excavated by Molodin in 1976.

The discussed mother-of-pearl pendants of irregular ellipsoid shape are distinct from the similar ornaments from contemporaneous sites in the Altai and adjacent regions. The differences are largely due to the source material—fossil Pleistocene *Unio* shells, the thickness of which (from 2.1 to 4 mm) allowed the ancient artisans to make relief products, which would be impossible or very problematic when using modern forms of bivalve mollusk of the *Anodonta* genus (*Colletopterum*) from the Upper Ob region.

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The Specifics of Japanese Terms Referring to the Jōmon Period, Based on Publications by Yamanouchi Sugao and Kobayashi Tatsuo

This article discusses difficulties in the use of Japanese archaeological terminology, especially with regard to the Jōmon period. The history of the notions of "style", "type", and "form" is outlined, which are the most adequate concepts for the interpretation, classification, and description of new styles of the Jōmon pottery. The evolution of the terms is traced using the works by Yamanouchi Sugao and Kobayashi Tatsuo. Their basic views on the typology of Jōmon artifacts and the notions behind the key terms are described.

Keywords: *Japanese archipelago, Jōmon, terminology, historiography, pottery, style.*

Introduction

The terminological apparatus is an important component of any scholarly research. Terminology issues are especially relevant when it comes to the archaeology of foreign countries. The terminological apparatus used by foreign authors often differs significantly from that used in Russia. This fully applies to Japanese scholarship. An incorrectly used term may lead to problems in understanding the essence of the phenomenon under consideration. This also applies to such broad concepts as "age", "period", and "culture".

The present-day Japanese archaeological terminology is one of the hardest to understand and adapt to other languages. Many descriptive terms are purely image-based and are used to varying degrees in a regional or local context, that is over the entire archipelago or only individual islands and regions. Difficulties of translating and understanding are also illustrated by specific aspects of collaboration with Japanese colleagues, which include relatively limited access to archaeological evidence (mainly museum expositions) and do not involve foreign archaeological expeditions to Japan (only in the form of invited participants or field schools). Another feature of Japanese archaeology is related to the specific aspect of their publications, most of which contain detailed information about individual sites, but do not provide the general picture of periods and ages for large regions and the entire archipelago.

Japanese archaeologists have traditionally used different terms depending on the period of ancient history. These differences are most pronounced when working with the collections of Paleolithic and Jōmon artifacts. When describing Paleolithic evidence, Japanese scholars use the terms accepted in European scholarship, while when analyzing specific features

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of Jōmon pottery, they employ both European and Japanese terms.

In a number of articles, we have already addressed general terms applied to the Jōmon period and their origins (Tabarev, Ivanova, 2016, 2018, 2020; Tabarev, Zhushchikhovskaya, Ivanova, 2020). This study discusses the notions of "style" (*yōshiki* 様式), "type" (*katashiki* 型式), and "form" (*keishiki* 形式), used in working with large collections of pottery evidence. We will focus on specific aspects of their emergence in the works of two luminaries of Japanese archaeology—Yamanouchi Sugao and Kobayashi Tatsuo, thanks to whom these concepts were introduced and became commonly applied to scholarly research.

History of research into Jōmon pottery

A typical feature of the material culture of the Jōmon period consists of numerous ceramic vessels, most of which are decorated with sophisticated ornamental compositions. The distinctness of this pottery both in terms of decorative motifs and the shapes of vessels has attracted the attention of scholars in various fields already since the late 19th century. Studies in typology and periodization have played a central role in the history of its research. Since the late 1920s, the systematization process of a huge amount of data on ancient pottery (of the Jōmon and Yayoi cultures) began in the Japanese scholarly community, for creating a universal terminological apparatus (Kobayashi Tatsuo, 2008).

In the developed periodization and classification of large pottery complexes, there are three basic, important notions: *style*, *type*, and *form*. In the archaeological community, it was Nakaya Jiujirō who discussed them in a systemic way for the first time (1929: 354–398). Later, Kobayashi Yukio carried out a systematic study of pottery of the Yayoi period in accordance with the concept of "style-type-form", created by Nakaya Jiujirō (Kobayashi Yukio, 1933). Yamanouchi Sugao introduced the concept of "type" to which he attached fundamental importance (1932). After making a detailed comparative analysis, Yamanouchi Sugao was the first scholar to create a table systematizing pottery evidence from the entire country. Yamanouchi Sugao's approach was to identify what he called "chronological units" according to such criteria as region, stage, and distinctive features. Each of the units corresponded to types of ceramic vessels, which were distinguished by their shape, decoration, and manufacturing features. These studies were aimed at bringing the huge amount of data on Jōmon pottery into a system by finding specific patterns.

In the 1960s–1970s, a number of scholars worked on refining, detailing, and unifying pottery typology. Additional impetus was given by re-evaluation of the Yayoi culture, which started to be regarded as a phenomenon in its own right rather than an intermediate stage between the Jōmon and Kofun periods. In these years, attention to contextual information increased. Classification (continuation of Yamanouchi Sugao's typology) started to be based on criteria such as shape, style, and decorative composition. Analysis of production, use, and disposal began to be actively applied. One of the main creators of the updated classification of the Jōmon pottery was Kobayashi Tatsuo, who repeatedly expressed his thoughts on the subject and elaborated his own terminology based on the classification by Yamanouchi Sugao (1975, 1977).

In the last decades of the 20th–early 21st century, it became common among the Japanese archaeologists that the term "type" designates "a set of stable features", "style" – "unique artistic features", and "form" – "a set of morphological features". The completion of the process of unifying the conceptual apparatus appeared in special issues of *Kōkogaku zasshi* (*Archaeological Journal*) in 1996–1997. In addition, a series of works by Ōtsuka Tatsurō on revision of the concepts by Yamanouchi Sugao (1996, 2017) has been published. Recent publications on the pottery complex of the Jōmon period take into account such aspects as correlation of features, origin of types, varieties, styles, etc., dependence of types on distribution methods, individual and collective production, and possibility of pottery replication. These are only the main trends in the present-day concepts used in Japanese archaeology, which require deeper study and are outside the scope of this work.

In order to understand the emergence of the conceptual apparatus applied to the Jōmon period, one needs to consider the evolution of ideas proposed by Yamanouchi Sugao and Kobayashi Tatsuo regarding three basic concepts: *style*, *type*, and *form*.

The theory of Yamanouchi Sugao: "Type" as a basic unit in periodization of Jōmon pottery

Yamanouchi Sugao (1902–1970) was one of Japan's most respected archaeologists and a key figure in systematizing the Jōmon pottery complex. In 1923, he began to successively study the variants of rope stamp impressions found on pottery of the Jōmon period (Yamanouchi Sugao, 1929). By 1930, Yamanouchi Sugao had identified almost all of their known combinations. His studies were duly appreciated in the archaeological community as "the largest analysis of rope stamp impressions". The results he obtained made the basis for his work on general typology and periodization of pottery (Yamanouchi Sugao, 1937). After analyzing

all the archaeological evidence available at his time, Yamanouchi Sugao divided the territory of the Japanese archipelago into nine zones and identified five stages in the Jōmon period (initial, early, middle, late, and final). The subsequent studies were focused on elaborating a more detailed periodization of the pottery complex and on chronological arrangement of all sites and finds known by that time. It is important to mention that this work gave impetus to active search and identification of new styles and types of pottery in different regions from Hokkaido to Okinawa (Ōtsuka Tatsurō, 2008).

In his research, Yamanouchi Sugao focused on the following points.

1. "Type" in Jōmon pottery corresponds to a certain "chronological unit" (Yamanouchi Sugao, 1932, 1937). This category was created for resolving the controversy on periodization of the Jōmon period over the vast territory of the archipelago. Its main tool was comparative analysis and theory of continuous development of pottery traditions in the Jōmon period.

2. A group of objects belonging to the same stage of the Jōmon period and similar in shape, ornamentation, method of application, and production techniques corresponds to a single type of pottery. It contains various kinds of vessels, so the type can be divided into various subtypes (Yamanouchi Sugao, 1969). For understanding the variety of types, one needs to study social relations on the archipelago in ancient times.

As it has already been mentioned, according to Yamanouchi Sugao, the main element of pottery typology was type (*katashiki* 型式). It defines chronological and territorial differences in Jōmon pottery. The most important criterion for distinguishing type is joint occurrence of vessels in a single stratigraphic (cultural) layer, as the main temporal indicator. The second criterion is stylistic unity. It can only be used in the framework of one group of vessels with similar shape or similar ornamental motif (Yamanouchi Sugao, 1937).

According to Yamanouchi Sugao, the concept of type was sufficient for identifying Early and Late Jōmon pottery on the archipelago, but it could not escape criticism for insufficient explanation of the complicated structure of the Middle Jōmon pottery complex. In this regard, it is noteworthy that in fact Yamanouchi Sugao used the notion of variety (*shiki* 式* – abbreviation of *katashiki*), which went beyond the category of type defined by him (Ōtsuka Tatsurō, 2008). This term was suitable for describing local pottery complexes in the context of a single site, for example, the pottery of the Ento type (Late Initial – Early Middle Jōmon period, Tohoku region). However, in the case of more sophisticated complexes, the use of the category of "type" and "variety" raises many questions. For example, Yamanouchi Sugao used the concept of "pottery of the Kamegaoka variety" (Final Jōmon period, Tohoku region), which included a large number of types (Ōbora varieties B, BC, C_1, C_2, A, and A′) used as chronological units (1930). However, he did not discuss the distinction between the Ōbora and Kamegaoka varieties. For the pottery of the Angyo variety (second half of the Late to Final Jōmon period, Kanto region), Yamanouchi Sugao established the Ryōkesarugai shell midden pottery complex (Kawaguchi City, Saitama Prefecture) as referential. This group included the evidence from the Angyō, Shinpukuji (Saitama Prefecture), and Iwai (Chiba Prefecture) shell middens. It was additionally subdivided into varieties 1, 2, 3a, 3b, and 3c (Yamanouchi Sugao, 1930, 1964). Thus, it was a carefully systematized group of pottery that corresponded to the notion of "type" in the concept of Yamanouchi Sugao, based on decorative and technical and typological features that were common for all samples of this pottery. Consequently, it appears as a single whole throughout its entire existence; and therefore, this group of pottery was given one common name (Ōtsuka Tatsurō, 2008).

Using the concept of type introduced by Yamanouchi Sugao, a chronological table of Jōmon pottery was compiled for all parts of Japan. However, subsequent research in this field, and in particular the studies of Kobayashi Tatsuo, have changed the initial meaning of the term "type", thereby resolving the terminological contradiction and providing a more precise content to the notions of "style" and "form". In his study of 1975, Kobayashi Tatsuo observed that Yamanouchi Sugao operated with the single notion of "type", while in research of the Yayoi pottery three notions (style, form, and type) were employed. In his opinion, systematizing pottery evidence from the Jōmon period using only the notion of type led to confusion and multiple variations, so it was necessary to use the system of notions that were applied to Yayoi pottery (Kobayashi Tatsuo, 1975: 48–49).

The theory of Kobayashi Tatsuo: The concept of style, type, and form

Kobayashi Tatsuo, a student of Yamanouchi Sugao and Professor Emeritus of Archaeology at Kokugakuin University (Tokyo) and Director of the History Museum of Niigata Prefecture, is recognized as the world's authority on the Jōmon period. He published a large number of articles, collections of articles, multi-volume academic publications, popular and educational books, including some in the English language. Kobayashi Tatsuo's archaeological interests in the Jōmon period

*This hieroglyph can also be translated as "style", which complicates our understanding of the terminological apparatus of Yamanouchi Sugao.

included the following areas: theory of type and style (1967a, b, c), calendar and economy (1975, 1983), primary and secondary tool complexes (1977), settlement system and village model (1973, 1980), decorative and narrative ornamentation (1981, 1986), adaptive strategy and socialization (1995), landscapes and ritual complexes (2005), emergence of the Japanese language (Ōno Susumu, Kobayashi Tatsuo, 2006), and many more. Central to his works are three fundamental fields (Ivanova, 2018: 29–30):

1. Jōmon society: its lifestyle, settlement development, food procurement strategies, interaction with the environment, and ways of using the landscape for people's needs. In the late 1950s, one of the dominant trends became the study of settlement complexes (Kobayashi Tatsuo, 1973). Importantly, Kobayashi Tatsuo's approach to the issue was new for that time. He took into consideration various aspects of Jōmon sites, including their location, total number of dwelling structures, presence or absence of utility pits and burial grounds, number and types of finds, and duration of settlement functioning (Kobayashi, 2004: 99–130; Habu, 2004: 61–62).

2. Perception of the surrounding space on the basis of sophisticated ritual and ceremonial complexes (accumulations of stones, stone circles, massive wooden platforms), attributes of ritual practice (*dogū*, *sekibō*, ceremonial vessels), and *basshi* initiation ritual (Kobayashi Tatsuo, 2005).

3. Specific aspects of pottery production and identification of new pottery styles using modern archaeological evidence. Analysis of pottery styles is primarily focused on techniques of vessel manufacturing (clay composition, nature of inclusions, molding, primary and secondary finishing, temperature impact on the quality of firing and color of pottery). Using the results of studies on the inner surfaces of vessels and experimental data, the relationship between the shape of the vessels and their possible functional purposes has been established (Kobayashi Tatsuo, 1975; 1977: 159–181).

The content of the notions of style, type, and form was formed and supplemented over several decades. These terms were first used by Kobayashi Tatsuo in 1967 (1967a, b, c) and then discussed in the article "Typology" (1975). However, these concepts became widely known among scholars after the publication of Kobayashi Tatsuo's work "The World of Jōmon Pottery", where he again insisted that at least three notions had to be applied to the description of this pottery, as with the Yayoi culture (Kobayashi Tatsuo, 1977: 154). He provided a theoretical basis for differences in views on basic terms, and elaborated a system of notions for studying the Jōmon pottery. For avoiding confusion, Kobayashi Tatsuo gave the following reading of the terms that he used earlier: style (*yōshiki*), type (*katashiki*), and form (*keishiki*).

Type (*katashiki* 型式). No two vessels are alike among the Jōmon pottery. All of them have individual features, since they were made by hand without the use of a potter's wheel. However, if we look at their external features and decorative elements, we may find vessels with many common features. Such a group of pottery can be correlated with the concept of "type".

When creating a vessel, it was as if the artisan first drew in his mind a certain model of the future artifact, and then embodied the idea in clay. The idea of the object was based on the information that potters had. Different people of the Jōmon period had a common model that formed the basis of one type. Consequently, they possessed some common information, which was based on the social structure of the Jōmon society and special organization of the living space in the settlements. The people of the Jōmon period lived in small families in semi-dugouts. In most cases, dwellings were located around a "central square". It was a place for collective activities and rituals, the participation in which, above all else, played another important role: the exchange of information. The most striking examples of settlements with concentric structure are the sites of Nishida (Iwate Prefecture) and Saikaibuchi (Yamagata Prefecture) of the Middle Jōmon period (Kobayashi Tatsuo, 1973, 1980, 1990; Ivanova, 2020). Daily communication, joint work and everyday life, and common thinking—all this influenced the development of a certain model by the potters. Since "type" was formed due to contacts within a group, we can conclude that it was a collective form of expression, a symbol of society (Kobayashi Tatsuo, 1975).

A similar idea was put forward by Sugihara Sōsuke and Serizawa Chōsuke. In the former case, it was a close connection of a certain type of pottery with a certain group of people (Sugihara Sōsuke, 1943: 139–140). Serizawa Chōsuke wrote that "type 'A' corresponds to a group of people who were born in the same area, produced and used pottery, and died there…" (1958: 170–172).

The type of pottery is related to the appearance of vessels as a whole, including their ornamental composition. For this reason, it is almost pointless to establish it by fragments of the neck, bottom, or body. When it comes to decoration, the general arrangement of patterns and the motif determine a specific type, while individual elements or method of application make it difficult to correctly distinguish the type, as opposed to style, which can be identified from a small fragment giving no idea as to the general form (Kobayashi Tatsuo, 2008: 3–4).

Style (*yōshiki* 様式). Initially, Kobayashi Tatsuo explained style as individual feeling and atmosphere (aura), but the scholarly community was against using vague concepts (Abiko Shōji, 2008: 887). Nevertheless, in the understanding of Kobayashi Tatsuo, style was related not to the physical shape of the vessel or specific

decorative motif on its surface, but to the perception of the integral image (Kobayashi Tatsuo, 2008: 4).

It is standard for different types of vessels manufactured and used at the same time to be found in the same region or site. These types may differ from each other in shape, arrangement of decorative belts or ornamental motif, but they have a common "atmosphere". Usually, it is perceived during an initial visual analysis, but sometimes after touching the pottery. This is the meaning of "style" (Kobayashi Tatsuo, 1978).

In addition to "atmosphere", style is determined by manufacturing technique and method of decoration. They are described by abstract concepts: "…each style has its own feeling and atmosphere… which already relate to the manner of manufacturing a ceramic product. At all stages of creating a pot, starting from preparation of clay, kneading the filler, preparing the compound, creating a shape, drawing a pattern, and further through the drying and firing process, a certain manner typical of different areas and periods of the Jōmon period can be discerned. Precisely the manner of making the vessel at all stages creates a special feeling and atmosphere…" (Ibid.: 44). According to Kobayashi Tatsuo, the "manner of manufacturing" was associated with various aspects of the life of society in physical and religious terms. In the former case, this concerned the choice of specific raw materials; in the latter case, various restrictions, taboos, incantations, or rituals.

Uniqueness of pottery style and its special manner manifests itself at all stages of manufacturing a vessel: in the choice of clay and types of fillers, method of molding the object, degree of drying the blanks, use of specific ornamental patterns, creation of pictorial motifs, as well as firing time and intensity of oxygen supply, etc. We will not dwell on all stages, but will only mention the most striking features of some styles. For instance, the Atamadai style pottery (first half of the Middle Jōmon period, Kanto region) is a spectacular example of a special manufacturing manner. Its originality manifests itself even at the stage of clay preparation, to which mica was added as a leaner. Mica created the effect of pieces of golden leaf, making the surface of the pots shine. A large amount of talc was added to the clay of the Sobata style pottery (Early Jōmon period, Kyushu), which gave the products a special smoothness and dull gloss.

There are many similar examples throughout the Jōmon period. In some cases, we see the use of non-standard types of leaner (graphite, mica, talc, chlorite slate, vegetable fiber, wool); in others, addition of large objects to the clay, such as whole acorns (Early and Middle Jōmon period) (Kobayashi Tatsuo, 1977, 1978, 1981). Thus, the manner of making pottery, which is observed at the stage of preparing raw materials, created a certain specific atmosphere for the pottery, and this was not limited to visual perception, but might also be felt during primary processing of the artifact at the level of tactile sensations.

If in most cases at the stage of preparing clay and molding the vessel, similarities have been observed, an "explosion" of stylistic originality has been noted at the stage of applying ornamentation. A special manner of manufacturing is manifested in processing the surface of a vessel (by rubbing or polishing), using various ornamental patterns (stamps, bundles, a shell, bamboo stick, or spatula), and creating pictorial motifs. The stage of applying ornamentation was the most creative process during which a unique stylistic atmosphere emerged. The most vivid decorative variety both in terms of technological methods and tools, and in terms of ornamental compositions, appears among the evidence of the Middle Jōmon period. According to archaeological data, twenty three pottery styles existed on the Japanese archipelago at that time, each with its own special "atmosphere". A good example is two variants of one of the classic methods of applying rope decoration, when sections with and without the pattern were separated by drawn lines. In one method (B), first the impressions of the rope were stamped, and then the outer or inner part of the pattern limited by lines was smoothened; in the other method (A), the outline of the pattern was first drawn, and then imprints of the rope stamp were applied inside or outside it. The smoothened variant of ornamentation (variant B) appears on the pottery of the Moroiso (second half of the Early Jōmon period, Kanto region) and Katsusaka (middle Middle Jōmon period, Kanto region) styles. However, variant A was typical of the Kasori E (second half of the Middle Jōmon period, Kanto region), Daigi 9 and 10 (same time, Tohoku region), and Horinouchi A (early–mid Late Jōmon period, from the south of Tohoku to Kinki) styles, while variant B was typical of the Kasori B style (mid Late Jōmon period, Kanto region). At first glance, both of these variants produce almost the same effect, but this distinction reveals different choices in pottery ornamentation in terms of time, territory, and style (Kobayashi Tatsuo, 2008: 8).

Each pottery style had its own temporal and territorial framework (the so-called stylistic zones). It is important to mention that styles were not isolated from each other: their mutual influence and borrowings can be observed in the border zones. In some cases, single specimens of pottery from the neighboring "stylistic zones" penetrated far into the depths of the adjacent territories. The spread of a style can be seen by the spread of the types that constitute it. This indicates the territorial unity of the group that used the same manner of pottery manufacturing. According to the majority of experts, the spread and mutual influence of styles occurred due to marriage unions (Ibid.: 9).

For the space of 10,000 years of the Jōmon period, Japanese scholars have identified over seventy five

main pottery styles*, which appeared one after the other in different places. They were the markers of local (regional) communities. According to Kobayashi Tatsuo, this indicates the existence of groups distinguished by commonality of thoughts regarding a certain atmosphere and its embodiment in pottery (1995). Yamanouchi Sugao described a territorial unit as an area corresponding to the habituation of a tribe (group) speaking the same dialect. The sedentary way of life, protection of one's own territory with its further modification (improvement) led to stabilization of the Jōmon society of hunter-gatherers. Development of trade networks within the archipelago led to the emergence of federations and areas with domination of specific dialects. Their boundaries to some extent may reflect the areas of specific styles (Yamanouchi Sugao, 1969: 86–88; Ōno Susumu, Kobayashi Tatsuo, 2006).

Form (*keishiki* 形式). Unlike "type", which determines style at a particular time and place, the notion of form goes beyond style. This notion is associated with the kind of items that have common morphological features, such as deep pots (*fukabachi* 深鉢), shallow pots (*asabachi* 浅鉢), jars (*tsubo* 壷), plates (*sara* 皿), etc. Form correlates with the function of the item, and characterizes it as an item belonging to kitchen utensils.

Forms of Jōmon pottery resulted from consistent adaptation of the carriers of the Jōmon culture to the natural conditions of the Japanese archipelago. Pottery was originally intended for cooking (boiling and frying), and this is why the vast majority of vessels were deep pots (*fukabachi*). They existed throughout the entire period and were the dominant type of pottery. Depending on the shape of the neck and body, from two to five or six varieties of *fukabachi* are often distinguished within the styles. However, with the development and sophistication of material culture, there was an increase in the variants of shapes and their functional diversity. Changes were most pronounced in the Middle Jōmon period in the regions of Kanto and Chubu. For example, the Katsusaka style stands out from other styles of that time by the variety and uniqueness of shapes. In addition to the classic type of pottery (deep *fukabachi* pots), there appeared a variety of ceramic trays (*kidaigata doki* 器台形土器), stemmed bowls (*daitsuki bachi* 台付鉢), vessels with handles for hanging (*tsurite doki* 釣手土器), and with edging and holes along the rim (*yūkōtsubatsuki doki* 有孔鍔付土器) (Kobayashi Tatsuo, 1981, 1986; Ivanova, 2018: 182–188).

*The singular and largest collection of pottery from the Jōmon period was published in 2008 (Sōran jōmon doki, 2008). This book was timed to the celebration of the 70th anniversary of Kobayashi Tatsuo, and was the first comprehensive work in the history of Japanese archaeological science on an individual cultural phenomenon. 169 authors contributed to this collection, which presents data on the 110 pottery styles that existed throughout the Jōmon period.

Conclusions

After considering the background behind the emergence of highly specialized terms for the Jōmon period in the works of Yamanouchi Sugao and Kobayashi Tatsuo, we may draw the following conclusions.

1. In the 1930s, the process of accumulation of data was underway. The first attempts were made to create a unified typology of Jōmon pottery, which involved the emergence of specialized terms used for describing the pottery complex.

2. The term "type", proposed by Yamanouchi Sugao, was the most widely used term in the academic circles of his time. His main goal was generalizing a huge array of information on Jōmon pottery with further creation of a system based on development patterns in the pottery complex. A detailed comparative analysis by Yamanouchi Sugao resulted in a unified periodization table of the Jōmon pottery for the entire archipelago, based on the notion of "type". The main criterion for distinguishing type was joint occurrence of vessels in a single stratigraphic layer, which proved the simultaneity of the pottery complex. Stylistic unity was also important. This criterion could only be applied within the framework of one group of vessels with the same shape and similar decoration. The work performed by Yamanouchi Sugao was invaluable for the first half of the 20th century; but owing to the variety of pottery from the Jōmon period, the notion of "type" did not become a universal tool that could fully describe all its specific features.

3. The model created by Yamanouchi Sugao formed the basis for the chronological scale that, with clarifications and additions, has been successfully used by Japanese archaeologists as a unique and most accurate tool for dating archaeological evidence of the Jōmon period.

4. In the mid 20th century, there was a need to improve the Yamanouchi Sugao model in accordance with new data and trends of the time, which resulted in a more detailed periodization of Jōmon pottery proposed by Kobayashi Tatsuo, based on the notions of style, type, and form. Currently, these are the basic notions for studying pottery complexes of the Jōmon period.

It can be concluded that it is necessary to adapt the Japanese conceptual apparatus used for analyzing technical and typological manufacturing features and decoration of vessels to the terminology and typology adopted in Russia for describing archaeological evidence. This would involve a long and difficult process that would consist not only of detailed study of literary sources, but also of consultations with Japanese colleagues who could point out some nuances in the use of terms in the course of field research, in reports at conferences, and in the educational process. An important step would be the creation of at least a

trilingual (Japanese-Russian-English) dictionary on the archaeology of the Japanese archipelago in general and the Jōmon period in particular.

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A New Andronovo (Fedorovka) Cemetery in the Eastern Irtysh Basin

We present the results of a multidisciplinary study of an Andronovo (Fedorovka) cemetery, Pogorelka-2, situated east of the Irtysh. Three burial mounds are described in detail, and elements of the funerary rite are outlined. All the mounds were constructed according to a single plan, characterized by a spatial separation of the burial platform, whereby one or several burials are surrounded by depressions in the ground. In two kurgans, these are four ditches with slightly sloping outer walls and steep inner ones. These ditches surround subsquare platforms with burials in the center. In the third kurgan, instead of ditches, there are small elongated pits. All the burials at Pogorelka-2 are cremations, as is typical of the Andronovo (Fedorovka) cemeteries in Baraba. On each burial platform, 1–3 burials were situated. Ceramics and other grave goods are described. Despite some specific features, they are typical of the Andronovo tradition. The cemetery belongs to the eastern part of the Andronovo (Fedorovka) distribution area. The analysis of funerary practices and goods reveals no contacts with the aboriginal Late Krotovo population.

Keywords: *Archaeology, Bronze Age, Irtysh basin, Andronovo (Fedorovka) culture, kurgan cemetery, burials.*

Introduction

In 1914, S.A. Teploukhov identified the Andronovo culture in the Minusinsk Basin (southern Siberia). But over 100 years of research in Siberia, a huge amount of data has been accumulated, which indicates the heterogeneity of the culture; therefore, it is more correct to regard it as a certain cultural unity that includes the Alakul and Fedorovka formations among others. The bearers of this culture occupied vast territories from the Southern Urals to the Minusinsk Basin, and penetrated into the regions of Central Asia and Xinjiang. They produced a significant effect on the formation of the so-called Andronovo-type cultures of the Middle and Late Bronze Age in Western Siberia. Over the long period of the Andronovo studies, a huge amount of information has been accumulated, which continues to be replenished, for example, with data on the anthropological and genetic features of that population; however, a great number of relevant issues remain unresolved. Therefore, it is so important to explore each new burial complex. The purpose of this study is the introduction and primary analysis of newly excavated materials of the Andronovo (Fedorovka) culture.

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Description of the materials

The kurgan cemetery Pogorelka-2 is located 2.5 km south of the village of Pogorelka, Chanovsky District, Novosibirsk Region, on a floodplain terrace on the left bank of the Om River (Fig. 1). The site was discovered by A.I. Solovyev in 1979. The necropolis occupies an area of more than 8 hectares and consists of 43 burial mounds (kurgans) of various sizes, mostly heavily damaged by plowing.

The Joint Russian-German expedition, which was made up of researchers from the Institute of Archeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences and the Eurasian Department of the German Archaeological Institute, excavated four kurgans (No. 3, 8, 13, and 43) in 2009, 2011, and 2012. Kurgan 8 was attributed to the terminal stage of the Sargat culture, and was dated to the period from the first centuries BC to the first centuries AD (Molodin et al., 2009: 348). Kurgans 3, 13, and 43 were left by the Andronovo (Fedorovka) people (Nagler et al., 2011, 2012).

Kurgan 13 was a rounded mound, 20 m in diameter and 0.45 m high, located on arable land in the northwestern part of the cemetery. Geomagnetic survey revealed a subsquare structure under the mound, with two magnetic anomalies in its central part (Fig. 2, *1*). The basis of the surface construction of the mound was a rectangular ditch; its corners were oriented to the cardinal points (Fig. 2, *2*). The ditch was discontinuous at the corners; it was divided into four parts. The southwestern part revealed a passage

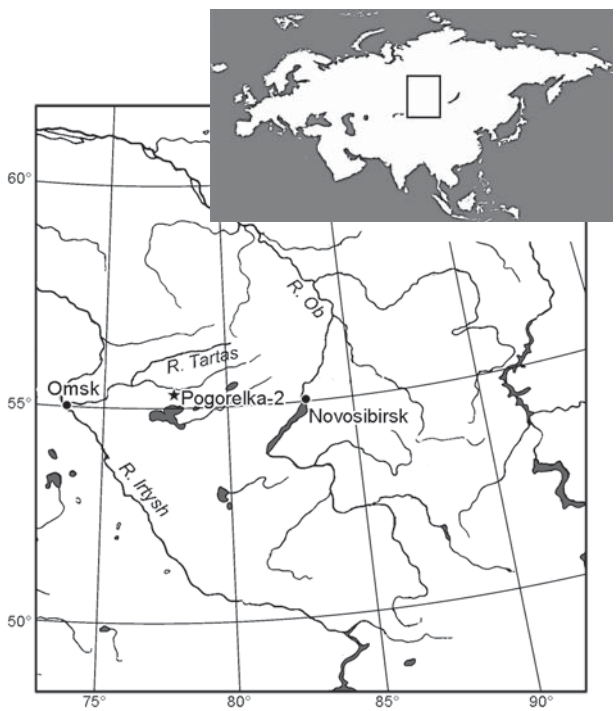


Fig. 1. Location of the Pogorelka-2 cemetery.

in the form of a dam 0.48 m wide. The elongated elements of the ditch showed uneven, slightly sloping outer walls and straight, steep inner walls. The width of the ditch ranged from 1.0 to 1.7 m. The floor was uneven and dipping towards the inner wall; the depth of the ditch varied from 13 to 47 cm from the level of the virgin land. The dimensions of the enclosed platform were 15 × 15 m.

In the mound of the kurgan, close to the passage in the southwestern part of the ditch (sq. S/10-11), remains of post-funeral feast were found—a keel and fragments of a duck's limb.

The northwestern part of the ditch was partially damaged by a subsquare pit (No. 1) measuring 2.55 × 2.7 m, 0.35 m deep (Fig. 2, *2*). A thick lens of calcined soil was noted in its eastern part. The layered structure of the ditch's filling consisted of the calcined soil alternating with layers of dark gray soil. Probably, the fire in the pit was lit repeatedly at significant intervals of time, during which the calcination was blocked by influxes of soil from the mound. A humerus fragment (sq. P/2) and elements of a complex sacrum of a duck, as well as a fragment of plain pottery, were found near the pit.

In the central part of the platform enclosed by the ditch, two burials parallel to each other were discovered (Fig. 2, *2*).

Burial 1 is a subrectangular grave-pit oriented along the NE-SW line (Fig. 3). Its dimensions are 2.9 × 1.66 m, the depth is 0.65 m (from the level of the virgin land). The western part shows traces of probable penetration. The filling of the pit is heterogeneous and heavily disturbed by rodent burrows. The following bones were recovered from the grave's filling: the lower jaw of a pike, two complex sacrums, a fork, two elements of the sternum, and two sets of bones, each consisting of the wing- and leg-bones of a mallard*.

Most likely, there were two complete duck skeletons in the grave before it was damaged; judging by the size of the bones, they were very big. In addition, the pit contained a complex sacrum and breast bone with the keel of the third duck, an element of the complex sacrum of the fourth duck, and fragments of the skull of a small bird—a thrush or a dove.

At the bottom of the grave, a lens of red ocher with charcoal pieces and burnt wood remains overlying a layer of black sooty soil were recorded. Four vessels were found in the grave: three vessels stood in a row along the southern wall, fragments of the fourth were situated in the northern corner (Fig. 3, *4–7*).

Burial 2 is a subrectangular pit oriented along the NE-SW line (Fig. 4). Its dimensions are 2.31 × 1.66 m, the depth is 0.70–0.79 m. Certain traces of disturbance were noted in the pit. In the filling of the grave, a humerus,

*Hereinafter, identifications of osteo- and ichthyological material by L.A. Koneva.

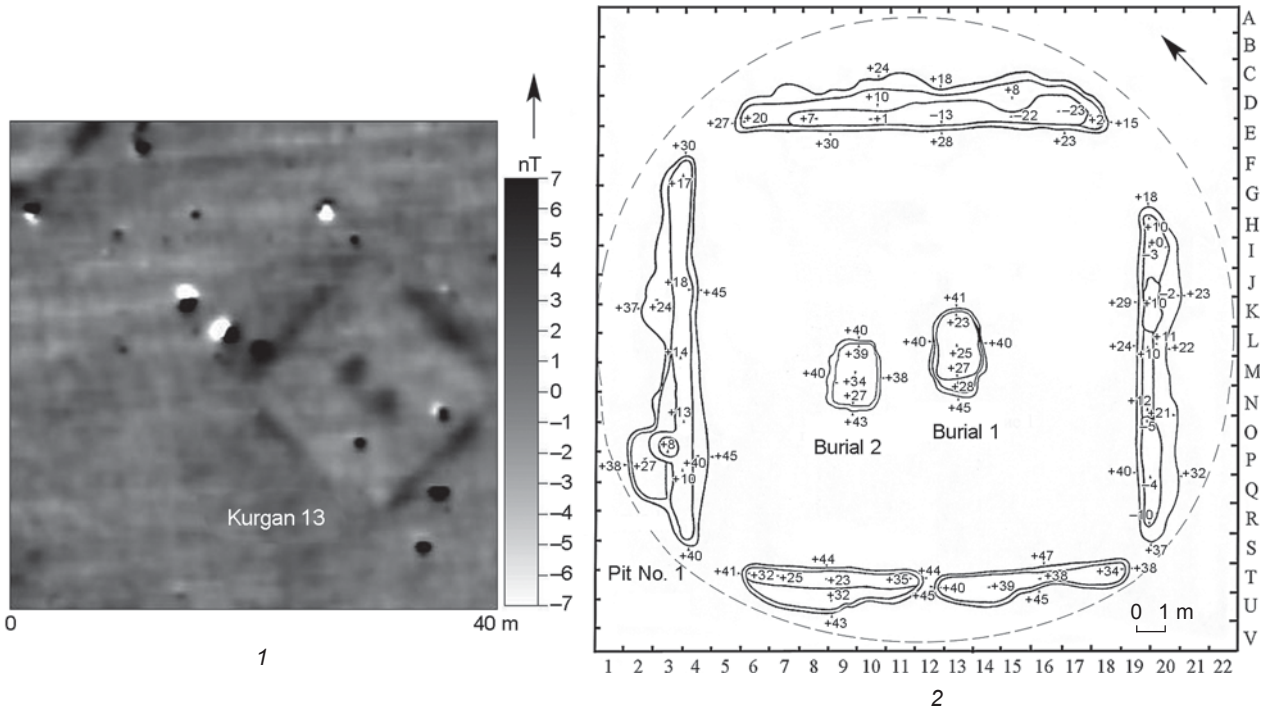


Fig. 2. Magnetogram (*1*) and the map of kurgan 13 at Pogorelka-2 at the level of virgin soil after removal of the filling (*2*).

fragments of a coracoid bone, elements of a complex sacrum (ilium bones with a broken ischium, a fork), parietal and frontal bones of a duck (mallard) skull were found. In addition, fragments of a coracoid bone and wings of another duck were discovered here. A layer of red ocher with charcoal pieces was noted at the bottom level. There were also traces of ocher on the walls in the northwestern and southeastern corners of the grave-pit.

In the northwestern corner of the burial, an accumulation of burnt bones from an adult human was found. Anthropologically identifiable were two finger phalanges, and skull fragments. In the southwestern and northeastern corners of the grave, two disintegrated ceramic vessels were recorded: one was archaeologically intact (Fig. 4, *4*), the second was heavily damaged (Fig. 4, *5*).

Kurgan 3 was located in the northwestern part of the cemetery, in a birch-aspen grove. It was a rounded mound 0.63 m high and 16–17 m in diameter. Geomagnetic survey revealed objects of amorphous outline under the mound; these were poorly readable, apparently owing to trees growing on the mound. Upon removal of the mound, a structure of four elongated ditches was found forming a regular square with open corners, oriented to the cardinal points (Fig. 5). The ditches had a straight, almost vertical inner wall and an uneven, slightly sloping outer wall. Their width ranged from 0.6 to 0.85 m, depth from 0.17 to 0.34 m. The dimensions of the enclosed space were 12.6 × 13.0 m. There was one grave in its central part.

Burial 1 is a subrectangular grave-pit oriented along the NE-SW line (Fig. 6). Its dimensions along the outer contour are 2.46 ´ 1.49 m, the depth is 0.64 m. The southern, northern, and western walls of the grave are straight and almost vertical, the eastern one is slightly sloping, with a step 0.09 m high in its lower part. The floor is flat, slightly dipping in the northeastern corner. The burial had been looted. In the central part of the mound and in the filling of the grave, a looting passage is traced. Two fragments of Russian ceramics of the 19th to early 20th centuries were found near the northeastern edge of the kurgan.

Almost in the center of the burial (slightly closer to the southern wall), an accumulation of burnt bones from an adult human was found. Among them, anthropologically identifiable were the bones of a skull, fragments of ribs, and tubular bones of limbs. At the bottom of the grave, next to the step at the eastern wall, there was a ceramic vessel (Fig. 6, *4*); another vessel was situated at the western wall of the grave (Fig. 6, *5*).

Kurgan 43 was located in the northwestern part of the burial ground, at the western edge of the birch-aspen grove. It was a rounded mound covered with thick grass, 0.47 m high, and 16–17 m in diameter. The structure of the mound was similar to that of the mounds 3 and 13; it consisted of very dense, lumpy soil. In the southern part of the mound, at the level of the second horizon, a lens of calcined soil was traced. Close to the calcination, at the edge of the southwestern part of the kurgan, a bronze

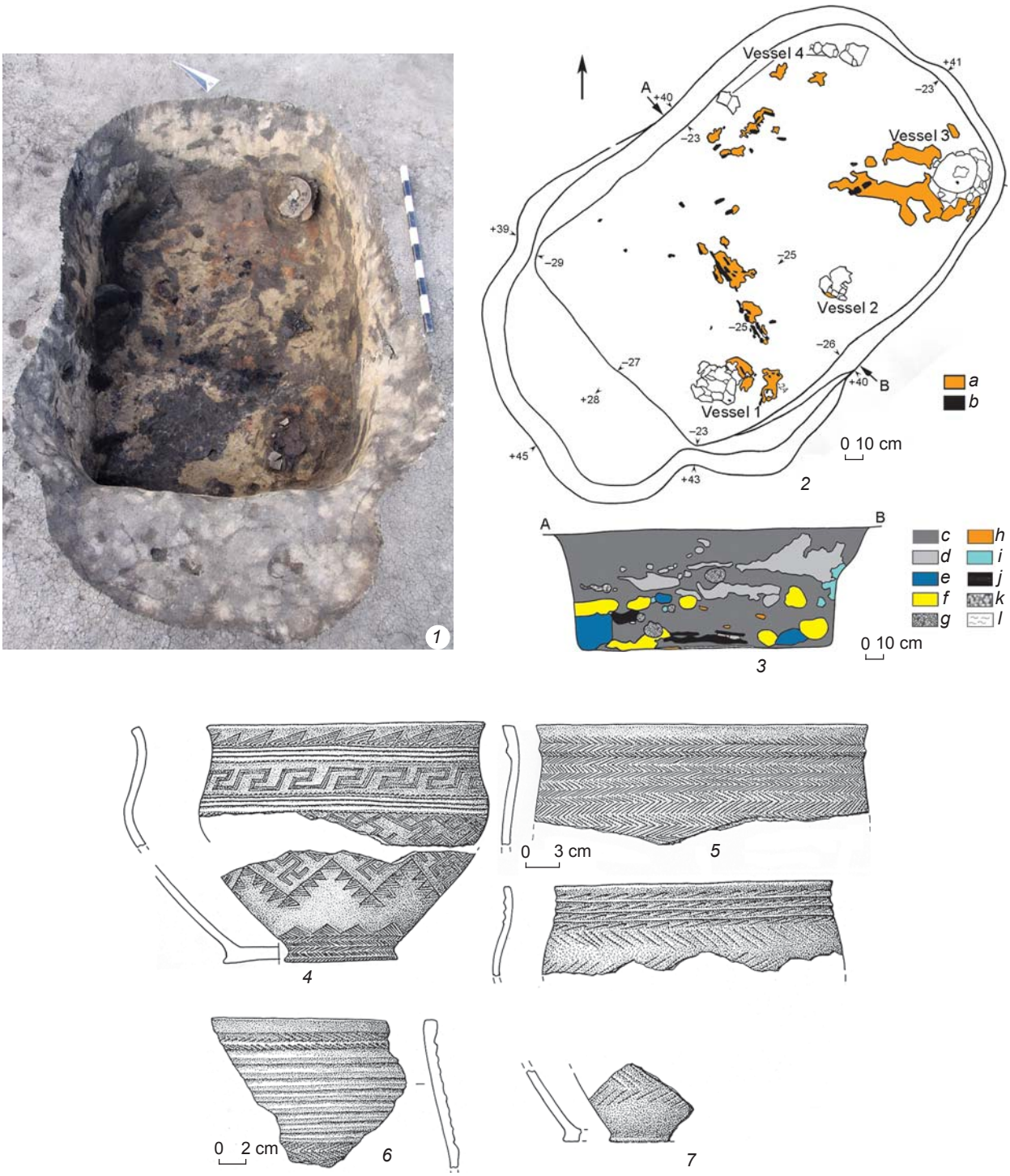
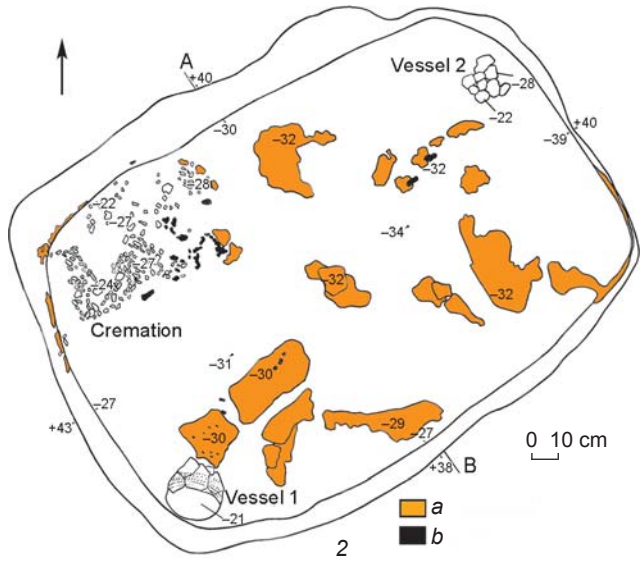
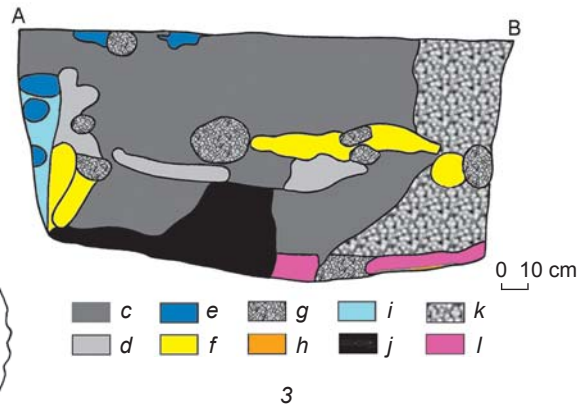
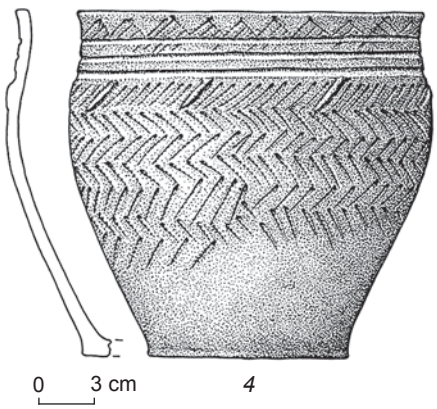


Fig. 3. Burial 1, kurgan 13, at the Pogorelka-2 cemetery.
1 – photo of the grave-pit; *2* – map: *a* – red ocher, *b* – charcoal; 3 – stratigraphic section: *c* – gray soil, *d* – gray soil with salt inclusions, *e* – mixed gray soil with yellow sandy loam inclusions, *f* – mixed yellowish-gray soil with yellow sandy loam inclusions, *g* – mixed yellow-white soil with gray humus inclusions, *h* – red ocher, *i* – yellow loam, *j* – black sooty soil, *k* – gray soil with ashy inclusions, *l* – coal; *4* – vessel 1; *5* – vessel *2*; *6* – vessel 3; *7* – vessel 4.







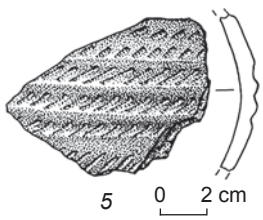


Fig.4. Burial 2, kurgan 13, at the Pogorelka-2 cemetery.
1 – photo of the grave-pit; *2* – map; *3* – stratigraphic section; *4* – vessel 1; *5* – vessel 2. Legend same as on Fig. 3.

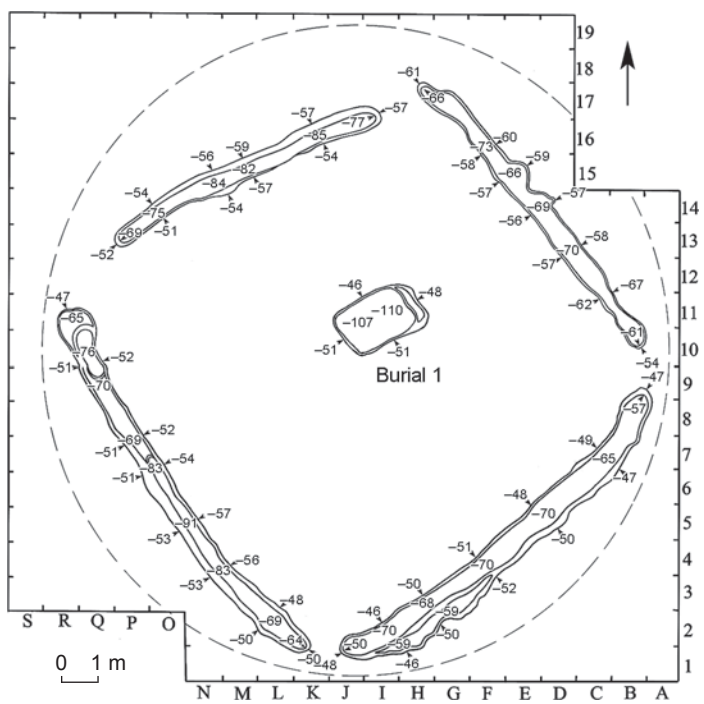


Fig. 5. Map of kurgan 3 at Pogorelka-2 at the level of virgin soil after removal of the filling.

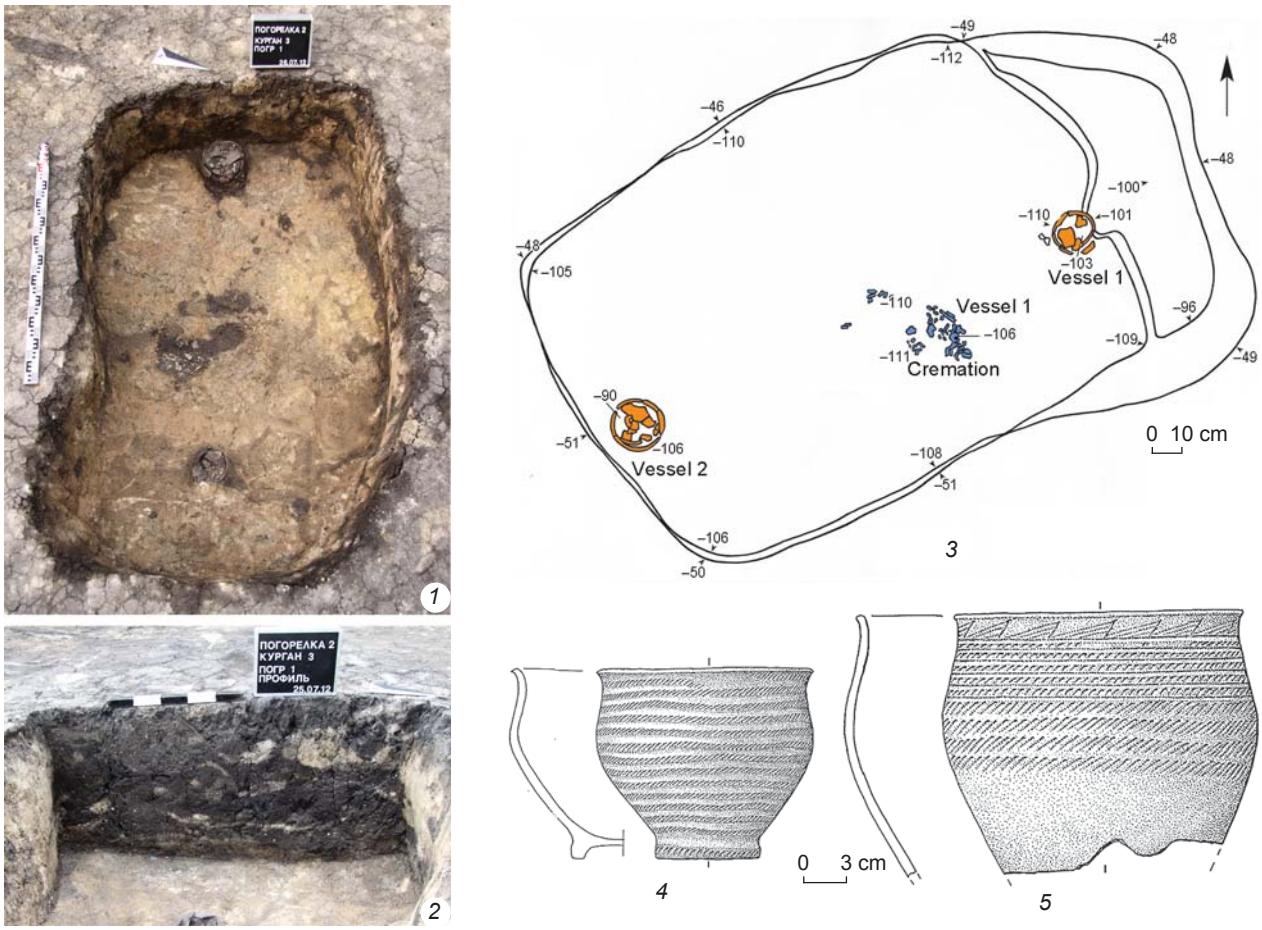


Fig. 6. Burial 1, kurgan 3, at the Pogorelka-2 cemetery.
1 – photo of the grave-pit; *2* – stratigraphic section; *3* – map; *4* – vessel 1; *5* – vessel 2.

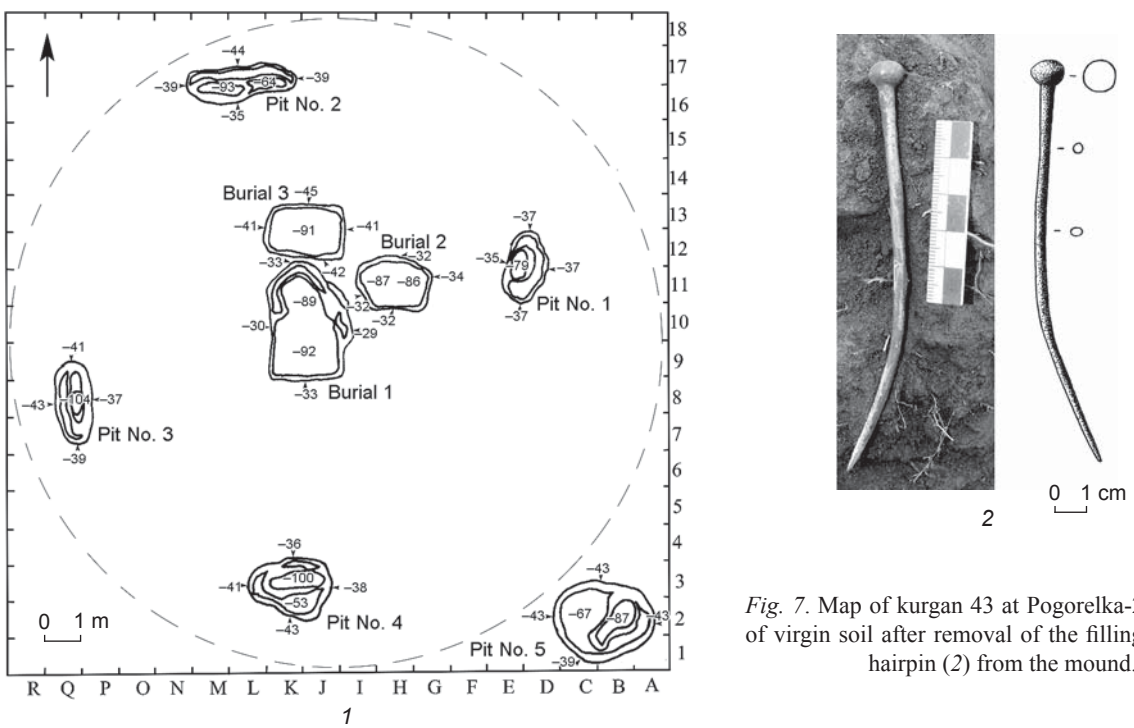


Fig. 7. Map of kurgan 43 at Pogorelka-2 at the level of virgin soil after removal of the filling (*1*); bronze hairpin (*2*) from the mound.

hairpin 12 cm long with a spherical head was found (Fig. 7, *2*). Similar items have been reported from various Bronze and Early Iron Age sites. The closest chronological parallels are known from the Bronze Age sites in Turkey: Kanlıgeçit (Özdoğan, Parzinger, 2012: Abb. 162, *1–3 b*) and Troy II and III (Sazcı, 2001: 388–389, Abb. 428). In the Andronovo (Fedorovka) complexes, such an item was encountered for the first time. A tooth from a large herbivore and several ornamented fragments of pottery were found in the mound soil.

Upon removal of the mound, a subsquare sacred space measuring 11.0 × 12.3 m was revealed; it was bounded by four pits, which were likely made instead of full-fledged ditches (Fig. 7, *1*). The entire structure was oriented along the NE-SW line. The pits were elongated trenches with rounded corners, steep inner walls, and gentle outer walls. The floor was uneven, with a depth varying from 0.42 to 0.64 m, width 0.94–1.77 m.

In the southeastern corner of the excavation, a rounded pit with gently sloping walls and an area of

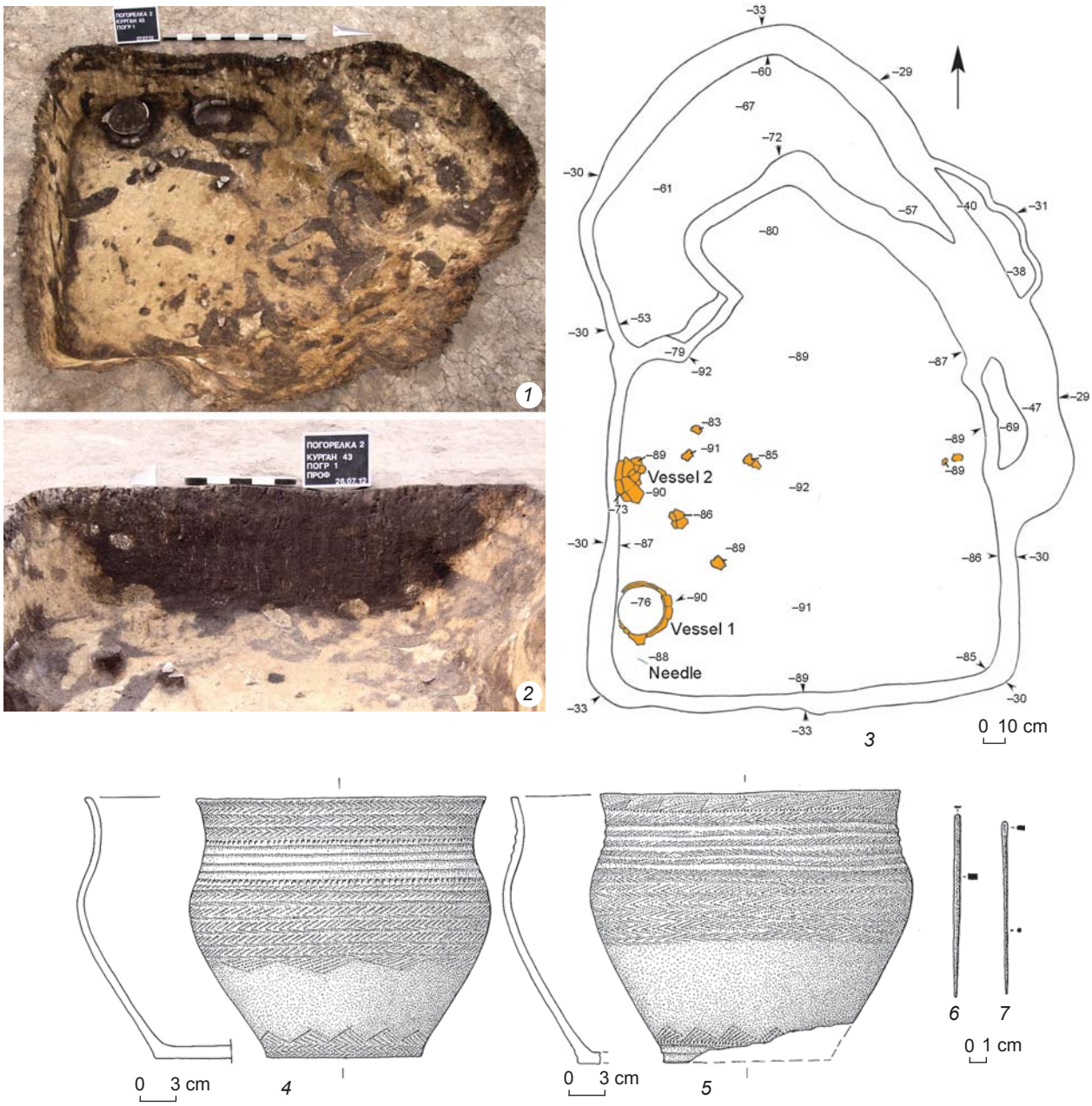
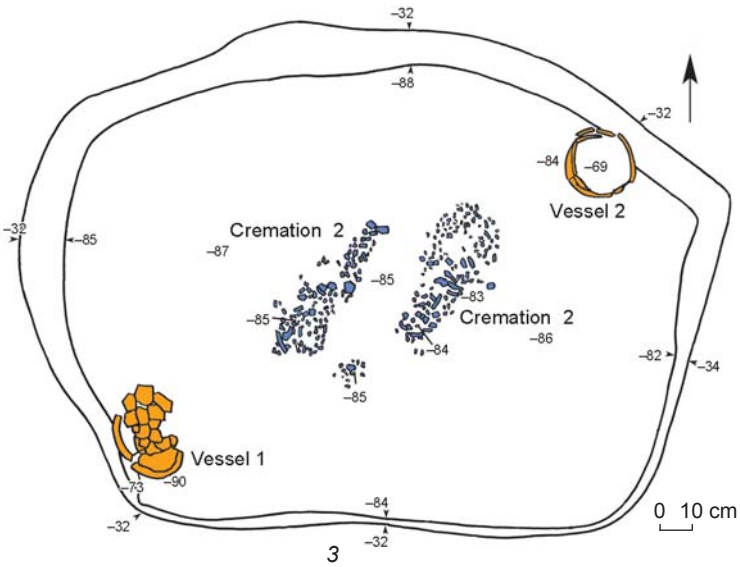


Fig. 8. Burial 1, kurgan 43, at the Pogorelka-2 cemetery.
1 – photo of the grave-pit; *2* – stratigraphic section; *3* – map; *4* – vessel 1; *5* – vessel 2; *6* – bronze awl; *7* – bronze needle.



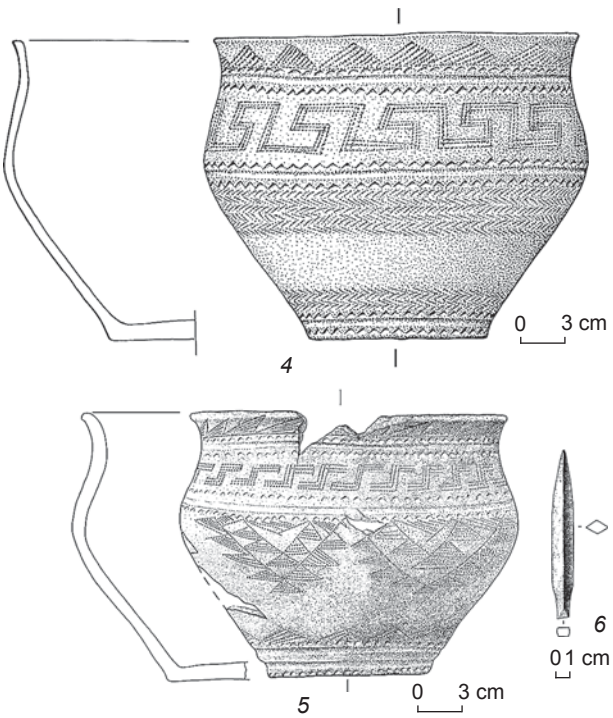


Fig. 9. Burial 2, kurgan 43, at the Pogorelka-2 cemetery.
1 – photo of the grave-pit; *2* – stratigraphic section; *3* – map; *4* – vessel 1; *5* – vessel 2; *6* – bone arrowhead.

strongly calcined soil, 0.14 × 0.19 m in size, was noted. The dimensions of the pit along the outer edge were 2.72 × 2.21 m, the maximum depth was 0.44 m.

In the central part of the platform bounded by pits, there were three burials. Two graves (No. 1 and 3) were located side by side, parallel to each other; the third grave (No. 2) was located to the northeast of them.

Burial 1 is partially destroyed by a looting pit (Fig. 8). The grave is oriented along the W-E line. The original shape was rectangular. Dimensions along the upper edge are 1.96 × 1.64 m, the depth is 0.62 m.

A fragment of a sternum with a keel and fragments of bones from the limbs of a duck, along with fragments of Andronovo (Fedorovka) ceramics, were found in the grave's filling. In the eastern part of the grave's floor, small fragments of burnt human bones were revealed. Found near the western wall were two vessels (Fig. 8, *4, 5*), a bronze awl (Fig. 8, *6*) located under one of vessels, and a bronze needle (Fig. 8, *7*). The awl is a forged rod with a square cross-section. One end is pointed, the other flattened. This item is 9.7 cm long and 0.4 × 0.5 cm thick. The needle is thin, rounded in cross section, with an "eye" (a small oval hole) at one end. This artifact is 9 cm long and 0.1–0.3 cm thick.

These items find numerous parallels in the Eurasian Middle Bronze Age cultures; however, their occurrence in the Andronovo (Fedorovka) burial complex is rather an exceptional phenomenon.

Burial 2 is an irregular subrectangular pit oriented along the W-E line (Fig. 9). Its dimensions are 2.0 × 1.47 m, depth 0.54 m. The southern and eastern walls of the burial are straight, almost sheer, while the western and northern walls are rounded and rather gentle. The filling of the burial yielded a bone arrowhead (Fig. 9, *6*) and several fragments of pottery. Bone arrowheads were placed in the burials of the Andronovo (Fedorov) culture extremely rarely.

In the central part of the grave's floor, two accumulations of burnt adult human bones were noted. Among them, anthropologically identifiable are the tubular bones of limbs, fragments of a skull, a clavicle, and fragments of a spine. In the southwestern and northeastern corners of the burial, crushed ceramic vessels were found (Fig. 9, *4*, *5*).

Burial 3 is a subrectangular pit oriented along the W-E line (Fig. 10). Its dimensions are 2.17 × 1.31 cm, the depth is 0.5 m. At the southern wall, two accumulations of burnt bones from an adult human were found, among which fragments of tubular bones of the extremities and finger phalanges were identifiable. At the northern wall, a crushed ceramic vessel was found; some of the potsherds were located next to the accumulation of the calcined human remains (Fig. 10, *4*).

At the southern wall, behind human bone accumulations, a rounded bronze earring, with a narrow conical ending, wrapped in gold foil, was found (Fig. 10, *5*); a similar earring (Fig. 10, *6*) was found in the northeastern part of the burial. The use of gilded bronze ornaments is typical of the Andronovo (Fedorovka) culture (Khavrin, Papin, 2006: 388). Earrings of this type and design served as one of the cultural markers of the Andronovo culture (Teploukhov, 1929: 43, tab. I, 27). Earrings with bell endings are widespread in Northern and Eastern Kazakhstan (Avanesova, 1991: 52–53; Arslanova, 1975: 75, fig. 2, *1–3*; Tkachev, Tkacheva, 1996); similar artifacts have been reported from the Irtysh region (Gening, Yeshchenko, 1973: 56, fig. 2, 4) and the Ob region (Matyushchenko, 1973: 19, fig. 3, *1*; 9, *1–5*). Thus, typical earrings of the Andronovo (Fedorovka) culture also occur, rather as an exception, in other Middle Bronze cultures of Asia.

Ceramic assemblage

Of the eleven vessels from three kurgans, eight were archaeologically intact, the rest were represented by fragments (Fig. 11, *1–8*).

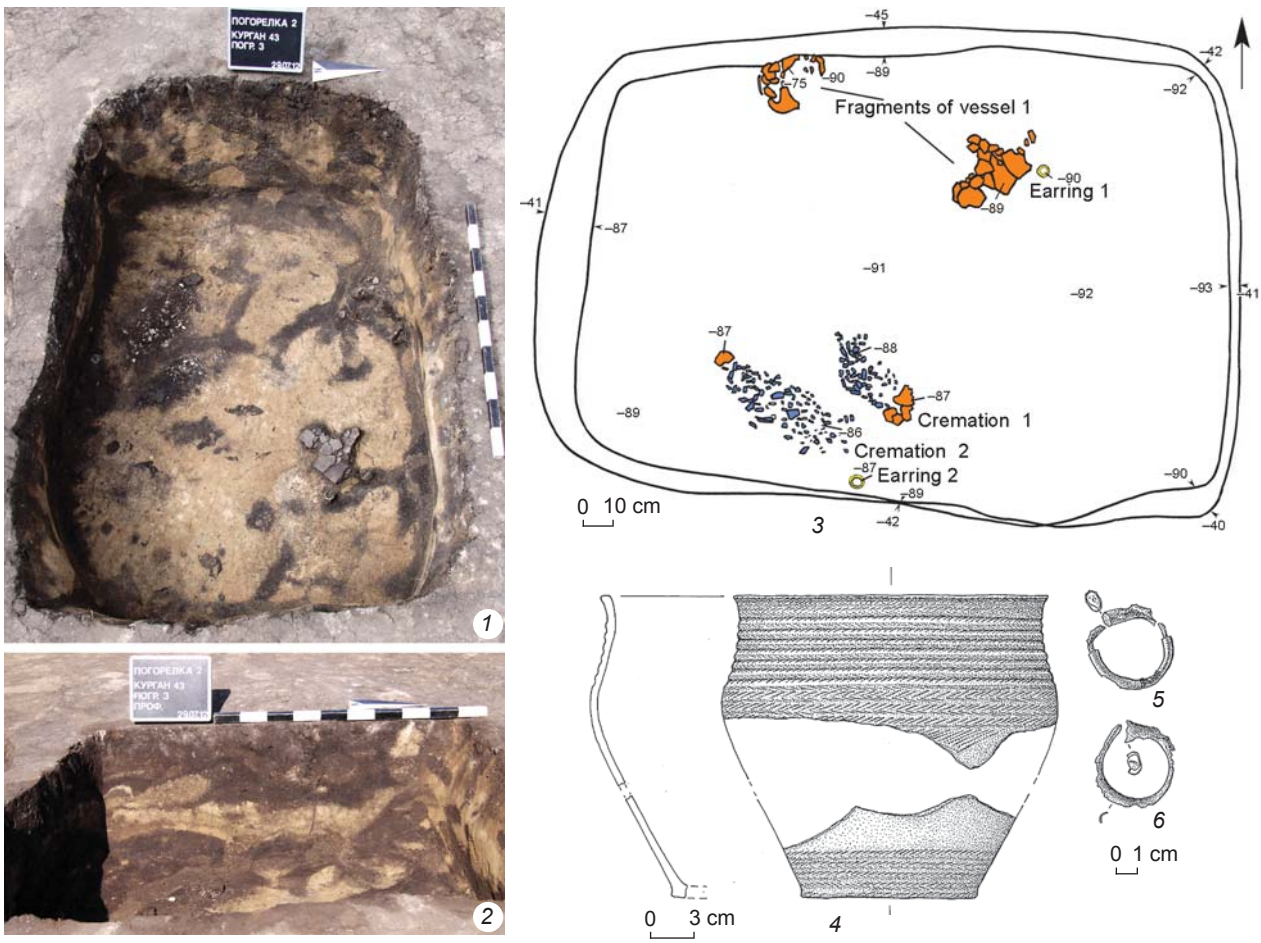


Fig. 10. Burial 3, kurgan 43, at the Pogorelka-2 cemetery.
1 – photo of the grave-pit; *2* – stratigraphic section; *3* – map; *4* – vessel 1; *5* – gilded bronze earring 1; *6* – gilded bronze earring 2.

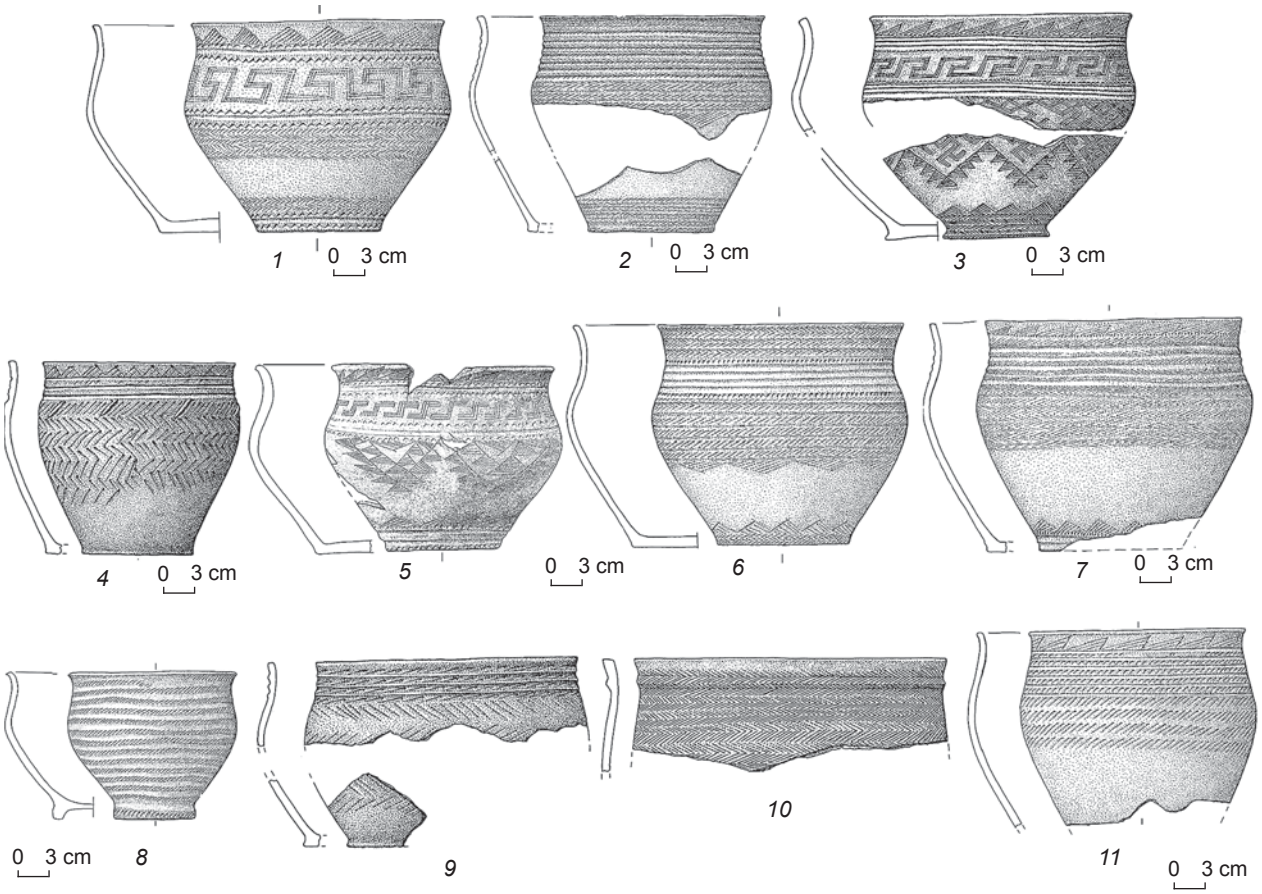


Fig. 11. Ceramic vessels from burials at the Pogorelka-2 cemetery.
1, *2*, *5–7* – kurgan 43; *3*, *4*, *9*, *10* – kurgan 13; *8*, *11* – kurgan 3.

All the items of this collection were analyzed using V.F. Gening's statistical processing program (1973, 1992) (see *Table*). Judging by the bottom-shape, all vessels are flat-bottomed; vessel 1 from burial 1, kurgan 3, has a pedestal (Fig. 11, *8*). All the considered vessels fall into one group for each of the features, with a few exceptions; consequently, they represent a single historical and cultural complex. The vessels show complete similarity in such features as neck height and breadth (see *Table*, NHI*, NBI), general curvature of the body line (see *Table*, BHI), and shoulder height (see *Table*, SHI). Thus, the assemblage consists of flat-bottomed vessels of "low and medium proportions", with a low, wide, and slightly or moderately curved necks. All the vessels have flattened bodies, high and "very slightly convex shoulders" (see *Table*, SCI), and wide bottoms. The neck curvature (see *Table*, NPI) is low or medium.

The vessels 1 and 5 from burial 2, kurgan 43, with "low overall proportions" (in V.F. Gening's terminology) are noteworthy; their ratio of height to total body diameter (height index) is lower than that of other specimens (Fig. 11, *1*, *5*). The same vessels show the average index indicating the configuration of the bottom part of the vessel according to the degree of curvature of the lower part of the body (see *Table*, BWI), as compared to the high relevant index of the rest of the vessels in the assemblage.

The curvature of the upper part of the vessel body is the index of shoulder convexity (see *Table*, SCI); it varies from very low to low.

All vessels are ornamented. The décor was located in the zones of neck, shoulders, and bottom part. No ornament was made at the bottom. Ornamental compositions are original, although show common motifs.

In the burial of kurgan 3, two ceramic vessels were found. Vessel 1 bears ornamentation in the form of horizontal lines all over the surface; the lines were made with a four-cogged comb stamp; the vessel has a pedestal decorated with a series of seed-like impressions (Fig. 11, *8*). Vessel 2 is decorated with oblique hatched triangles made with a comb stamp in the neck zone (Fig. 11, *11*).

Vessel 1 from burial 2, kurgan 13, is decorated with hanging slanting appliquéd fillets in the neck zone

*Hereinafter, the abbreviations by V.F. Gening.

Distribution of vessels' indices by size categories

Vessel No.	Pot shape feature																															
	Height (HI)				Neck height (NHI)				Neck breadth (NBI)				Neck profile (NPI)				Body height (BHI)				Shoulder height (SHI)				Shoulder convexity (SCI)				Base width (BWI)			
	Very low	Low	Medium	High	Very low	Low	Medium	High	Very low	Low	Medium	High	Very low	Low	Medium	High	Very low	Low	Medium	High	Very low	Low	Medium	High	Very low	Low	Medium	High	Very low	Low	Medium	High
1		+				+						+			+			+						+	+						+		
2			+			+						+		+				+						+	+							+	
3			+			+						+			+			+						+		+						+	
4			+			+						+		+				+						+	+							+	
5		+				+						+		+				+						+		+					+		
6			+				+					+			+			+						+	+							+	
7			+			+						+			+			+						+	+							+	
8			+			+						+		+				+						+	+							+	

(Fig. 11, *4*). An elegant pot decorated with meanders and a composition of hanging triangles (Fig. 11, *3*) represents the classical version of Andronovo (Fedorovka) ceramics; the vessel was found in burial 1 of the same kurgan.

Five ceramic vessels were found in three burials in kurgan 43. The neck of vessel 1 from burial 1 is decorated with hatched triangles made in the technique of comb stamp (Fig. 11, *7*). Vessel 2 from the same burial was ornamented with a "herringbone" motif executed in the same technique (Fig. 11, *6*).

Ceramic vessel 1 from burial 2 is ornamented along the neck with a row of hatched isosceles triangles and two rows of subtriangular impressions separated by a groove; the body zone bears the motifs of meander, below which there were two rows of subtriangular impressions separated by a groove (Fig. 11, *1*). Ceramic vessel 2 was found in the northeastern corner of the same burial (Fig. 11, *5*). Its neck is decorated with a row of hatched oblique triangles made with a fine-cogged comb, and two rows of subtriangular depressions separated by a groove. The body shows an ornamental composition of large hanging triangles connected to each other in a checkerboard pattern, each triangle consisting of smaller hatched triangles.

The vessel from burial 3, kurgan 43, is ornamented with horizontal lines and a "herringbone" motif executed with a comb stamp (Fig. 11, *2*).

The excavated ceramics, despite some original features, are typical of the Andronovo (Fedorovka) sites. These vessels have numerous parallels throughout the area of distribution of the Andronovo (Fedorovka) culture (see (Kuzmina, 2008; Margulan et al., 1966; Matveev, 1998)): from the Southern Trans-Urals to the Minusinsk Basin, including Baraba (Maksimenkov, 1978; Molodin, Novikov, Zhemerikin, 2002).

Burial architecture and rituals

The creation of burial structures throughout the sacred platform probably began with removal of the sod layer—buried soil layers were absent at all the features studied. Elements of structures (the mound, spoil heaps from ditches, and ash lenses) lie immediately on the virgin land. All the features were constructed according to a single pattern, which is indicated by the number and location of the graves. For example, in kurgan 13, graves are at the same distance from the geometric center.

All three objects are characterized by the spatial isolation of the burial platform. Around the central burial/burials (from four sides), there are depressions in the ground: in kurgans 3 and 13, four elongated ditches with a sloping outer wall and a steep inner one. These outline a subsquare platform with burials in the center. In kurgan 43, instead of ditches, there are small, elongated pits, similar in design to the ditches. Construction of small pits symbolizing full-fledged ditches should probably be associated with a simplification of the burial ritual. This trend is also reflected in the contemporaneous Andronovo (Fedorovka) cemetery Stary Tartas-4, in Central Baraba (Ibid.). Ditches under the mounds of some Andronovo kurgans were noted in Baraba (Molodin, 1985: 105; Molodin, Novikov, Zhemerikin, 2002: 253) and the Upper Ob Region (Kiryushin, 1995: 67). Examples of outlining the burial space with rectangular

or square stone enclosures have been recorded in the Andronovo (Fedorovka) sites in the Minusinsk Basin and in the territory of Kazakhstan (Usmanova, 2005: Fig. 32, *1*; 34, *3*; Margulan et al., 1966: 82–86, fig. 22; Maksimenkov, 1978: Pl. I, XVIII, XXI).

Thus, it can be assumed that at the Pogorelka-2 cemetery, in the Irtysh Region, we observe the result of transformation of the burial practice of the newly-arrived Andronovo (Fedorovka) population migrated from the territory of Kazakhstan. The replacement of stone enclosures with elongated ditches or pits in Baraba is explained by the absence of stone outcrops in this area; the use of waterfowl and fish as funerary food is explained by the specifics of the region's bioresources.

Both innovations were embodied in the Late Andronovo sites in Baraba. For example, in the funeral rite of the Tartas-1 cemetery, the traditional Andronovo funeral food was replaced by fish (Molodin et al., 2008: 206). Notably, the occurrences of duck bones in the burials clearly indicate that these graves were constructed in the spring-summer-autumn period.

The shape of the above-the-grave structures was likely determined by ditches; it could be subsquare in plan view. During the excavations of the central parts of all three burial mounds, areas of dense lumpy soil containing fragments of "rolls" were revealed. The surviving "rolls" were ellipsoidal in shape (15–20 cm long, 7–10 cm wide). These were the remains of unbaked clay bars or pieces of sod, deformed owing to high humidity, from which the surface burial constructions were probably built, at least their central parts.

The construction of an earthen structure above the burial chamber was accompanied by the traditional fire-lighting; traces of fire in the form of one or several spots of calcined soil were found in all the three kurgans. In kurgans 13 and 43, traces of fire were recorded in ritual pits, which formed a single complex with burials. Apparently, it was a stable element of the funeral rite associated with fire.

All burials at the Pogorelka-2 cemetery correspond to the rite of cremation typical of the Andronovo (Fedorovka) sites in Baraba (Molodin, 1985: 105); the features of this rite have also been recorded in the contiguous regions of the Ob forest-steppe region (Kiryushin, 1995: 59–61). On each burial platform, there were from one to three burials: in kurgan 3 – one central burial; in kurgan 13 – two burials parallel to one another; in kurgan 43 – three burials arranged in staggered order.

Grave-pits of subrectangular and rectangular shape had rounded corners; in two burials, a small step was built at the eastern wall. The burials were usually oriented along the NE-SW or W-E line, which is generally characteristic of the Andronovo (Fedorovka) culture.

In burials 1 and 2 at kurgan 13, the grave floors were covered with ocher powder. This feature has been recorded in several elite burials of the Andronovo (Fedorovka) culture in the Ob Region (Mylnikova et al., 2007: 346; Mylnikova, Durakov, Kobeleva, 2010: 111).

No order in the arrangement of calcined bones (the remains of cremation) has been observed in the graves. In some burials, usually with traces of looting, bones were found in the filling of the grave-pit (burial 1, kurgan 13; burial 1, kurgan 43). In burial 1 at kurgan 1 and burial 2 at kurgan 43, calcined bones were localized in the center of the grave-pit. In burial 2 at kurgan 43, the bones formed two compact piles in the central part. Perhaps two people were buried in this grave. In burial 1 of kurgan 13, the remains of cremation were concentrated in the northwestern corner of the grave-pit.

Apparently, cremation took place elsewhere; and the remains were subsequently buried in the grave. In all cases, cremation is represented by a compact accumulation of bone remains. The actual ritual space of the grave was small. Some bones (finger phalanges, ribs) are partially preserved and anthropologically identifiable. None of the goods found in the graves show traces of burning; consequently, they were placed there after cremation.

Conclusions

Analysis of the burial practice, the ceramic assemblage, and the grave goods gives the possibility of attributing the studied features to the Andronovo (Fedorovka) culture; sites of this culture are abundant in the Baraba forest-steppe (Molodin, 1985). According to the architecture of the above-the-grave structures and the funeral rite, their closest parallels are the kurgans of the Stary Tartas-4 cemetery, located in Central Baraba, downstream the Om River from the village of Pogorelka (Molodin, Novikov, Zhemerikin, 2002: 53, fig. 3, *2*).

In this region, other patterns of organizing the sacred space were also used in the Andronovo (Fedorovka) burial practice. This is evidenced, for example, by the archaeological materials from the Tartas-1 cemetery, located next to Stary Tartas-4. At Tartas-1, about 500 burials of Andronovo (Fedorovka) culture have been studied. The most common type of necropolis layout is a characteristic arrangement of graves in rows, stretched from south to north along the eastern edge of the terrace occupied by the burial ground. Another type of organization of the burial field is the placement of burials in its northwestern part, its main structural unit being a burial and memorial complex (BMC), consisting of several ditches and pits surrounding one or more burials. Currently, about 50 such complexes have been studied. Of all the BMC ditches at Tartas-1, only one is close in shape to a quadrangle with open corners (Molodin, Kobeleva, 2021); all the rest are round, oval, or segment-shaped.

No other differences in the funeral rite and grave goods have been identified. It is important to note that in the Ob-Irtysh forest-steppe, such a variety of ditches (round, oval, segment-shaped, amorphous) has been recorded nowhere else but Tartas-1.

The studied complexes of the Pogorelka-2 cemetery undoubtedly belong to the eastern area of distribution of the Andronovo (Fedorovka) cultural and historical community. They reveal no contacts between the newcomers and the Late Krotovo aboriginal population; the relevant transformations would have manifested themselves in burial practice or in grave goods, including pottery.

The occurrence of grave goods (needle, awl, arrowhead), as well as the remains of duck-meat and fish, in the graves can be explained by the local features of burial practice of the Andronovo (Fedorovka) population. The bronze hairpin with a spherical top is remarkable, and puzzling in its own way. Similar products have not been found in the Andronovo sites in Baraba. The discovery of the hairpin at this cemetery has not yet found an unambiguous explanation.

The studied materials complement the existing understanding of the Middle Bronze Age as a whole, and are the basis for interpreting the innovations recorded in the burial practice of the Andronovo (Fedorovka) population.

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Stone Tools from an Island in Berd Bay, Novosibirsk Reservoir

This article presents the results of a multidisciplinary study of stone tools (discoid mace-head, adze, and axe) found on an island in Berd Bay, Novosibirsk Reservoir. Trace analysis suggests that the mace-head is made of fragile sandstone, precluding its use as a striking weapon. Therefore, it was likely a ceremonial weapon. The adze and the axe are also made of a local rock—shale. The specimens resemble prestigious weapons of the Early and Middle Bronze Age from the forest-steppe zone of southwestern Siberia. Discoid mace-heads, like globular ones, are typical of the Middle Bronze Age. Importantly, all the specimens were found where the submerged Fort Berdsk was possibly situated. Early artifacts have also been found near other Siberian forts such as Tomsk, Umrevinsky, and Sayansk, suggesting that these were built at places with a long history of habitation.

Keywords: *Upper Ob, Bronze Age, stone tools, trace analysis, prestigious weapons, Fort Berdsk.*

Introduction

The area around Berd Bay in Novosibirsk Reservoir (Iskitimsky District, Novosibirsk Region) is promising for localization of the flooded objects of archaeological heritage (Borodovsky, 2002: 21–45). Before filling the reservoir, this area in the vicinity of the old town of Berdsk had almost not been surveyed. However, there was some information about random finds indicating the presence of archaeological sites at the mouth of the River Berd (Ibid.: 9). Subsequently, a number of stone items were found on the shallows of Khrenovy Island during regular discharges of water from the reservoir (Fig. 1, *2*), including a disc-shaped finial submitted to the Berdsk Historical and Art Museum (VKEFZK* 15/3), and two tools (Fig. 2, *2*, *3*) discovered by N.V. Ermakova, which are kept in the collection of the Novosibirsk State Museum of Local History (GK 9089827 NGKM, OF-22851/1 and 2). According to their morphological features, the artifacts belong to the turn of the fourth to third millennium BC, and mark one of the early periods in the development of the area where Fort Berdsk was founded in the early 18th century (see Fig. 1, *1*). Microscopic study of these items involved the methods of experimental trace analysis and technological analysis, elaborated by S.A. Semenov and G.F. Korobkowa (Semenov, 1957; Korobkowa, 1999). The experience of working with evidence from the archaeological collections of Paleolithic and Neolithic sites in Northern and Central Asia was also applied (Volkov, 1999, 2010, 2013). For general trace examination of artifacts, the MBS-10 binocular microscope, with one-sided lateral illumination of the item and discrete operating mode of magnification from 16 to 56 times, was used. For comparative analysis of wear traces on ancient stone tools, the evidence from the Siberian reference collection of trace standards was

*Temporary Storage of the Expert Evaluation and Collection Procurement Commission.

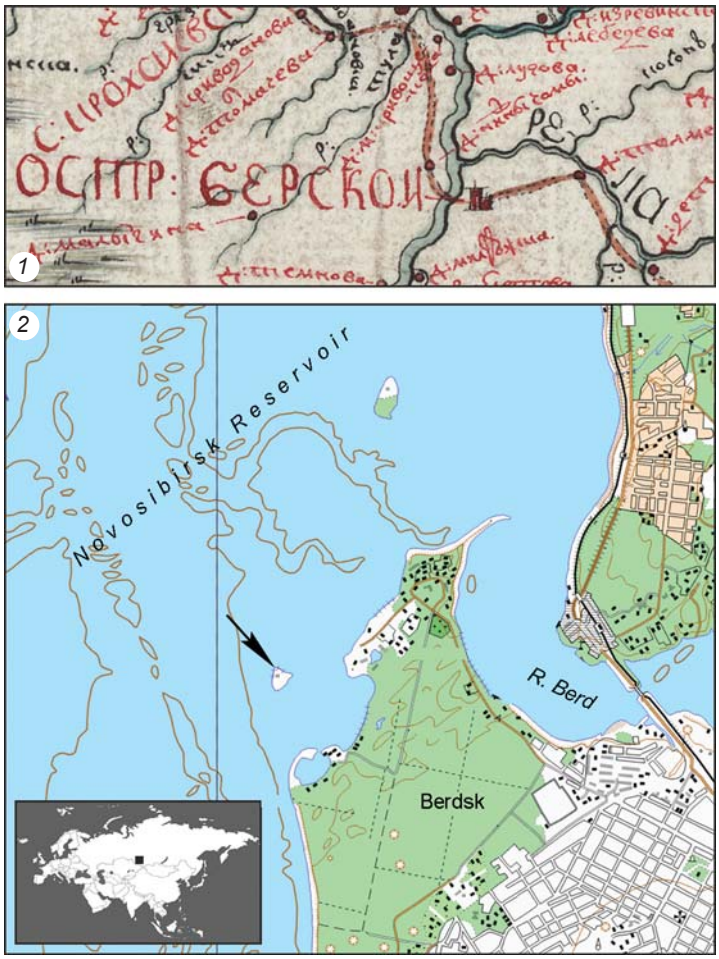

Fig. 1. Fort Berdsk on the General Map of the Office of the Kolyvan-Voskresensk mining authorities (Generalnaya karta…, 1777) (*1*) and the place of discovering lithic artifacts in the area of its possible location (after (Borodovsky, 2002: 4)) (*2*).

employed. The terminology of trace analysis used in this article corresponds to the catalog of terms in the monograph "Experimental Practices in Archaeology" (Volkov, 2013: 99–126).

Research results into the items and discussion

The disc-shaped finial is 92 mm in diameter and 27 mm in thickness. It weighs 278 g (see Fig. 2, *1*) and was made from a flattened, rounded river pebble of relatively loose sandstone. The lateral surface and one of the relatively flat sides of the item were grainy and rough, and show no traces of processing (Fig. 3, *1*). Naturally spalled surfaces, polished on a relatively fine-grained abrader in some places, are observed in several areas of the pebble (Fig. 3, *2*).

The pebble blank had been processed with an abrader in order to flatten the item. Probably, the polished surface was wet, which led to the noticeable destruction of the sandstone and the emergence of relatively deep linear traces under the impact of its particles (Fig. 3, *3*). As the treated surface dried, the marks became less deep (Fig. 3, *4*) and, accordingly, the quality of processing increased.

The hole in the item was made by drilling from the unpolished side. The technological traces indicate the use of high-speed drilling with uniform translational movement of the tool (Fig. 4, *1*). The edges of the channel at the point where the tool entered the processed material are even. No traces of punching or displacement of the point of the drilling start have been found (Fig. 4, *2*). There are reasons to believe that the process was suspended at the moment when the first marks of the exiting drill appeared on the opposite side, and the exit section of the drilling channel was flared using a reamer: its operation is manifested by stepped traces of a stop in the rotational movement of the tool clockwise (Fig. 4, *3*).

No signs of increased or repeated fitting of the item on any base were found on the surface inside the hole. Microscopic examination of the artifact's surface revealed no traces of use.

Massive stone discs might have served several purposes. One of them was weighting elements for digging sticks or drilling devices (Aseev, 2003: 144, fig. 96). With this use, almost any item made of loose, fragile stone (which was used for making the disc from the island in Berd Bay) would inevitably show marks of forced or repeated fitting on the handle. Such marks were not found on the stone disc under discussion. No marks from a wedge, which was often used while fastening flywheel weights on spindles, drilling devices, tools for making fire, etc., were present on the edges of the hole.

It is also unlikely that the disc from the island in Berd Bay was used as a fishing sinker. Stone sinkers for nets were not made of such loose material that becomes weak when wet. Even if this artifact was used for that purpose, it would have been a one-time use. Therefore, it was hardly worth the effort and application of very "serious" tools for drilling it. Notably, the item in question was generally not suitable as the central sinker of a drag-net, because it has small size and weight.

Judging by its morphological features, the disc-shaped object from the island in Berd Bay can be described as the finial (head) of a mace or club*. The mace is a short-

*According to some secondary sources, a mace was a variety of club (Bolshaya Rossiyskaya entsiklopediya, 2004: 220), while according to other sources, these were different types of impact-crushing weaponry (GOST R 51215-98, 1999: 4, 5; Kulinsky, 2007: 18, 23).

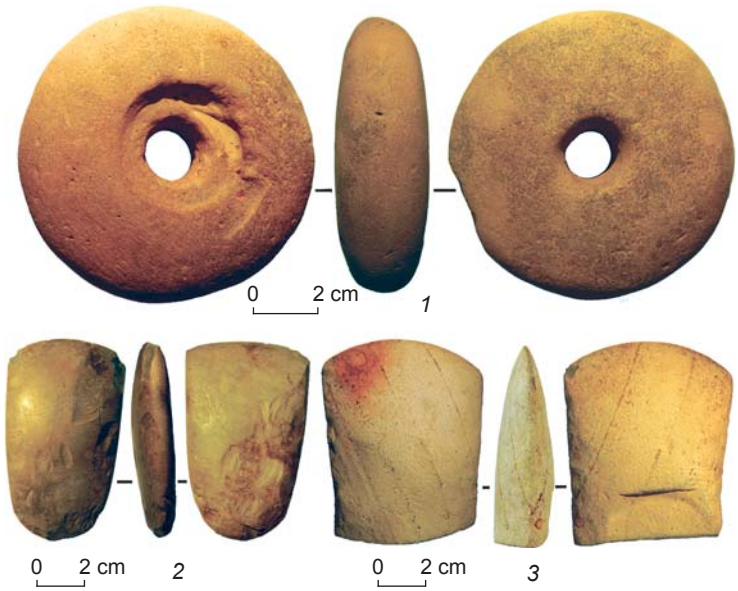

Fig. 2. Disc with a hole (*1*), adze (*2*), and axe (*3*).

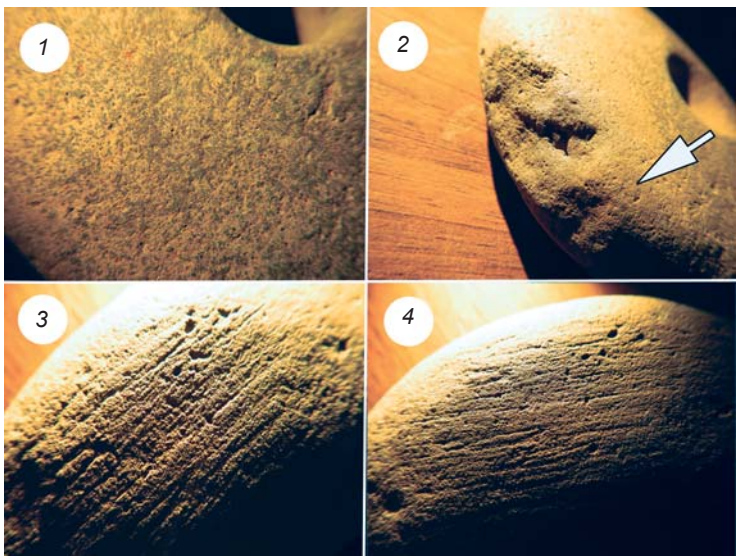

Fig. 3. Natural surface of pebble blank (*1*), polished natural spalled surfaces (*2*), and areas with traces of polishing with coarse and fine-grained abrader (*3*, *4*) on the disc-shaped item.

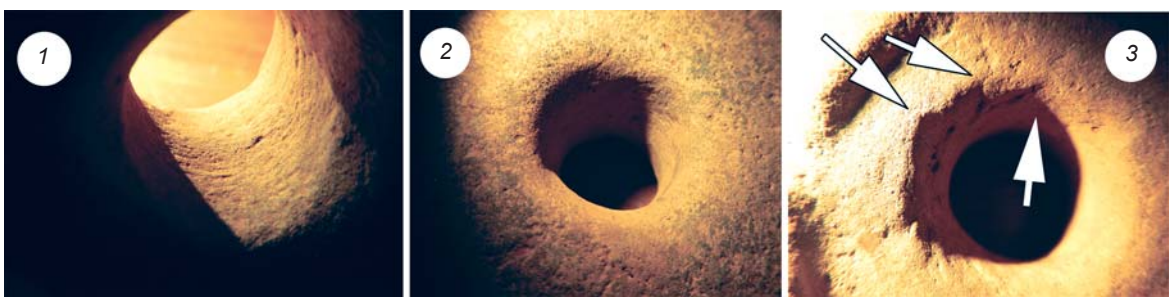

Fig. 4. Surface inside the hole of the disc-shaped item (*1*), on the entry (*2*) and exit (*3*) sections of the drilling channel.

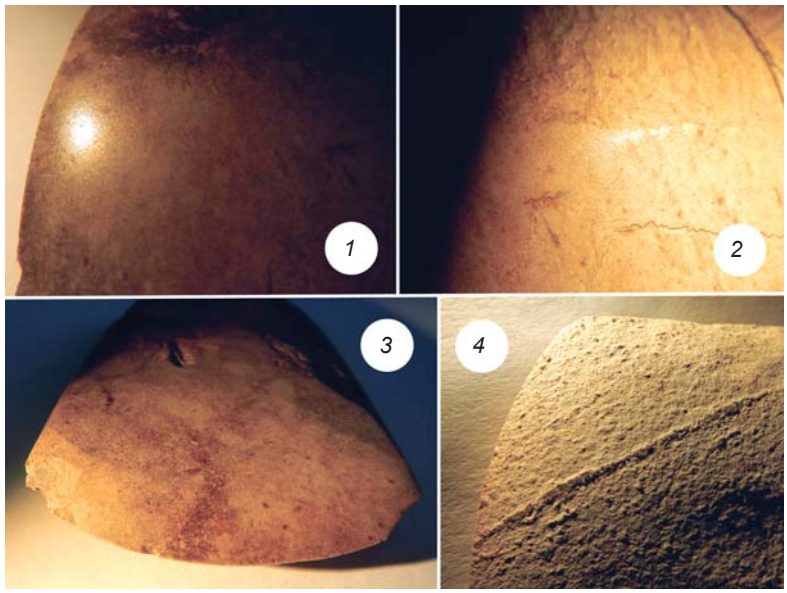

Fig. 5. Traces of adze wear on the convex (*1*, *2*) and concave (*3*) parts of the working edge and surface of the working edge of the axe (*4*).

handled impact-crushing weapon. Its handle is about 0.5–0.8 m; the weight of the head is 200–300 g.

Marble and slate finials with serrated edge for stunning fish have been found on the clubs from the Southern Primorye and Amur Region in the Neolithic and Early Metal Ages (Kononenko, Alkin, 1994). If we assume that this artifact was used without immersing it into the water while stunning fish, we should note that the phenomenon of massive spawning of fish, as it happens in the Amur River where such practice was possible, is untypical of the Upper Ob River.

In the context of the functional and symbolic interpretation of the stone disc with a hole, it is important that maces (clubs) served as insignia of power in China and Korea. These insignia were one of the cultural universals in manifesting social hierarchy. Stone mace finials of the Middle and Late Bronze Ages have been found at several sites (Shlyapovo, Kirza, Milovanovo-3, Fedosovo) in the Novosibirsk Ob region (Borodovsky, 2002: 8, 69). However, they all were of the spherical type, while the item from the island in Berd Bay was disc-shaped. Nevertheless, its weight corresponds to functional parameters of this high status weapon.

Trace analysis of marks on the surface of the artifact from the finds of N.V. Ermakova, with the collection number GK 9089827 NGKM OF-22851/1, has made it possible to identify it as an adze—the tool for processing wood (see Fig. 2, *2*). The size of the item is 9.2 × 5.7 × × 2.1 cm; its weight is 54 g. Traces of wear in the form of distinctive polishing (Volkov, 2013: 122–123) are observed along the entire working edge of the tool on its convex surface (Fig. 5, *1*). The degree of wear of the adze was relatively high. Individual traces of active contact with the processed material (Fig. 5, *2*) were found at a significant (over 1 cm) distance from the cutting edge. The spread of polishing on the concave part of the working edge is minimal, and is typical for the tools of this type (Fig. 5, *3*).

The artifact with the collection number 9089851 NGKM OF-22851/2 was identified by its morphological features as an axe (see Fig. 2, *3*). Its size is 10 × 7 × × 2.8 cm; its weight is 76 g. Considering that one end of the item was broken, the initial size of the axe had been much larger. The tool was made of fine-grained sandstone; it was subjected to intense destruction in the aquatic environment, and no traces of use have been preserved on its surface (see Fig. 5, *4*).

The morphology of the stone axe and adze is relatively standard for the sites of the Late Bronze to Early Iron Ages in the Upper Ob region. However, the presence of this set of items in the hypothetical area of the flooded Fort Berdsk is indicative for reconstructing the historical dynamics in the development of that place.

Conclusions

A set of stone artifacts (mace finial, axe, and adze) that was discovered on the island in Berd Bay has close parallels in the grave goods from some Chalcolithic burials (Fig. 6, *1*, *2*) at the Borovyanka XVII flat-grave burial ground, in the Middle Irtysh region (Khvostov, 2001). The head of the stone mace from the area of the former mouth of the River Berd also shows obvious parallels with one mace of the Bronze Age from Southeast England, currently

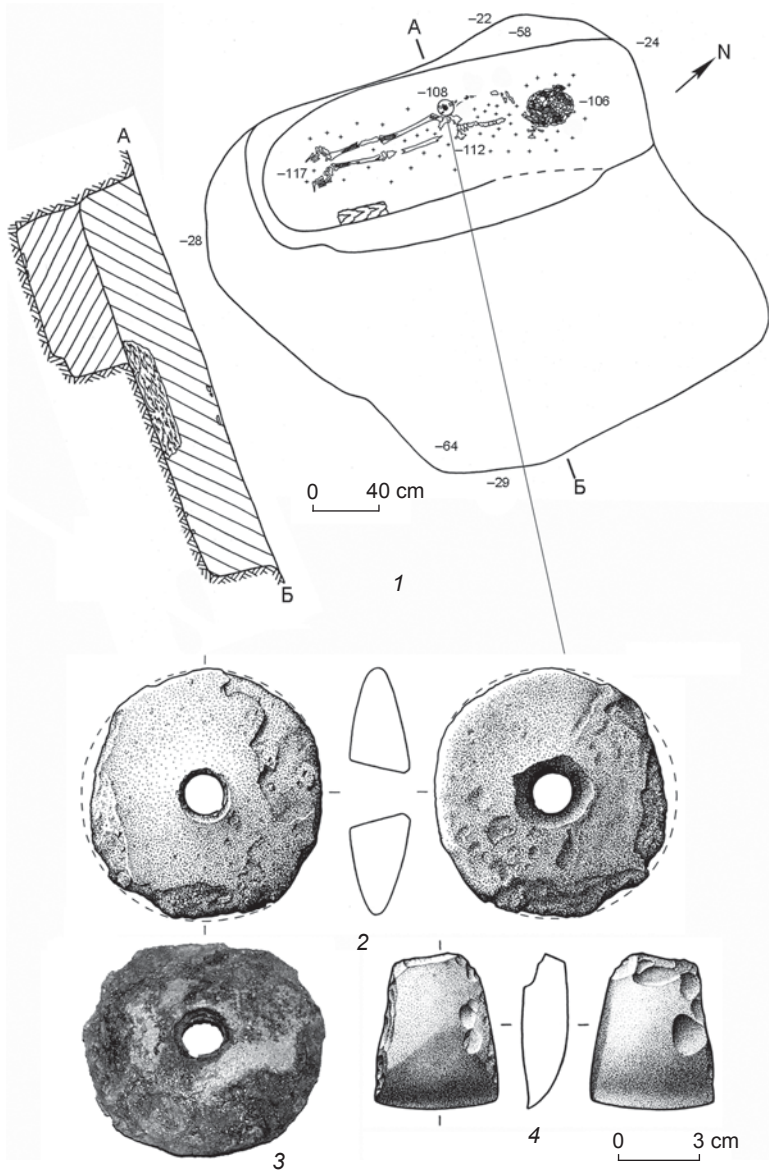

Fig. 6. Burial 112 at the Borovyanka XVII burial ground (according to the archival evidence of A.S. Trufanov).
1 – ground plan and cross-section of the burial; *2–4* – stone inventory: *2*, *3* – mace finial, *4* – adze.

on display at the Higgins Art Gallery and Museum in Bedford (item No. 13/9/2k).

The typological and functional features of stone items from the island in Berd Bay indicate the period of the finds as the turn of the Early and Middle Bronze Age. The disc-shaped mace finial was most indicative for such dating, since disc-shaped and spherical varieties of mace-heads were typical of the Middle Bronze Age. This morphological feature makes it possible to consider the complex of the finds under discussion as the earliest artifacts in the area around the mouth of the River Berd. Broad territorial parallels for the finial of a stone mace emphasize the chronological specificity of this item.

The use of a natural form of stone (a pebble) for manufacturing the disc-shaped finial corresponds to the archaic technological tradition of adopting natural forms. This can be most clearly seen in the bone-carving (Borodovsky, 2012) and woodworking industries of the Stone and Metal Ages. In addition, there are precedents for ritual adoption of unusual or "correct" shapes of stones in the ethnographic practices of the peoples of Siberia. All this points to the possible sacred semantics of the material used for the mace-head. This is a fairly important feature for a mace as a high status weapon. In this context, the functionality of the material was unimportant. Sandstone is not only not resistant to mechanical stress, but also prone to loosening even with slight moisture. This circumstance may explain the absence of traces of intense use on the mace finial from the island in Berd Bay.

Thus, these material and functional features once again emphasize the votive nature of the stone mace finial and its possible connection with high-status objects. The very fact of discovering a set of stone items (finial of a mace, axe, and adze) at the location of Fort Berdsk reveals the area at the confluence of the Berd and Ob rivers as a territory with a fairly long history of development. This situation was typical for the most strategically important parts of the historical landscape. In the Early Modern period, precisely such locations were used for building some Russian forts (Fort Sayansk, Fort Tomsk, Fort Umrevinsky) in Siberia (Vasiliev, Skobelev, 1998, 2001; Skobelev, Mandryka, 1999; Nechiporenko, Pankin, Skobelev, 2000; Chernaya, 2002: 15; Borodovsky, Gorokhov, 2009: 25). The discovery of rather early and unusual artifacts in the hypothetical place of Fort Berdsk (1717) is one indirect sign of its localization.

Acknowledgments

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Metal Celts from the Little Sea Coast of Lake Baikal

This article examines metal celts accidentally found 2 km west of Kurma on the Little Sea coast of Lake Baikal, in the foothills of Primorsky Ridge, Olkhonsky District, Irkutsk Region. Detailed information is provided on the conditions in which they were found and aspects of their technology, form, and decoration. The specimens have no eyelets, are rectangular in cross-section, and were cast in bivalve molds. They differ in size and decoration. On their wide sides, there are holes for supports inserted into the mold halves. While no exact parallels to the celts are known, several chronological indicators (body shape, socket cross-section, absence of eyelets, and decoration) point to the Scythian-Tagar stage. The most similar specimens are the Krasnoyarsk-Angara type of celt, distributed over the taiga belt from the Yenisei to the Angara. X-ray spectrometric analysis suggests that the celts were made of "pure" copper. In the Olkhon area, the Scythian-Tagar celts are associated with the Slab Grave culture, dating to 2778–1998 cal BP.

Keywords: *Cis-Baikal region, Olkhon area, Lake Baikal, Scythian-Tagar period, copper celts, X-ray spectrometry.*

Introduction

Metal items (copper or bronze) occur quite rarely among the evidence of the Bronze and Early Iron Ages from the Cis-Baikal region and particularly from its Olkhon area (western shore of Lake Baikal, from Cape Elokhin in the north to the Bolshaya Buguldeika River in the south, including Olkhon Island). Such items have been found in burials (most of which were destroyed in ancient times) and accidentally. In this regard, each new discovery of an item made of metal is of great scholarly value.

This article presents two metal celts discovered on the coast of the Little Sea of Lake Baikal, in the vicinity of the village of Kurma (Olkhonsky District of the Irkutsk Region). These wedge-shaped tools with socket perpendicular to the blade were used as axes or adzes. Their function can be established from the method of attachment to the handle and side view of the tool (symmetric or asymmetric) (Gryaznov, 1947). Celts were widespread in the Bronze Age cultures of Southern and Western Siberia, Mongolia, North China, and other regions. In the Cis-Baikal region, such finds are rare, and almost all of them are surface finds. They have not been discovered before in the Olkhon area.

The celts discussed in this article were accidentally found by A.V. Vokin while walking as a tourist in the vicinity of the village of Kurma in 2016. In 2020, the finds were submitted to the "Baikal Region" Research Center at Irkutsk State University. In the summer of the following year, the locations where these items were found, were topographically surveyed.

Description of the celts

The items were discovered 1.9 km north of the Khagdan-Dalai Bay of the Little Sea of Lake Baikal (near the

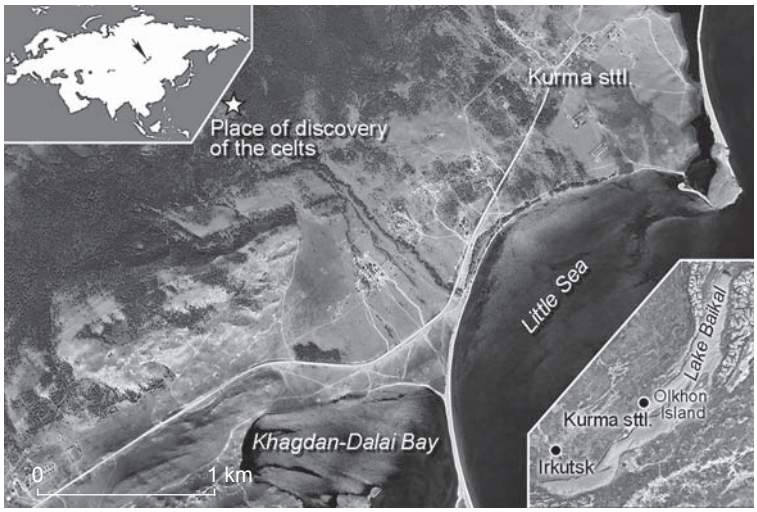

Fig. 1. Satellite image of the place where the celts were discovered.

Fig. 2. View from the west of the place where the celts were discovered.

Fig. 3. Celt 1 from the vicinity of the village of Kurma.

foot of the Primorsky Ridge), 2 km west of the village of Kurma (Fig. 1). A flat rectangular stone measuring about 45 × × 20 cm lay between ruts on a forest road that abutted a small watercourse. The tip of a metal item was visible from under the stone. Two celts were found there. No other stones were present on this section of the road. A survey of the area, carried out in 2021, showed that the road runs along a small spur of the Primorsky Ridge, which is located to the west of the road (Fig. 2). The slopes of the mountain are steep and overgrown with grassy vegetation. At the present, to the southeast-east of the location of the archaeological objects, there is a small clearing without any accumulations of stones, covered with dense grass and bushes. The location for a campfire, probably used by some tourist center in the vicinity of the village of Kurma, is on the edge of the clearing, about 3–4 m from the road.

The celts were both without eyelets, and differing in size and decoration, they were cast in split bivalve molds. The largest one (celt 1) is symmetrical relative to its vertical axis; the cross-section of its body and socket is rectangular (Fig. 3). The body of the item is wide and slightly expands towards the broken blade. The upper part of both wide surfaces was decorated with ornamentation in relief. A horizontal narrow band covering the item along the entire perimeter runs at a distance of 1 cm from the edge of the open facet. A V-shaped chevron pattern made in relief is below the band on one side. It is possible that initially there were five V's (the far right V was effaced, which possibly resulted from a defect in the casting mold). Ornamentation on the other side consists of three groups of chevrons in the form of V's set one inside the other, separated by vertical double lines. Holes with traces of grooves from protrusion-supports of the core appear on both wide surfaces in the central part of the ornamented field; these holes are wider on the inner side of the item. Protruding narrow pegs up to 0.8 cm long (Fig. 4) are on the sides and at the bottom at a distance of 0.6–0.7 cm from these holes. The pegs might have been for better fixation of the core inserted into the cavity of the casting mold. The height of the preserved part of the celt is 7.5 cm; the length of the socket

is 6.3, and its width is 2.9 cm. The weight of the item is 295.9 g.

The second celt (celt 2) is short and wide, with a rounded and slightly widening blade (Fig. 5). The side view of the item is slightly asymmetrical. The cross-section of the socket and body is rectangular. Parts of the socket and blade have been broken off. Casting seams are visible on the narrow (side) surfaces. A recessed ornamentation of inclined zigzags between two horizontal lines (the distance between them is 1.0–1.1 cm) is on the upper part of the item. There are holes below the ornamentation (in the center) on both wide surfaces. The height of the celt is 5.5 cm; the length of the socket is 5.5, and the width is 2 cm. The weight of the item is 97.4 g.

Both celts were studied at the Institute of Geochemistry of the Siberian Branch of the Russian Academy of Sciences in Irkutsk by L.A. Pavlova in order to establish the composition and chemical properties of the metal used. The method of X-ray spectral electron probe microanalysis using a Superprobe-733 device (Japan, JEOL Company) was applied. It was discovered that both items were made of "pure" copper (see *Table*).

Fig. 4. Inner side of celt 1.

Fig. 5. Celt 2 from the vicinity of the village of Kurma.

Discussion of the material and its dating

All known metal celts are categorized using various combinations of features revealed by the shape and design of their socket part, as well as the absence or presence of different variants of band-like ornamentation. It has been observed that most celts of the eastern type, as opposed to the western type (Seima-Turbino, etc.), have distinctive rims and collars bordering the socket (Grishin, 1971: 20; Chlenova, 1992).

The Kurma celts do not have direct parallels. Some features of their shape and ornamentation, which can be used for periodization, make it possible to suggest their chronological attribution. Celts similar in shape and cross-section have been found in the Verkhne-Metlyaevo hoard in Balagansky District of Irkutsk Region (Maksimenkov, 1960b: 13). Two such tools stand out. They are symmetrical relative to the vertical axis and have a rectangular horizontal cross-section (Fig. 6, *1*). Ornamentation (on both sides of the items) was formed by convex bands; it consists of two horizontal lines and three groups of chevrons in the form of V's set one inside the other (Ibid.: 39–40). The celts were made of tin bronze (additives reaching 2.2 %) (Sergeeva, 1981: 22). G.A. Maksimenkov attributed the bronze items from the Verkhne-Metlyaevo hoard to the Tagar period (1960a: 151; 1960b: 17), and attributed small celts with geometrical ornamentation to the fourth group of celts of the Krasnoyarsk-Angara type. Notably, the main elements of relief decoration, appearing on the first Kurma item (horizontal band, vertical dividers, chevrons), have been found in various combinations on all celts of the Krasnoyarsk-Angara type. The items under consideration are distinguished by the presence of holes (on both wide

Composition of metal in the Kurma celts, wt%

Item	Cu	Sn	As	Pb	Sb	Fe	Ni	Ag
Celt 1	Base	0.68	0.59	0.09	0.20	0.04	0.07	0.02
Celt 2	Base	0.562	0.41	0.16	0.17	0.00	0.02	0.00

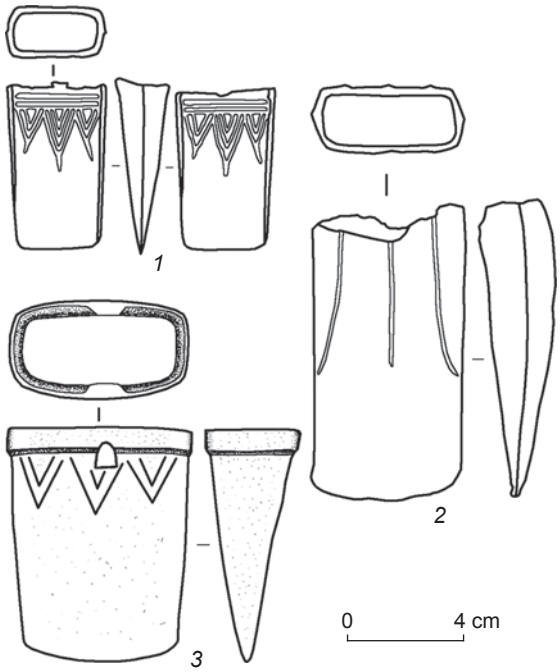

Fig. 6. Bronze celts (after (Maksimenkov, 1960b; Shmygun, Sergeeva, Lykhin, 1981; Tsybiktarov, 1998)). *1* – Verkhne-Metlyaevo hoard; *2* – Kurla, burial 1; *3* – Sayantui, burial 10.

surfaces) remaining from the supports for better fixing the core inside the casting mold.

Fragments of two bronze rectangular celts have been found in the compression layer on Sosnovy Island, located 8 km from Lake Baikal, at the source of the Angara River (Sedyakina, 1955). Judging by the published drawing (Ibid.: Pl. 1, *13*), the body of one of them somewhat expands towards the rounded blade. The upper part of the item was partially broken off. There are three vertical thin bands reaching the middle of the tool on its wide surface. We cannot say anything about the presence of ornamentation on the other side due to the absence of a drawing.

A celt similar to the Kurma celts in shape, cross-section, and presence of holes on the wide surfaces was found at the Katun I site (Chivyrkuisky Bay of Lake Baikal), in the coastal talus (Goriunova, Nomokonova, Novikov, 2008). The item is asymmetrical; its body is low and wide; it has a rounded and somewhat widened blade (due to subsequent hammering) (Fig. 7). The cross-section of the socket and body is rectangular. Its wide surfaces have one round hole each. Bands run along the edge of the socket and at a distance of 1 cm from it. The height of the celt is 6.5 cm; the length of the socket is 5 cm, and the width is 2.6 cm. Analysis of the chemical composition of the metal has revealed the presence of arsenic additives (more than 1 %), which makes it possible to describe it as arsenical bronze. The authors synchronize this celt-adze with the complex from layer IIIB of the Katun I settlement, which has been dated to the 7th–5th centuries BC (Ibid.). This dating was based on a dagger with a butterfly-shaped crossbar of Early Scythian appearance, typologically associated with the 6th–5th centuries BC (Gryaznov, 1941). It was also made of arsenical bronze with arsenic content of 1.0–1.5 %.

Two similar bronze celt-adzes were found in burials 1 and 3 at Kurla Bay in the Northern Baikal (Shmygun, Sergeeva, Lykhin, 1981). These items are asymmetric and rectangular in horizontal cross-section (see Fig. 6, *2*). The bodies are straight; the blades are slightly convex. On both sides, the celts were decorated with three thin bands diverging in the form of rays, which reach the middle part of the items. The upper parts of the tools were broken off. Casting seams are visible on the side surfaces. The remains of wood have been preserved in the sockets of both tools. The height of one celt is 10 cm; the length of the socket is 5.2 cm, and the width is 2.5 cm. Spectral analysis has shown that one item was made of arsenical bronze (arsenic content 2.6 %), while the other celt was made of alloy with arsenic (4 %) and antimony (1.3 %) (Ibid.). According to N.F. Sergeeva, bronze with relatively significant arsenic content was typical of the Transbaikal region, while in the Cis-Baikal region, the arsenic content was low (1.0–1.5 %) (1981: 25). On the basis of the typological analysis and composition of alloys, bronze items from the burials in the Kurla Bay were dated to the middle or second half of the first millennium BC (Shmygun, Sergeeva, Lykhin, 1981).

In the Transbaikal region, bronze celts are associated with the Slab Grave culture. One item with rectangular cross-section of the socket and body has been found in

Fig. 7. Celt from the Katun I site.

burial 10 at the Sayantui burial ground (Chlenova, 1992: 452, pl. 102, *10*; Tsybiktarov, 1998: 60, 256) (see Fig. 6, *3*). It has a wide band (collar) around the socket. Below it is a chevron-like ornamentation in the form of three groups of V's set one inside the other. There are holes in the middle on both sides under the band. The height of the item is 8 cm; the length of the socket is 6 cm; the width is 3.5 cm. A bivalve casting mold made of stone and intended for casting rectangular celts decorated with a horizontal band has been found in a slab grave in the Darasun area (Tsybiktarov, 1998: 60, 249). A.D. Tsybiktarov correlated these burial complexes with the Early Scythian-Tagar period (Late Bronze to Early Iron Age). The bronze items of the Zakamensk hoard, discovered in Buryatia on the Dzhida River (Khamzina, 1981; Chlenova, 1992: 451, pl. 101, *39–42*) were dated to the same period. These celts (4 items) were rectangular in horizontal cross-section; some of them had a wide band (collar) around the socket; three celts had holes remaining from the support for fixing the core inside the casting mold. Decoration (a horizontal band) has been observed only on one item.

All of the celts under discussion belonged to the Scythian-Tagar period and did not go beyond the 8th (7th)–3rd centuries BC. They are similar to each other and to the Kurma items in the shape of the body (straight or slightly expanding towards the blade), cross-section of the socket and body (rectangular), and absence of eyelets. In terms of ornamentation, the first Kurma celt was the most similar to the Krasnoyarsk-Angara type (in particular, to the fourth group), common in the taiga zone from the Yenisei to the Angara region. Their similarities include the geometric thin-band ornamentation and main elements of the pattern (horizontal band, dividing vertical lines, and chevrons). A distinctive feature of the Kurma celts is the presence of holes from the support for fixing the core inside the casting mold and the specific decoration of the second item. They differ from the Transbaikalian celts, which also have holes on the wide surfaces, with the absence of a band or collar around the socket and ornamentation—it is simplified or completely absent on the Transbaikalian celts (with the exception of the celt from burial 10 at the Sayantui burial ground).

The Kurma celts are also distinguished by the composition of metal ("pure" copper). Celts of the Krasnoyarsk-Angara group and Transbaikalian Scythian-Tagar celts were mostly made of tin and arsenical alloys (specimens from "pure" copper are extremely rare) (Sergeeva, 1981: 22–25, 34–35).

Conclusions

In terms of the set of specific features, the Kurma celts described in the article belong to the items of the Scythian-Tagar period. In this period, burials belonging to the carriers of the Slab Grave culture appeared in the Olkhon area. The center of this culture was the Transbaikal region and Mongolia (Chlenova, 1992; Tsybiktarov, 1998: 23–26; Turkin, 2003; Goriunova, Magdeeva, Novikov, 2019). The Olkhon area and Kudin steppe are the extreme northern zones of the Slab Grave culture. So far, 47 slab graves have been discovered there (almost all of them were damaged in the ancient times); copper-bronze items made in the Scythian-Tagar tradition were found in 14 graves (Goriunova, Magdeeva, Novikov, 2019). These items include figurative plaques and a hook-pendant with zoomorphic imagery, socketed arrowheads, stirrup-shaped horse bits, etc. A unique bronze sword that was accidentally found in one of the valleys of the Primorsky Ridge, between the village of Chernorud (the present-day Shara-Togot) and the Sarma Gorge (Molodin, Medvedev, 2015), was linked to that period. The authors who described it dated it to the Scythian period on the basis of a number of features (distinctive shape of the guard in the form of bear heads, mask in the center of the crossbar, etc.). In the Olkhon area, celts were found for the first time.

Currently, a series of corrected radiocarbon AMS-dates (20 dates) is available for slab graves in the Olkhon area. Their chronological range is 2778–1998 cal. BP (Waters-Rist et al., 2016; Goriunova, Magdeeva, Novikov, 2019). These dates testify to the penetration of carriers of the Slab Grave culture into this territory from the 8th century BC.

It could have been assumed that the Kurma celts belonged to a destroyed burial, but examination of the area where they were found has shown the absence of grave structures. Linking them to a settlement complex is also doubtful, since no other archaeological evidence that would indicate the presence of a cultural layer has been found in the vicinity of the place of discovery. It seems that the compact placement of the celts and their deliberate covering with a relatively large stone may indicate that they belonged to a small cache (hoard). Hidden metal things undoubtedly seemed valuable owing to their rarity and limited availability of raw materials for their manufacturing in the Cis-Baikal region. Complexes with similar functional purpose (caches, hoards) are widely known from the evidence of the Scythian-Tagar period in the adjacent territories (the hoards of Verkhne-Metlyaevo, Zakamensk, Korsukovo, etc.).

The Kurma celts show a general similarity to the Krasnoyarsk-Angara type, commonly found in the forest and forest-steppe belts, and to the Transbaikal-Mongolian celts typical of the steppe regions. Some of their original features probably reveal cultural influence and borrowings from the inhabitants of neighboring territories. The composition of metal in the Kurma celts ("pure" copper) may indicate the use of local raw materials.

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A Group of Large Kurgans in the Suusamyr Valley, Kyrgyzstan

We introduce recently discovered large kurgans of the Saka period in the Suusamyr valley, northern Kyrgyzstan. There are two cemeteries with large mounds, each of which is surrounded by ditches, stone enclosures, and ramparts. Apparently, each kurgan and the constructions around it form a whole burial complex. The kurgans are rounded in plan view, 30–73 m in diameter. Some were possibly square in plan view. West of them, there is a line of enclosures, most of which consist of eight boulders. In terms of nature and form of the constructions around kurgans, the burial complexes fall into six types, each of which is described in detail. Parallels are found among Early Iron Age cemeteries in the Tian Shan, Semirechye, central and eastern Kazakhstan. Common and distinctive features of the Suusamyr group are listed. On the basis of the comparative analysis, the group dates to 800/700–200 BC. We conclude that the kurgans were destined for the Saka elite, and were constructed over several generations. The materials of the study allow us to state that the alpine Suusamyr valley, which is hard to access, was a key political and/or cult center of the Tian Shan in the Saka period.

Keywords: *Tian Shan, Suusamyr valley, Early Iron Age, large kurgans, eight-stone enclosures.*

Introduction

The high-mountainous Suusamyr valley is one of the areas of Kyrgyzstan poorly studied archaeologically. It is located south of the Kyrgyz Ridge and east of the Talas Ridge, at a height of over 2000 m above sea level. The climate of the valley differs from that of the neighboring valleys: it is colder in winter and much cooler in summer. The valley is crossed by a dense network of rivers and streams, the Suusamyr River being the largest (Sovetskiy soyuz, 1976: 148).

In 1953, A. Kibirov discovered over 300 kurgans and a fortified settlement in the south and southeast of the valley (1955: 126–136). In the course of research, 15 ordinary kurgans were excavated and two exploratory pits were made in the area of the settlement. On the basis of the data obtained, the kurgans were attributed to various historical periods—from the Wusun period to the Late Middle Ages. In addition to ordinary mounds in the southeastern part of the Suusamyr valley, Kibirov discovered six groups of large kurgans up to 6–7 m high, which he attributed to the Wusun (Ibid.: 127).

In 2019, the Kyrgyz-Romanian archaeological team of specialists from the Kyrgyz-Turkish Manas University and the National Museum of Banat (Romania) surveyed

the Suusamyr valley as a part of the research project aimed at exploring the local archaeological sites. Twenty-nine archaeological features, including over a thousand objects (kurgans and enclosures) were identified and mapped in the southeastern part of the valley. The results of the work on mapping and processing the geoinformation data obtained have been published (Saraşan et al., 2020).

This article presents new evidence on large kurgans of the Early Iron Age in the Suusamyr valley, describes its burial grounds, large burial mounds, and the adjacent area, provides typology of the objects under discussion, and identifies their parallels in the complexes from other regions.

Cemeteries with large kurgans

Large kurgans from the Early Iron Age of Eurasia are sophisticated burial and memorial complexes consisting of single or multiple burials under the mound and a variety of related structures around them, including underground ones (Gass, 2011, 2012; Parzinger, Gass, Fassbinder, 2017; Nagler, 2017; Mozolevsky, Polin, 2005). Thanks to interdisciplinary studies of large kurgans scattered over the vast region of Eurasia from Tuva in the east to the Northern Black Sea region in the west, it was possible to establish not only specific features of individual large kurgans (or groups of kurgans), but also layouts of cemeteries, shapes and structures of burial mounds, and locations of various accompanying structures around them. Reconstruction of these burial and memorial complexes, interpretation of every detail and identification of regional features will be the objectives of forthcoming research. Today, the task of collecting and systematizing all available data seems to be more relevant. In this regard, large kurgans discovered in the Suusamyr valley are of interest.

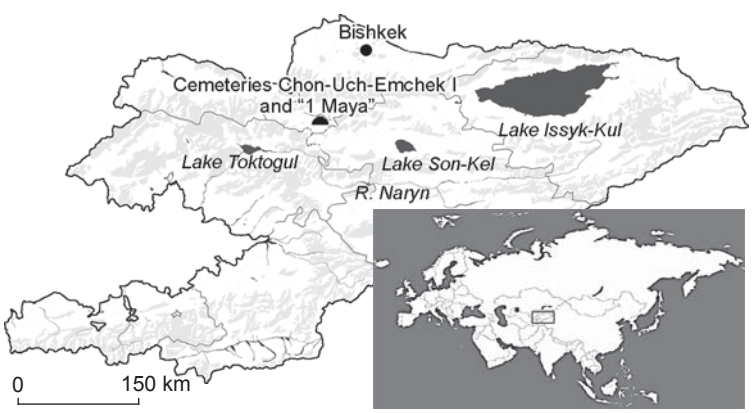

Fig. 1. Location of the Chon-Uch-Emchek I and "1 Maya" cemeteries in the Suusamyr valley (Kyrgyzstan).

Two cemeteries have been found in the southeastern part of the Suusamyr valley, on a flat hill between the valleys of the Chon-Uch-Emchek and Kichi-Uch-Emchek Rivers (Fig. 1). These include kurgans with a diameter of 30–73 m and height of over 2 m, designated as large, and kurgans with diameters of 4–9 and 10–28 m, designated as ordinary and medium-sized respectively.

The *"1 Maya" cemetery* consists of twenty kurgans and 102 stone enclosures of various sizes. Six kurgans with diameters of 37–73 m can be described as large; nine kurgans with diameters of 18–26 m as medium-sized; and five kurgans with diameters of 4–8 m as ordinary.

The kurgans constitute four chain-like groups, 160–300 m apart, stretched along the N-S line. A chain of large kurgans is located in the eastern part of the cemetery, and chain of medium-sized kurgans runs parallel to that chain in the western part. All kurgans show traces of looting. Ramparts and stone placements have survived around large kurgans (Fig. 2). On the western side of the kurgans, there are chains of stone rings made of eight boulders, usually stretched similarly to kurgans along the N-S line.

The *Chon-Uch-Emchek I cemetery* is located 1 km south-southeast of the southern outskirts of the village of 1 Maya. There are 89 stone-and-soil kurgans and 154 stone enclosures at that cemetery. Seven kurgans with diameters of 31–65 m can be described as large, 35 kurgans with diameters of 10–30 m as medium-sized, and the remaining 47 kurgans with diameters of 4–9 m as ordinary. The kurgans constitute four chain-like groups at a distance of about 3 km from each other, stretched along the NNE-SSW line. All the kurgans have depressions and craters—traces of looting. Four large kurgans of that cemetery are surrounded by ditches, square or rounded in plan view, located at a distance of 10–30 m from the kurgan's bottom (Fig. 2). The medium-sized kurgans are encircled by double ring-shaped enclosures located 3.6–20 m from the kurgan's bottom. The ditches and ring-shaped enclosures have passages on their eastern and western sides. Rows of enclosures made of eight stones and stretching along the N-S line are observed to the west of the large and medium-sized kurgans.

Types of large kurgans

Large and medium-sized kurgans differ in terms of form and nature of the constructions that surround them. They can be divided into the following types: kurgan on a square platform surrounded by double rectangular stone enclosure; kurgan encircled by double stone ring; kurgan encircled by double stone ring, with a vertically set stone in the

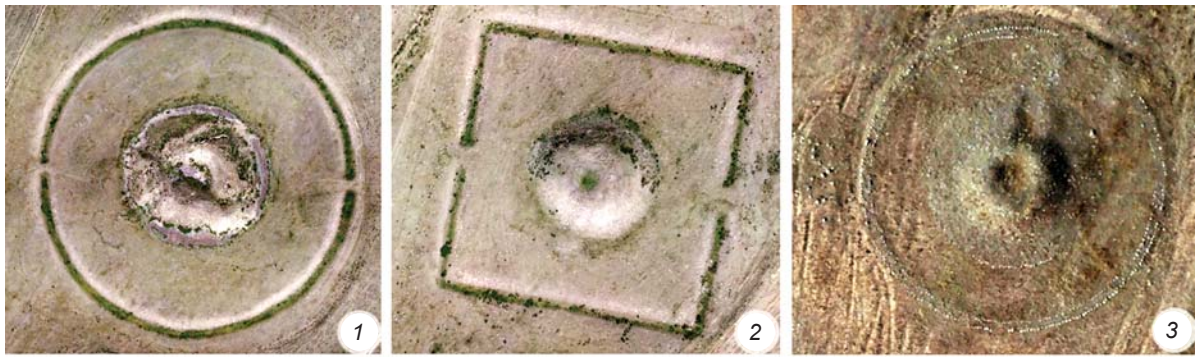

Fig. 2. Aerial photographs of large kurgans and the adjacent areas at Chon-Uch-Emchek I and "1 Maya".

southern and northern sides of the outer ring; kurgan surrounded by rectangular ditch; kurgan surrounded by ring-shaped ditch; and kurgan encircled by double rampart (Fig. 3).

1. Kurgan on a square platform surrounded by double rectangular stone enclosure (Fig. 3, *1*) is represented by one object (kurgan 3) at the "1 Maya" cemetery. This kurgan is 71 m in diameter and 8.7 m in height; it has a stone-and-soil mound, subcircular in plan view and truncated-cone-shaped in cross-section, with a large robbers' crater in the center (Fig. 4, *1*). The base of the kurgan is surrounded by a band of black pebbles 2.5–3.5 m wide, with 1.5–2.0 m long gaps (Fig. 4, *2*). The mound was made over a square stone-and-soil platform oriented to the cardinal points with its sides. The length of the platform's sides is 74–75 m; the height is 0.1–0.4 m. Placement of large stones survived in some areas along the edges of the platform.

This kurgan is surrounded by a double stone enclosure, rectangular in plan view. The enclosure, just like the platform under the mound, is oriented to the cardinal points with its sides. The space between the inner and outer enclosures is empty; no traces of stone flooring have been found. A passage 3.8 m wide is in the middle of the western wall of the double enclosure; it is not clearly identified, owing to the destruction of stonework in the eastern wall. The width of the double enclosure is 2.3–2.4 m; the distance from the base of the kurgan to the middle of the sides of the inner enclosure is 33–35 m; the length of the sides of the outer enclosure is about 140 m.

Two partially destroyed enclosures, each made of eight stones, were found 2.5–8.0 m east of the northeastern corner of the double enclosure. The diameters of the enclosures are 2.5 and 3.6 m.

The burial and memorial complex described above is not the only one of its kind in Kyrgyzstan. Identical structures have been found at the Zhapyryk burial ground in the Inner Tian Shan (Tashbaeva, 2011: 101, fig. 16, 18), where two (out of three) large kurgans rest on rectangular stone-and-soil platforms surrounded by double rectangular stone enclosures, with passages in the middle of the eastern and western walls. Chains of enclosures made of eight stones are most often located to the west, and in one case, to the east of the kurgans. According to topography, layout, and some external features, these kurgans were attributed to the Saka period (Ibid.: 101).

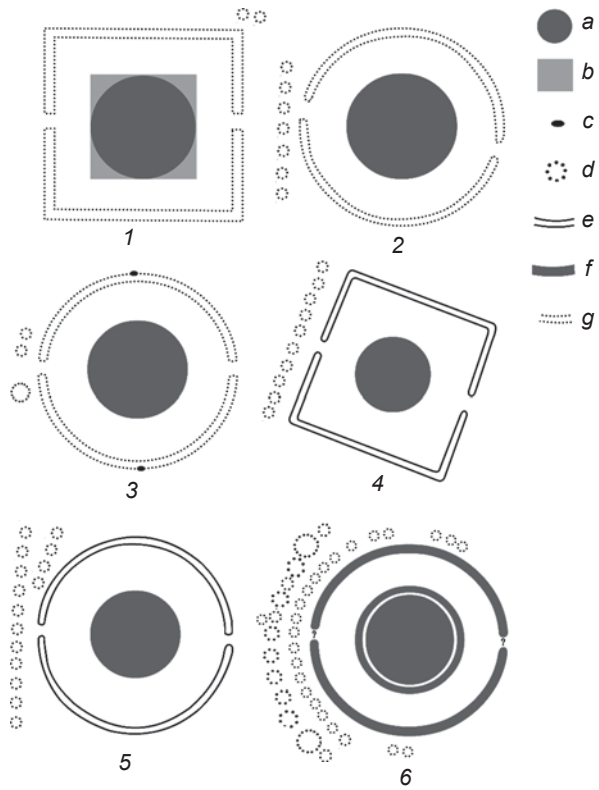

Fig. 3. Schematic representations of types of large kurgan at Chon-Uch-Emchek I and "1 Maya".

1 – kurgan on square platform surrounded by double rectangular stone enclosure; *2* – kurgan encircled by double stone ring; *3* – kurgan encircled by double stone ring, with a vertically set stone in the southern and northern sides; *4* – kurgan surrounded by rectangular ditch; *5* – kurgan surrounded by ring-shaped ditch; *6* – kurgan encircled by double rampart.

a – kurgan mound; *b* – stone-and-soil platform; *c* – vertically standing stone; *d* – stone enclosure; *e* – ditch; *f* – rampart; *g* – stone placement.

Among numerous large kurgans of the southeastern Semirechye, we were unable to find a complete parallel to the Suusamyr kurgan under consideration. On this territory, there are dozens of kurgans comparable only in some respects with the Suusamyr one. For example, 16 kurgans with double stone rectangular (square) enclosures, with passages on the eastern and western sides, have been found at a number of cemeteries in Semirechye (Gass, 2011: 60; Parzinger, Gass, Fassbinder, 2017: 223). However, unlike the Suusamyr kurgan, they had different forms of mounds and did not have a platform and enclosures of eight stones. It is difficult to explain the reasons for these differences. At this stage of research, it can be concluded that all these structures belonged to related tribes living in the Saka period.

2. Kurgan encircled by a double stone ring (see Fig. 2, *3*; 3, *2*). Kurgans of this type were most numerous in the complexes under consideration, amounting to one large

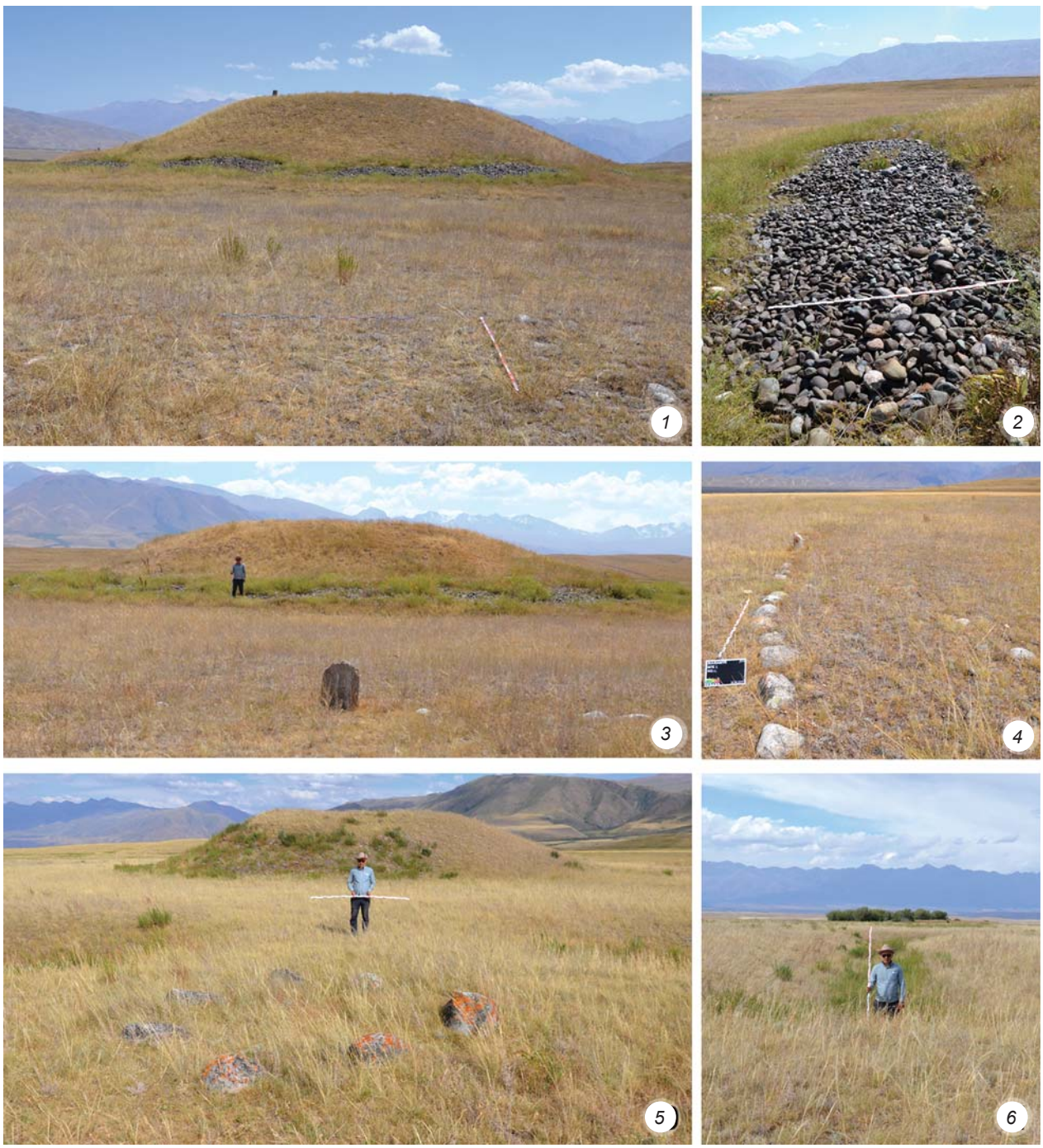

Fig. 4. Large kurgans and associated structures around them.

and 22 medium-sized. All medium-sized kurgans were surrounded only by the double stone ring. Particularly indicative is kurgan 30 at the Chon-Uch-Emchek I cemetery. It is 37 m in diameter, 3.5 m in height, and has a truncated-cone-shaped stone-and-soil mound, subcircular in plan view, with an extensive robbers' crater in the center. Sodded stones, apparently belonging to the stone shell of the kurgan, are visible on the surface. The southern slope of the mound is less steep than other sides. At a distance of 17–20 m from the base, the kurgan is surrounded by a double ring stone enclosure 1.0–1.1 m wide. The enclosure's walls are made of medium-sized stones set on their edges. Passages are slightly visible on the eastern and western sides. Six enclosures 2.5–3.0 m in diameter, each made of eight stones, were found 40 m west of this kurgan. The enclosures form a chain stretched along the N-S line.

The results of archaeological research in the Tian Shan and Semirechye indicate that kurgans surrounded by double stone rings were more common than kurgans of other types. All surviving medium-sized kurgans at the two cemeteries under consideration were surrounded exclusively by double stone rings. In the Tian Shan, in addition to one large kurgan at the "1 Maya" burial ground, the type under discussion included a large kurgan at the Zhapyryk cemetery (Tashbaeva, 2011: 101, fig. 16, 17). At least five more large and medium-sized kurgans surrounded by similar stone structures have been found in the Kochkor valley and Ketmen-Tobo depression (Ibid.: 38; Kibirov, 1959: 74). In the southeastern Semirechye, a total of about twenty kurgans surrounded by double stone rings are known at nine cemeteries (Gass, 2011: 60; 2012: 470; Parzinger, Gass, Fassbinder, 2017: 219). When some of the rings were excavated and unearthed, it was discovered that the spaces between the inner and outer rings were paved with rubble and stones. It is unknown whether such pavement was present between the stone rings of the Suusamyr kurgans, since excavation and unearthing have not yet been carried out. It should be mentioned that there are also cases when the spaces between the rings around large kurgans were empty, which were established, for example, at the Katartobe cemetery in the eastern Semirechye (Chotbaev, Ongar, 2014).

3. Kurgan surrounded by a double stone ring; in the outer ring, strictly along the N-S line, one stone is placed in a vertical position at each of two sides (see Fig. 3, *3*). This type is represented by one object (kurgan 13) at "1 Maya". In all its structural elements, it is similar to kurgans of the previous type, yet differs by the presence of two vertically set stones in the northern and southern zones of the outer ring. Kurgan 13 (52.3 m in diameter and 7.3 m high) is a soil mound rounded in plan view and truncated-cone-shaped in cross-section; it has a large robbers' crater in the center (see Fig. 4, *3*). Sodded stones that might be remains of the stone shell are visible in some places on the surface of the kurgan. A band of mostly black pebbles 2.0–4.5 m wide runs around the kurgan bottom. Individual accumulations of black and dark blue pebbles are visible above the black stone band on the western and southwestern slopes of the mound.

The kurgan is surrounded by a double stone enclosure 2.3–2.6 m wide; this is located 20–22 m from its bottom. The space between the inner and outer enclosures is empty; stone flooring is not visible on the surface of the earth. A passage 4.0–4.3 m wide is present on the eastern and western sides of the double ring. Vertically set stones 0.7 m high are observed in the southern and northern zones of the outer enclosure (Fig. 4, *4*). The remains of a stone ring-shaped enclosure 5.5 m in diameter were found 55–60 m west of kurgan 13. Twenty-six wall stones are visible on the surface. Two enclosures, each of eight stones and with a diameter of 3 m, are located 5–8 m to the north of the wall.

There are no exact parallels to kurgan 13 among the known complexes in the Tian Shan and Semirechye. Obviously, it is structurally and therefore semantically close to kurgans of the previous type, which are quite common. However, the presence of stones set vertically along the N-S line distinguishes that kurgan from the total mass of similar kurgans, and makes it possible to consider it unique.

4. Kurgans surrounded by a square ditch (see Fig. 2, *2*; 3, *4*). These are two kurgans (9 and 31) at the Chon-Uch-Emchek I cemetery. Kurgan 31 is 41.4 m in diameter and 5.5 m in height; it has a truncated-cone-shaped stone-and-soil mound, subcircular in plan view, with a large robbers' crater in the center (Fig. 4, *5*). The southern slope of the kurgan is steeper than the other sides. Sodded stones that could have belonged to the stone shell are visible on the surface of the mound. The kurgan is surrounded by a ditch rectangular in plan view; its sides are oriented to the cardinal points. The ditch has a passage about 6 m wide on its eastern and western sides (see Fig. 4, *6*). The distance from the base of the kurgan to the ditch is 18–20 m. The length of the ditch's sides is about 90 m; the ditch's width is about 6 m; its depth is 1.0–1.3 m. Along the western ditch running around kurgan 31, seventeen enclosures made of eight stones and measuring 2–3 m in diameter are stretched in a chain about 120 m long, along the N-S line.

As far as we can see in the literature, large kurgans surrounded by rectangular ditches are quite rare. With the exception of two kurgans in the Suusamyr valley, similar structures are unknown both in the Tian Shan or Semirechye, although it is possible that they will be discovered in the future. According to the presently available archaeological evidence, during the Saka period, kurgans surrounded by rectangular ditches were built much less frequently than those encircled by ring-shaped

ditches. This also applies to large Scythian kurgans in the Northern Black Sea region; only in one case had the ditch a "square layout untypical of the Scythian period" (Mozolevsky, Polin, 2005: 295).

5. Kurgans surrounded by a ring-shaped ditch (see Fig. 2, *1*; 3, *5*) are represented by three objects (10, 12, 17) at the Chon-Uch-Emchek I burial ground. The largest of them, kurgan 10, is quite noteworthy. It is 65.8 m in diameter and 8 m in height, has the appearance of a truncated-cone-shaped mound of stone and soil, subcircular in plan view, and a large robbers' crater in the center. The base of this kurgan is encircled by a band of pebbles of dark, blue, and white tones 2–3 m wide. The kurgan is surrounded by a ring-shaped ditch 8 m wide and about 2 m deep, located 30 m from the base. On the eastern and western sides, the ditch has causeway passages 4.0 and 4.5 m wide.

Two rows of enclosures, each made of eight stones and oriented along the N-S line, are located at a distance of 40–300 m west of kurgan 10, near the outer edge of the ditch. The short row consists of ten objects and is located to the northwest of the mound, while the long row consists of about 75 enclosures 2.0–3.3 m in diameter (see Fig. 2, *1*; 3, *5*).

Ring-shaped ditches have often been found around large kurgans. A total of nineteen large kurgans with ditches round in plan view were found at five cemeteries in the southeastern Semirechye (Gass, 2012: 471; Parzinger, Gass, Fassbinder, 2017: 226). In most cases, these ditches are continuous; they have no causeway passages, as opposed to the ditches around the Suusamyr kurgans. Large kurgans of the Tasmola and Shilikty cultures of the Early Saka period in Central and East Kazakhstan are also surrounded by ring-shaped ditches, indicating the popularity of this design in time and space (Beisenov, 2015; Toleubaev, 2018: 59).

6. Kurgan surrounded by a double rampart (see Fig. 3, *6*). This is kurgan 2 at the "1 Maya" cemetery. It is 73.8 m in diameter, 8.5 m in height, and has a truncated-cone-shaped soil mound, rounded in plan view, and a large robbers' crater in the center. A band of predominantly dark-colored pebbles 1.5–7.0 m wide has survived around the base of the mound. Individual clusters of pebbles of blue and white colors were found on the slope of the mound above the dark-colored band. A stone-and-soil rampart 3.0–3.3 m wide runs around the kurgan, at a distance of 4.8–5.0 m from its base. A second stone-and-soil rampart 2.8–3.0 m wide and up to 0.1 m high was found 25 m from the first rampart. Like the first one, it encircles the kurgan. Owing to the weak manifestation of the rampart on the present-day surface, it is not possible to establish any signs of a possible passage in it. The distance from the second rampart to the base of the kurgan is 30–32 m. In some locations, placement of stones has survived along the edges of the outer rampart.

Stone ring-shaped enclosures forming two irregular chains were found along the western half of the outer rampart (see Fig. 3, *6*). Most of the enclosures are built of eight boulders. The first chain, located close to the rampart, consists of enclosures with a diameter of 1.5–1.8 m; the second chain, located to the west of it, mainly includes enclosures with a diameter of 2.5–3.5 m. Large enclosures with diameters of 7.5–8.0 m, built of 30–32 stones, are at the southern and northern ends of the second chain. Two more chains of enclosures, each made of eight stones and stretched along the E-W line, were built to the south of the kurgan, along the outer rampart.

Eighty-seven enclosures were found around kurgan 2. Sixty-four of them were made of eight stones each, and the remaining 23 enclosures were made of a larger number of stones. With the exception of two, they are located south of kurgan 2, and are stretched along NNW-SSE line.

As an accompanying structural element around a large kurgan, ramparts occur at a number of the Saka cemeteries in the southeastern Semirechye (Gass, 2012: 473). However, the rampart is not double there, as is the case with the Suusamyr kurgan under consideration. Ramparts in the immediate vicinity of the kurgan bottom's were detected around nine kurgans at two cemeteries. Six objects have a ditch along with a rampart around the kurgan. Kurgan 7 at the Turgen cemetery is surrounded by a stone rampart located, similarly to the second outer rampart in the Suusamyr kurgan, at some distance from the edge of the mound (Ibid.). Taking into account the nearby stone enclosures associated with it and the absence of other identical kurgans, the Suusamyr kurgan can be considered unique.

There is no information in the literature about the presence of a passage in the ramparts at the Semirechye burial grounds. It is reliably known that the rampart located 4–7 m from the base of two kurgans at the Besshatyr cemetery had a passage (Akishev, Kushaev, 1963: 30, fig. 7). There are two passages on the eastern and western sides in the ramparts around large Scythian kurgans (Mozolevsky, Polin, 2005: 298). This makes it possible to assume the presence of two passages in the rampart around kurgan 2 at the "1 Maya" cemetery (they are not clearly visible on the present-day surface). This is indirectly confirmed by the presence of passages in all ditches and stone rings around the Suusamyr large and medium-sized kurgans.

The presence of stone enclosures to the west of the kurgans is typical for the burial mounds of all types at "1 Maya" and Chon-Uch-Emchek I. The vast majority (over 250) are rounded enclosures 1.3–4.0 m in diameter, made of eight stones spaced apart from each other (see Fig. 4, *5*). Several stone enclosures, rounded or subrectangular in plan view, were made of more than eight stones placed next to each other. The chains of 2–87 stone enclosures are oriented along the N-S line.

In the Tian Shan, enclosures of eight stones have been previously studied in the valley of Lake Son-Kul, as well as in the Naryn and At-Bashi valleys (Sher, 1964; Tabaldiev, 2011: 36–47; Tashbaeva, 2011: 101). Large kurgans at the Zhapyryk cemetery are of the greatest interest among these: according to a set of external features, including the presence and location of enclosures, they completely correspond to the kurgans from the Suusamyr valley.

Notably, according to external features, large kurgans at the southeastern Semirechye cemeteries completely or partially coincide with large kurgans in the Suusamyr valley, but have no enclosures of eight stones. Kurgans with enclosures are known from the Early Scythian and Scythian cemeteries in Central and East Kazakhstan (Toleubaev, 2018: 21; Beisenov, 2014, 2015). Medium-sized and large kurgans with enclosures in these complexes are often surrounded by stone rings and ditches. All these coincidences are hardly accidental.

Conclusions

Thirteen large kurgans that were discovered at two cemeteries in the Suusamyr valley may be divided into six types, according to the shape and building-technique of the surrounding structures. The structures are double stone placements, ditch, and rampart. These are square (rectangular) or rounded in plan view. The kurgans are truncated-conical or hemispherical in cross-section. The former shape is typical of large kurgans; the latter, mainly of medium-sized kurgans. In plan view, kurgans are rounded or subcircular. Kurgans square in plan view have not been clearly identified. As is known, they have often been found at the cemeteries in the southeastern Semirechye (Gass, 2011: 60). Scholars established the following pattern: if a large kurgan was square, the structure surrounding it (stone placement, ditch, and rampart) had the same shape (Gass, 2012: 471; Parzinger, Gass, Fassbinder, 2017: 223). The link between the shape of the kurgan and the structure around it at the sites in the Suusamyr valley has not been detected clearly. However, it should be kept in mind that the original shape of almost all large and medium-sized kurgans in the region under consideration has been damaged by robbers, which is clear by large craters in their center. In such cases, advanced research methods make it possible to establish the original shape of the deformed kurgans. For example, thanks to geophysical surveys, it has been discovered that one of the seemingly round kurgans at the Zhoan-Tobe cemetery in the southeastern Semirechye, was originally square (Parzinger, Gass, Fassbinder, 2017: 222–223). Therefore, at this stage of research, we can not exclude that large kurgans of the Suusamyr valley surrounded by square (rectangular) ditches and stone enclosures had had a square (rectangular) plan view.

The parallels presented make it possible to attribute the Suusamyr large kurgans and related structures to the 8th (7th)–3rd centuries BC. The date can be established with better precision after excavating the sites and analyzing the finds. It is quite clear that such sophisticated burial and memorial complexes were created to honor the representatives of the upper stratum of the Saka society. The accumulation of thirteen large kurgans at two cemeteries located 4 km apart suggests that they were built by several generations. All this indicates that in the Saka period, the Suusamyr valley was one of the important political and/or cult centers in the Tian Shan.

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Female Burials with Weapons in the Early Nomadic Kurgans in the Southern Urals (Late 5th to 2nd Centuries BC)

An attempt is made to classify, analyze, and interpret female burials with weapons in the graves of early nomads in the Southern Urals, dating to late 5th–2nd centuries BC. In the Early Iron Age, this vast region was a center of the nomadic elite. The sample includes 23 graves with 24 buried individuals at well documented cemeteries. Only individuals for whom skeletal sex indicators are available have been included. Criteria and opinions are revised. Weapons in female burials include mostly quiver sets; whereas daggers, swords, and spearheads are rare. The placement of weapons was the same as in male burials: bladed weapons were placed on the right side, with hilts directed to the right hand, whereas quivers were found mostly on the left side. The remaining funerary items were exactly like in other female burials: there were numerous ornaments, bronze mirrors, spindle whorls, and stone altars. Female burials with weapons were found in kurgans regardless of social status. Apparently, those women represented all social strata, from elite to low-ranking nomads. Nothing indicates the existence of female military units, which, however, does not imply that women took no part in armed conflicts or did not use weapons to protect themselves and their homes.

Keywords: *Southern Urals, Early Iron Age, early nomads, kurgans, female burials with weapons, "Amazons".*

Introduction

Female burials with weapons found at cemeteries of various pastoral cultures of the Early Iron Age in Northern Eurasia have been the subject of ongoing discussions among scientists for almost a century. A complete historiographical review of this problem is presented in the works of M.S. Strizhak (2007), S.A. Yatsenko (2015), and T.V. Bogachenko (2017). This article highlights the research that is directly related to the region, and to the chronological period under consideration.

The first works in which the gender-specific aspects of the early nomadic burials were studied in detail (on the materials of all the Volga-Ural burial grounds accessible to the author) were publications of Strizhak (2006, 2007). Having examined 87 burials of the 6th–4th centuries BC, with skeletal sex indicators, she concluded that "the militancy of the 'Sauromatian' women" is greatly exaggerated (Strizhak, 2007: 74), since arrowheads in female burials of this period are rare, and a dagger was found in only one (Ibid.: 75). Almost 10 years later, an article by A.K. Gilmitdinova (2016) was published, who studied the social roles of women of the early nomads of the Southern Urals in the chronological range from the 6th century BC through the 2nd–4th centuries AD. The research base seems to be very extensive: 184 female

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burials (with skeletal sex identification), belonging to three periods—Sauromatian, Early Sarmatian, and Late Sarmatian. The author took into account only individual graves. Female burials with weapons were found only on Early Sarmatian sites. The weapons were found in the graves of women of all ages, with a predominance of the "young age" (Ibid.: 67–68).

It is easy to see that, despite the differences in source bases and chronological frames, some of the conclusions made by Strizhak and Gilmitdinova match. First, this is a conclusion about a relatively small number of weapons in the burials of the Sauromatian period. The largest number of female burials with weapons falls on the Early Sarmatian time. Its samples are comparable to those found in male graves. In the burials of women of the Late Sarmatian period, weapons are absent. Both researchers used in their calculations only graves with skeletal sex identification.

The source base on the history of the Sarmatians of the Southern Urals is constantly expanding, and new monuments are being introduced into scientific circulation. In this regard, it has become necessary to return once again to the topic of female burials with weapons, to develop criteria for their selection, and present a summary of such burials in the Southern Urals, which can later be supplemented.

Methodological aspects

Until now, uniform criteria for identifying female burials with weapons have not been developed, although this issue has been repeatedly raised (Bogachenko, Maksimenko, 2008: 48–50; Bogachenko, 2017: 182; Sinika et al., 2020: 83–86). The range of opinions is wide. Some researchers consider it possible to classify the ruined grave-pits, graves with single arrowheads, and burials without anthropological sex identification as "Amazon" burials (Fialko, 2015: 60–79). According to others, with whom I generally agree, the presence of skeletal sex identification is mandatory, and burials with single arrowheads or completely looted should not be used for analysis (Sinika et al., 2020: 79–86). Some authors note that more stringent criteria can significantly narrow the range of sources (Bogachenko, 2017: 181–182). One can dispute this. The situation with skeletal sex identification is, of course, far from ideal, but not hopeless. Materials from the early nomadic cemeteries in the Southern Urals make it possible to collect an impressive database of anthropologically sexed burials, most of which have been described in publications and are available for analysis. Using a quality source will lend more support to the conclusions.

I suggest that a burial can be classified as a female one with weapons only if the following conditions are met:

– Skeletal remains must have professional skeletal sex identification;

– The belonging of grave goods (weapons) to a specific individual (woman) must be undeniable. Accordingly, these burials must be ether undisturbed individual burials; or disturbed, but with preserved sections; or undisturbed paired or multiple burials, in which personal belonging of the goods is beyond doubt;

– Weapons can be described as an accompanying grave goods. In other words, these must be a separate item (dagger, sword, spearhead, armour, etc.) and/or a complex (quiver set, remains of a quiver) lying *in situ* and accompanying the deceased as personal property or funeral offerings/gifts.

Characteristics of sources

The source base of the work is a sample of female burials (24 individuals, 23 grave-pits), formed on the basis of all materials available to me from the burial grounds of the Southern Urals, which meet the above criteria and chronologically belong to the Early Prokhorovka and Prokhorovka antiquities (see *Table*). Some of them have been published (see (Zhelezchikov, Klepikov, Sergatskov, 2006: 13–15, 26–27; Kuptsov, Kuptsova, 2018; Kurgany…, 1993: 30–31, 48, 1995: 35–36; Morgunova et al., 2003: 138–141, 145–153, 168–173; Smirnov, 1975: 108, 121, 131–132, 136–143; Tairov, Botalov, Pleshanov, 2008; Yablonsky, 2008; 2010: 21–22); Yablonsky, Treister, 2019)), some of them are not yet available in publications (Botalov, 2008; Sirotin, 2010). Skeletal sex identifications were taken from publications. For the unpublished cemetery of Kichigino I, anthropological identification (skeletal sex indication) was made by E.P. Kitov (Miklouho-Maklay Institute of Ethnology and Anthropology, Moscow), for the single mound Yakovlevka II by V.V. Kufterin (Museum of Natural History of the Akmulla Bashkir State Pedagogical University, Ufa) and by A.I. Nechvaloda (Institute of History, Language and Literature, Ufa Scientific Center, Russian Academy of Sciences; Museum of Natural History, Ufa).

Research results and discussion

Female burials with weapons were found in almost all large burial grounds, both in elite (Filippovka I, kurgan 1, pit 2) and ordinary (Lebedevka VI, kurgan 34) kurgans. They were located both in the central part and on the periphery of the burial grounds. A number of cemeteries contain kurgans where several such burials were found (Mechetsay, kurgan 8, burial 1 and 5; Shumaevsky II, kurgan 9, burial 8, 11, and 18; Kichigino I,

Female burials with weapons from cemeteries in the Southern Urals

Object	Age	Type of burial	Weapons	Localization
Lebedevka V, kurgan 9, burial 5, skeleton 6	25–35	Multiple: skeleton 1 – 15–17 (sex not identified); 2 – 2–5; 3 – 20–25 (fem.); 4 – 12–15 (sex not identified); 5 – 45–55 (male); 7 – 14–16 (sex not identified); 8 – 35–40 (fem.)	AH* (36, quiver), quiver hook	On the chest
Same, burial 3	45–55	Individual	AH (9)	At the left knee
Lebedevka VI, kurgan 34, burial 1	35–45	"	AH (30)	In the area of the right shoulder, in pieces
Pokrovka-2, kurgan 8, burial 5	30–35	"	AH (16, quiver)	At the left arm
Mechetsay, kurgan 6, burial 2b	45–55	"	AH (29, quiver)	At the left shin
Same, kurgan 7, burial 8	*Adultus*	"	AH (26, quiver)	At the feet
Same, kurgan 8, burial 1	"	Paired, *Adultus* (male ?)	AH (not less than 50, quiver)	At the left arm
Same, burial 5, skeleton 1	*Maturus*	Paired, 25–30 (fem.)	AH (10, quiver)	At the left leg
Same, skeleton 2	25–30	Paired, *Maturus* (fem.)	AH (95, quiver), quiver hook	At the right shoulder
Pokrovka-8, kurgan 1, burial 6	40–45	Individual	AH (18), dagger	Dagger – to the right of the hip, AH – in the area of the left knee and the chest
Same, kurgan 5, burial 2	25–30	"	AH (6), dagger	Dagger – above the right femur, AH – at the left hip
Shumaevsky II, kurgan 9, burial 8	25–30	"	Dagger in sheath, sword in sheath	On the right along the body
Same, burial 11, skeleton 2	16–19	Paired, app. 15 (sex not identified)	SH** with remains of the shaft, belt set	Under the left hand
Same, burial 18	17–25	Paired, infant (in a niche)	AH (34, quiver), quiver hook, dagger	Dagger – on the right hand and the right hip, quiver – along the left leg
Prokhorovka, kurgan B, burial 3	*Juvenis*	Individual	AH (111, quiver), quiver hook, SH	At the right hip
Kichigino I, kurgan 3, grave-pit 3, burial 2	30–40	"	AH (148, quiver), quiver hook	Along the left forearm
Same, grave-pit 4***	*Adultus*	"	AH (122, quiver), quiver hook	Along the left leg
Imangulovo II, kurgan 8, burial 1, skeleton 1	25–35	Paired, 6	AH (44, quiver)	Near the right leg
Yakovlevka II, burial 2, skeleton 1	25–30	Paired, 7–8	AH (244, quiver), quiver hook, set of bridles	Along the shin
Same, burial 3	25–35	Individual	AH (133, quiver), quiver hook, iron stiletto	Between the hips
Same, burial 4, skeleton 2	25–35	Paired, 30–35 (fem.)	AH (208, quiver), quiver hook	Behind the head
Same, burial 6	25–30	Paired, less than 1 year	AH (53, quiver), quiver hook	Along the right forearm
Filippovka I, kurgan 1, burial 2	App. 35	Individual	AH (97, quiver), bow fragment	To the right of the body
Same, kurgan 11, burial 1, skeleton 2	20–25	Multiple: skeleton 1 – 30–35 (male); 3 – 20–25 (male); 4 – app. 30 (male)	AH (46, quiver), 4 sets of bridles	At the left elbow, on the mirror

*Arrowheads.
**Spearhead.
***Anthropologically, sex was not identified owing to the poor degree of preservation of the bones.

kurgan 3, burial 3 and 4; Yakovlevka II, single kurgan, burial 1, 3, 4, 6).

The proportion of female burials with weapons (out of the total number of female burials, burials weapons, etc.) can only be calculated with a high degree of conventionality, because there is no certainty that the cemeteries have been fully explored, that such burials were not among the destroyed/plundered/looted, etc. Of the 195 anthropologically identified female burials in the Southern Urals, 24 (more than 12 %) can be considered full-fledged burials with weapons.

In the sample under consideration, six burials were primary. Of these, one is individual (Lebedevka VI, kurgan 34), three are paired (Mechetsay, kurgan 8, burial 5; Shumaevsky II, kurgan 9, burial 11; Imangulovo II, kurgan 8, burial 1), and two are multiple (Filippovka I, kurgan 11; Lebedevka V, kurgan 9, burial 5). The rest of the burials were located on the periphery of the kurgans (18). These are secondary burials, usually individual ones; only four are paired (single kurgan Yakovlevka II, burial 2, 4, and 6; Shumaevsky II, kurgan 9, burial 18).

Of course, there was a relationship between the localization of the burial and its design. In the peripheral grave-pits, pits furnished with special niches (*podboi*), constructed on the longitudinal wall, slightly predominate (11 pits out of 18, 61.1 %). The primary graves are represented by three simple pits with ceilings, a pit with a dromos, and two with *podboi* niches. Nevertheless, there is no connection observed between the localization of a female burial, its design, on the one hand, and the presence of weapons in grave goods, on the other hand. This may be explained by the fact that the choice of burial site was primarily determined by the vertical and/or horizontal status of the deceased.

Despite the general Sarmatian canon of the funeral rite, the burials under consideration are variable. Among the individual burials, there are primary and secondary, relatively modest and elite. The quiver set from an elite female burial (Filippovka I, kurgan 1, burial 2) can, perhaps, be interpreted as a ceremonial weapon, part of the funeral gifts. This can be confirmed by its localization in the grave-pit (at some distance from the body, next to the silver vessels).

Four of the paired burials have women buried with children. In two cases, these are infants—a newborn and a child died before reaching its first year. Two other women were buried with children aged 6 to 8. Babies were not accompanied by their own goods; all items were associated with women. A six-year-old child (Imangulovo II) had a quiver with arrows placed on his chest and an iron dagger (akinak) to the left of his body (Kuptsov, Kuptsova, 2018: 147). A child of 7–8 years old (Yakovlevka II) was accompanied by adornments.

Teenagers were buried in one of the paired burials (Shumaevsky II, kurgan 9, burial 11, central). Both were lying on a stretcher, but only the female skeleton (No. 2) was accompanied by the goods that included many adornments, a belt set, and an iron spearhead (Morgunova et al., 2003: 152). Two grave-pits have two women buried in each: Mechetsay, kurgan 8, burial 5 and Yakovlevka II, burial 4. In the first case, quivers accompanied both of them, in the second, a quiver set and numerous other items were found in one, the other deceased had no goods. The only paired burial of a man and a woman is Mechetsay, kurgan 8, burial 1 (Smirnov, 1975: 133). The man was accompanied by an iron sword, and the woman by a quiver of arrows.

A large primary multiple burial (Lebedevka V, kurgan 9, burial 5) contained the remains of eight people: a child, three teenagers, three women, and a man. One of the women had a quiver with arrows placed on her chest (skeleton 6). No other weapons were found (Zhelezchikov, Klepikov, Sergatskov, 2006: 14). The multiple burial in kurgan 11, Filippovka I, was destroyed, only the remains of two people (a man and a woman) remained undisturbed. The latter was accompanied by a quiver with arrows and four sets of horse harness (Yablonsky, 2008: 170–171).

The preponderance of the sample consisted of burials of young and middle-aged women (25–35 years old), generally belonging to the *Adultus* category—17 deceased (70.9 %). Five burials belonged to older women—from 35 to 55 years old (20.8 %). In two burials (8.3 %), young persons (up to 25 years old) were found, both in kurgan 9, Shumaevsky II.

Weapons in female burials are presented in the absolute majority of cases by arrowheads (22 burials, 91.6 %). As a rule, arrows were in quivers, supplemented with quiver hooks. Only in two burials (Shumaevsky II) were there no arrowheads, and the dead were accompanied by a sword, dagger, and spear. In general, in the studied burials, in addition to arrowheads, four iron daggers, a sword, a stiletto, and two spearheads were found (see *Table*). They were deliberately placed in the grave, and were battle weapons.

The tendency, common in the world of the early nomads, to replace bronze arrowheads with iron ones and to increase the proportion of bladed weapons can also be observed in the female burials. Weapons in the female burials of the early cemeteries of the Trans-Urals and Cis-Urals Kichigino I, Yakovlevka II (burial 2), Filippovka I (late 5th–4th centuries BC) are represented only by quivers with bronze arrowheads. In a number of burials (Yakovlevka II, Kichigino I), these are very large quiver sets, consisting of more than 100, and in the case of Yakovlevka, more than 200 arrows (see *Table*).

In female burials of a later period (4th–2nd centuries BC) (Shumaevsky II, Pokrovka-8,

Prokhorovka), bladed and pole iron weapons (swords and spears), as well as iron arrowheads, begin to appear. Large quiver sets with bronze items disappeared. The types and sizes of weapons are similar to those recorded in the contemporaneous male graves. For example, the length of the iron spearhead from the female burial of the Shumaevsky II cemetery (kurgan 9, burial 11) is 29 cm, and the surviving part of the shaft is 70 cm (Morgunova et al., 2003: 152). The sword from burial 8 of the same kurgan is 78 cm long, and the dagger is 38 cm (Ibid.: 141). The length of the daggers from the burials of Pokrovka-8 is 28 and 40 cm (Kurgany…, 1993: 48).

In most female burials, weapons were located in the same place where they were usually placed for men. As a rule, bladed weapons were located to the right of the interred, or were placed on the body of the deceased, with hilts directed to the right hand. Quivers were most often (11 cases, i.e. half of all the burials with quivers) placed on the left along the body, less often on the right, at the legs, behind the head, on the chest, or between the legs (see *Table*). Notably, in all the female burials (with the exception of three), the goods fully corresponded to the female gender and included a large number of ornaments (including those made of precious metals), beads, bronze mirrors, spindle whorls, and various utensils.

Female burials with weapons have been recorded in all pastoral cultures of the Early Iron Age in the Eurasian steppe (Berseneva, 2012: 56–57). The article by R.S. Bagautdinov and V.N. Myshkin (2013) provides a brief summary of the occurrence of various categories of grave goods in the burials of nomads in the Samara-Ural region from the 6th to 2nd centuries BC. The authors are inclined to explain the presence of quivers in female burials (only five were taken into account) by the high social status of the deceased (Ibid.: 46). In general, this sample is not complete enough and did not allow more definite conclusions to be drawn. The number of female burials with weapons in the Lower Volga region can be judged from the summary given by M.A. Balabanova and co-authors (2015: 18–31, tab. 7). Six burials with quiver sets were recorded, and iron swords were found in three (Ibid.: 28–29). Researchers note that full-fledged weapons are presented only in the burials of women of the *Juvenis-Adultus* category, i.e. up to 35 years old. The exception is a sword in the burial of a woman of an older age cohort (Ibid.: Tab. 7). In total, 9 % of female burials in the Lower Volga region contained weapons, including graves with single arrowheads (Ibid.: 28).

Female burials with weapons in the Don region were discussed in the article by T.V. Bogachenko and V.E. Maksimenko (2008), as well as in the monograph by T.V. Bogachenko (2017). The authors tabulated authentic female burials of the Lower Don region, with skeletal sex identifications proven at the time of publication of the article (Bogachenko, Maksimenko, 2008). In this sample, there are 11 burials dating to late 5th to 2nd century BC, but in three of the graves only fragments of arrowheads were found; so only eight should be taken into account. Weapons are represented by quiver sets, three swords, a dagger, five spears, projectile points, and an armour. The authors note that the sample "is dominated by deceased of 25–35 years of age" and the rest of their goods can be characterized as "typically female" (Ibid.: 54). These conclusions are fully consistent with those made on the Ural materials.

Despite the fact that the cemetery Novy on the Don River dates back rather to the Middle Sarmatian period, researchers tend to attribute its materials to Early Sarmatian (Vdovchenkov, 2013: 289). E.V. Vdovchenkov notes: "16 % of women at the age of 16 to 35 buried at the cemetery Novy have weapons (sword, arrows, dagger). The burials of women with a child (20 %) are also equipped with weapons" (Ibid.: 291). Unfortunately, there is no detailed description of these burials, nor the criteria for their identification. Nevertheless, the source seems to be of high quality, and in general, the presence of female burials with weapons is not in doubt.

The presence of weapons in the female burials of the Scythians was reliably recorded in a number of burial grounds, but there is no unanimity among researchers regarding the criteria for their identification and, consequently, their numbers (see (Sinika et al., 2020; Yatsenko, 2018: 203–204)). It seems that the figures given in the work of E.E. Fialko are greatly overestimated (2015: 90–91). A more or less substantive comparison of Sarmatian and Scythian female burials with weapons is not yet possible.

Returning to the Sarmatian materials, we can state that a unique feature of the burials in the Southern Urals, especially of the early period (late 5th–4th centuries BC), is the absolute predominance of quivers with arrows among weapons in female burials. At the same time, it is from this territory that the largest quiver sets (up to 200 arrows) originate; these were recorded in the Trans-Urals (Kichigino I, Yakovlevka II). In terms of other parameters (age groups, the presence of paired and communal burials, ornaments, and other goods), the considered sample of female burials fits well into the overall picture of the funeral rite of the early nomads of Eastern Europe.

Conclusions

Weapons in the female burials at cemeteries of the Southern Urals are represented mainly by quivers with arrows. Bladed weapons are rare.

Most of the women buried with weapons (more than 2/3) died young (25–35 years). No consistent pattern was found between the age of the deceased and the categories

of weapons. However, in order to establish the dynamics of the relationship between the age of the died women and the presence of weapons, it is necessary to conduct research within age groups.

Female burials with weapons were found in kurgans of all status levels—from the modest mounds of Pokrovka and Lebedevka to the "royal" kurgans of Filippovka I. This partly answers the question often asked by researchers about whether the "Amazons" constituted a certain social stratum or armed formations on a constant basis. Obviously, the women of the early nomads in the Southern Urals, who were buried with weapons, did not represent either one or the other, and had a different vertical social status, i.e. belonged to various strata of society, from the elite to low-ranking nomads. A significant part of them was found in multiple and pair burials, including those with children.

The main question is: what exactly did the weapons symbolize in the burials of women: profession, social status, participation in armed conflicts? Archaeological materials do not give a definite answer; there are plenty of explanations, and almost all of them are warranted (Bogachenko, Maksimenko, 2008: 55). However, it seems that the women of the early Sarmatians undoubtedly knew how to handle ranged weapons, and some, probably, even were skilled with the contact ones. The life of nomadic herdsmen was full of dangers, and mastering the skills of handling weapons increased the chances of survival for both the woman and her offspring.

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The Chemical Analysis of Glass Samples from Roman Era Cemeteries in the Crimean Piedmont

We assessed the chemical composition of more than 40 fragments of glass vessels from the Roman Period cemeteries in the Crimean piedmont— Druzhnoe, Neyzats, and Opushki, using X-ray spectral microanalysis. The results suggest that the glass from all the cemeteries belonged to the soda-lime-silica group, based on natural soda. The samples fall in glass groups "Levantine I", "HIMT", and "Roman glass", typical of central and peripheral Roman manufacture in 0–500 AD. Most vessels are made of glass with a high content of iron, manganese, and titanium, as in the HIMT group, most common in Europe since 300 AD. The likely workshops are those in the Syro-Palestinian area, northern Egypt, and Sinai, pointing to contacts of the northern Pontic with other parts of the Greco-Roman world. The composition of glass from all the three cemeteries is the same, suggesting that the sub-mountainous Crimea imported glassware from the same workshops.

Keywords: *Roman glass ware, chemical composition, X-ray spectroscopic microanalysis, Northern Black Sea region, Crimea, ancient cemeteries.*

Introduction

In the Northern Black Sea region, glassware appears with the Greek colonists at the turn of the 6th–5th centuries BC and gradually conquers local markets. In ancient times, glass vessels were luxury items, but over time they became widely used in everyday life. This became possible with the development of glassmaking in the 1st millennium BC, especially the emergence and spread of the blowing technique, which made it possible to produce glassware quickly and in large quantities. Vessels began to be made in various shapes in accordance with their purpose. Flasks or bottles were made for storing liquids and bulk products, while jugs, dishes and plates, cups, bowls, kantharoi, etc. for the tableware.

In Roman period, glassware, along with other antique imports, appeared in the sub-mountainous Crimea. Here, on barbarian settlements and burial grounds, a large number of glass vessels (both intact and fragmented) were found. These were items of exchange or trading, gifts to leaders or war trophies. For many decades, experts have been systematizing and analyzing this category of finds. New materials are introduced, typologies of glass products are developed, chronological boundaries of their existence are established, and assumptions are made about the ways in which glass vessels appeared in the sub-mountainous Crimea. The effectiveness of research is ensured by the use of natural scientific methods. The prospects of such an approach are obvious: it will bring the study of glass vessels of the Roman period stored in Crimean museums at a qualitatively new level. So far, only the first steps are being taken in this direction (Rumyantseva, Trifonov, 2021).

In recent years, natural scientific methods have been widely used in the study of ancient glassmaking. For example, modern archaeometric studies have confirmed the data of written sources on the main composition of ancient glass: the products of Greco-Roman glassmaking belong to the soda-lime-silica glass group and have a composition typical of glass made on natural soda (Scott, Degrise, 2014: 21). Such glass became widespread in Europe and the Near East in the second half of the 1st millennium BC to the 9th century AD. Before this period, ash from salt-marsh plants served as the basis for glass production (Devulder, Degryse, 2014: 87). It was found out that in the ancient era, glassmaking included two production stages—glass melting and glass working, which were separated not only technically, but also geographically (Rumyantseva, 2011: 87). In one place, glass mass was made, then it was transported in ingots to different parts of the ancient world, where various glass products were made from these semi-finished products. This feature of glass production is confirmed by analyses (Degryse et al., 2014: 107, 112).

The purpose of this work is to introduce the results of the analysis of the chemical composition of glass vessels from Roman era cemeteries located in the south of the Crimean Peninsula. Research materials are 46 samples from three cemeteries: Druzhnoe (4), Neyzats (30), and Opushki (12). One specimen is dated to the 1st century BC–1st century AD; two samples to the 2nd century–first half of the 3rd century AD; another sample to the second half of the 3rd century AD. The rest of the samples date to the 4th century AD. Materials from the excavations of the cemeteries of Druzhnoe, Neyzats, and Opushki, including glass vessels, are stored in the collections of the Central Museum of Taurida (Simferopol).

Methods

Chemical composition of the glass samples was identified by electron probe (X-ray spectral) microanalysis in the Laboratory of Local Methods of Substance Research of the Faculty of Geology of the Lomonosov Moscow State University. The studies were carried out in flat-polished sections, pre-coated with a carbon film 25 nm thick. To prepare flat-polished sections, fragments of glass vessels were poured with epoxy resin into blocks, using the cold pouring technique. The blocks were then ground using abrasive papers of various grits (including P2500 for fine grinding and polishing) and polished with diamond abraders, with successive grain reduction to surface roughness value of <0.1 μm.

For analytical measurements, we used a JSM-6480LV scanning electron microscope (Jeol Ltd., Japan) equipped with an X-MaxN energy dispersive spectrometer (Oxford Instruments, Great Britain), with an ultrathin window and a crystal active zone area of 50 mm^2. Analytical measurements were carried out at an accelerating voltage of 20 kV and an electron probe current of 10 nA. With a deadly time value of 23–26 %, the data processing rate was ca 13–16,000 PPS.

The same conditions and exposure time (100 sec.) were also set when measuring standards—stoichiometric compounds and natural minerals (standards from the Catalog of Standards for Electron Probe Microanalysis by Jeol Ltd., Japan; standards of the National Institute of Standards and Technology, USA). The relative measurement error of the main (more than 10 wt%) components, estimated according to the standards of the corresponding minerals, did not exceed 1 %. For minor components (from 1 to 10 wt%), the relative error was within 5 %. The detection thresholds for all analyzed elements do not exceed 0.01–0.05 wt%. Analysis of the glass composition with a small amount of microliths was carried out by scanning a surface with an area of 0.06 mm^2. The reproducibility was assessed by a three-stage analysis of individual samples. The INCA program (Oxford Instruments, version 21) was used to process the results using the XPP correction algorithm. Oxygen was calculated by stoichiometry

(Fe and Mn were assumed to be bivalent, the remaining elements in the highest oxidation states).

The relative standard deviation characterizing the reproducibility of the analysis results does not exceed 1 % for SiO_2, 3 % for Na_2O, Al_2O_3, CaO, 5 % for MgO, K_2O, Cl, 10 % for SO_3, FeO, as well as MnO, Sb_2O_5, PbO (with content of more than 0.1 wt%). The relative standard deviation at an oxide content of 0.01–0.1 wt% (for P_2O_5, TiO_2, CoO, CuO, as well as MnO, Sb_2O_5, PbO) averages 30 %; with an oxide content of 0.1–0.2 wt% (for P_2O_5, TiO_2, CuO) 10–20 %.

Results

Druzhnoe cemetery is located in the center of the sub-mountainous Crimea, southeast of the city of Simferopol, near the village Druzhnoe, on the slope of the mount of Shpil (Fig. 1). The first small excavations of the cemetery were carried out in 1984. In 1990–1994, systematic research of the site was carried out by the archaeological expedition of the Simferopol State University. In the burials of the second half of the 3rd to 4th century AD, more than 20 glass vessels, intact and fragmented, were found. Their description and characteristics are given in a summarizing monograph devoted to the findings of the study of the cemetery (Khrapunov, 2002: 56–57).

From the collection of the cemetery, four samples of glass vessels were analyzed—three cups and a flask. Glass samples No. 1 and 4 are transparent, thin, and colorless (Table 1), No. 2 and 3 have blue and olive tint.

According to the results of the analysis, the glass belongs to the type of soda-lime-silica glass, has a composition typical of glass made on natural soda, in which the content of K_2O does not exceed 0.62 %, MgO 0.82 % (boundary value for these oxides is 1.5 % (Scott, Degryse, 2014: 21)). Manganese was used as a bleaching agent (MnO_2 content was 1.0–1.8 %). No impurities of Cu, Co, Sb, and Pb were found. In terms of composition, the olive-tinted glass from which flask No. 3 was made (Fig. 2, *1*) (see (Khrapunov, 2002: Fig. 89, *2*)) shows a higher content of FeO – ca 1 % (in other samples 0.48–0.66 %); and blue-tinted glass (sample No. 2) has no significant differences from colorless glass (samples No. 1, 4). Notably, the glass of the second half of the 3rd century AD (No. 4) (Fig. 2, *2*) (see (Ibid.: Fig. 93, *7*)) differs in chemical composition from the other three vessels in a lower content of Na_2O (13.7 and 18.8 %, respectively, Table 2) and Cl (0.8 and 1.24 %), and a higher content of CaO (8.2 and 5.7 %), Al_2O_3 (2.7 and 2.1 %), MnO (1.8 and 1.2 %). The lower content of sodium oxide may be due to the effect of leaching; however, this fact is usually recorded when analyzing the ground surface, and not the prepared flat-polished sections.

Neyzats cemetery is located in the central part of the sub-mountainous Crimea, on the right bank of the Zuya River, 1 km south of the village Balanovo (see Fig. 1). The site has been known since 1927. Its systematic archaeological research was carried out in 1996–2015 by the expedition of the Taurida National University. During the excavations of the cemetery, more than 150 intact and fragmented glass vessels were found. Their description and characterization are given in several publications (Khrapunov, 2011; Shabanov, 2011).

For microanalysis, 30 samples were selected, dating to the 2nd–4th centuries AD. The sample is dominated by cups of various shapes, which became widespread in the late Roman period in the Crimean piedmont; there are also jugs and a plate. The analyzed glasses are transparent, colorless, of light blue, greenish, olive, and light brown shades.

The analysis has shown that all the glass from the Neyzats cemetery, as well as from the previous one, refers to the soda-lime-silica type, i.e. soda type. The maximum content of K_2O in the entire sample is 0.88 % (average 0.50 %), the maximum content of MgO is 1.13 % (average value 0.75 %).

The colorless glass of a cup with a cylindrical body (No. 33) (Fig. 2, *3*), dated to the 2nd–first half of the 3rd century AD, contains both antimony and manganese (Sb_2O_5 – 0.89 %, MnO –

Fig. 1. Map of Crimea. Location of the described cemeteries.

Table 1. **Fragments of glass vessels from the described Crimean cemeteries**

Find No.	Vessel	Place of discovery, grave No.	Inv. No.	Date	Source
1	2	3	4	5	6
			Druzhnoe		
1	Cup	3	–	4th century AD	Khrapunov, 2002: Fig. 71, *16*
2	"		D-4974		Ibid.: Fig. 71, *17*
3	Flask	18	D-5210		Ibid.: Fig. 89, *2*
4	Cup	20	D-5391	Second half of the 3rd century AD	Ibid.: Fig. 93, *7*
			Neyzats		
5	Cup	4	D-8253	4th century AD	Shabanov, 2011: Fig. 6, *40*
6	Jug		D-8255		Ibid.: Fig. 7, *50*
7	Cup	15	D-8308		Ibid.: Fig. 1, *4*
8	"	19	D-8415		Ibid.: Fig. 1, *5*
9	"	22	D-8455		Ibid.: Fig. 1, *8*
10	"		D-8457		Ibid.: Fig. 4, *32*
11	"		D-8490		Ibid.: Fig. 1, *7*
12	"	33	–		Ibid.: Fig. 3, *19*
13	"	115	D-10593		Ibid.: Fig. 6, *42*
14	"	163	D-11217		Ibid.: Fig. 2, *11*
15	"	180	KP-51723 A-28251		Ibid.: Fig. 2, *12*
16	"	200	D-11849		Ibid.: Fig. 11, *71*
17	"	201	–		Ibid.: Fig. 4, *27*
18	"	224	D-12938		Ibid.: Fig. 2, *14*
19	Jug	230	D-12948		Ibid.: Fig. 7, *51*
20	Cup	275	D-14616		Ibid.: Fig. 5, *38*
21	Jug		–		Ibid.: Fig. 8, *56*
22	Cup		D-14617		Ibid.: Fig. 5, *36*
23	"		D-14618		Ibid.: Fig. 5, *57*
24	"	306	D-14848		Ibid.: Fig. 2, *16*
25	"		D-14855		Ibid.: Fig. 4, *28*
26	Plate		D-14893		Ibid.: Fig. 11, *72*
27	Cup		D-14926		Ibid.: Fig. 2, *17*
28	"	321	D-15067		Ibid.: Fig. 12, *27*
29	"	371	D-16319		Ibid.: Fig. 1, *1*
30	"	485	D-18292		Ibid.: Fig. 6, *45*
31	"	500	D-18952		Not published (excavations by I.N. Khrapunov, 2012)
32	"	510	D-19046	Second half of the 3rd century AD	Khrapunov, 2016: Fig. 2, *3*
33	"	584	D-20190	2nd to first half of the 3rd century AD	Not published (excavations by I.N. Khrapunov, 2015)
34	Cup	Pit with vessels No. 6	D-16391	4th century AD	Shabanov, 2011: Fig. 6, *41*

Table 1 (end)

1	2	3	4	5	6
Opushki					
35	Cup	2	D-12725	4th century AD	Shabanov, 2020: Fig. 2, *2*
36	"	124	D-20530		Ibid.: Fig. 2, *1*
37	?	190	D-22128	1st century BC to 1st century AD	Ibid.: Fig. 1, *4*
38	Cup	253	D-22725	4th century AD	Ibid.: Fig. 2, *3*
39	"	260	D-22754		Ibid.: Fig. 2, *5*
40	"	262	D-22764		Ibid.: Fig. 2, *7*
41	"	274	D-22799		Ibid.: Fig. 2, *4*
42	"		D-22797		Ibid.: Fig. 2, *9*
43	Cup		D-22784		Ibid.: Fig. 2, *8*
44	Bowl		D-22793		Ibid.: Fig. 2, *10*
45	Cup	287	KP-64079 A-34685		Shabanov, 2021: Fig. 4, *1*
46	Balsamarium	307	–	2nd to first half of the 3rd century AD	Not published (excavations by I.N. Khrapunov, 2020)

0.30 %). These elements are used as glass decolorizers. Studies have shown that in the production of glass only one of the decolorizers was always used; in the raw material collected during excavations and explorations of glass-making centers, two decolorizers have never been recorded together. The presence of both manganese and antimony in colorless glass suggests its modification during secondary production. Such glass is considered to be the result of the wide use of glass waste (Jackson, 2005: 771). In the composition of the glass from which the cup was made (sample No. 33), Al_2O_3 is 1.90 %, SiO_2 – 67.66, CaO – 5.90, MgO – 0.48, K_2O – 0.49, oxides of cobalt, copper, and lead less than 0.01 %.

Glass of a cup with a thickened bottom (No. 32) (Fig. 2, *4*), dated to the second half of the 3rd century AD, was manganese-decolorized (MnO 1.33 %). The reduced content of Na_2O (14.17 %) may be the result of leaching. The glass shows a higher content of Al_2O_3 (2.97 %) and CaO (7.85 %), while oxides of cobalt, copper, lead, and antimony are less than 0.01 %.

Glass vessels dating back to the 4th century AD, according to the chemical composition, can be subdivided into four groups (see Table 2): group 1 is manganese-decolorized glass; group 2 is manganese-decolorized glass, containing an admixture of Cu and Pb; group 3 is antimony-decolorized glass, which often leads to an increase in the average value of Na_2O and a decrease in CaO, Al_2O_3, and other oxides (Schibille, Sterrett-Krause, Freestone, 2017: 1226, 1230); group 4 is glass containing both Mn and Sb.

Vessels made of glass of group 1 are the most abundant in the total sample—22 specimens out of 30 (No. 6–11, 13–24, 27–29, 31). The average value of MnO is 1.2 %. The content of Na_2O in the samples is 14.7–21.0 %. The reduced content of Na, as noted above, may be due to the leaching of samples during weathering. The Na_2O content of less than 17 % was found in five samples, which are generally characterized by elevated contents of Al_2O_3 and CaO, the content of cobalt, copper, lead, and antimony oxides is less than 0.01 %.

Glass of a greenish and olive tint of group 2 is represented by two cups (No. 30, 34) (Shabanov, 2011: Fig. 6, *41*, *45*). The average value of CuO in it is 0.1 %, PbO – 0.4, Al_2O_3 – 2.05, SiO_2 – 64.75, CaO – 5.86, the content of cobalt and antimony oxides is less than 0.01 %.

The antimony-decolorized glass from group 3 is also represented by two specimens, including fragments of a large plate (No. 12, 26) (Ibid.: Fig. 3, *19*; 11, *72*). The average value of Sb_2O_5 is 0.6 %, MnO – 0.02, Al_2O_3 – 1.93, SiO_2 – 66.41, CaO – 6.22, the content of cobalt, copper, and lead oxides is less than 0.01 %.

Group 4 glass was used to make two glass vessels (no. 5, 25) (Ibid.: Fig. 4, *28*; 6, *40*). It contains both antimony and manganese in comparable amounts of ca 0.61 %. These vessels were probably manufactured

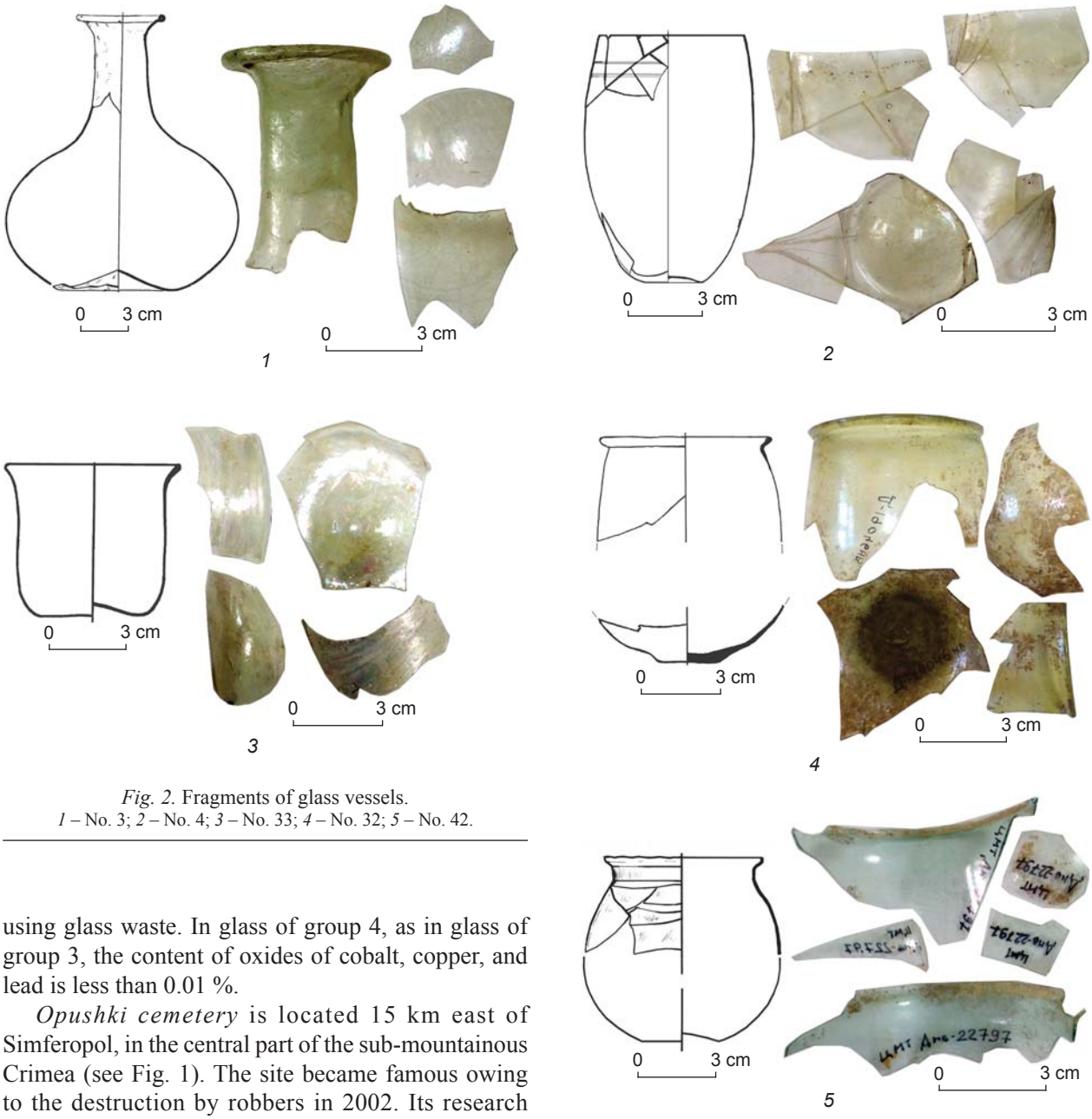

Fig. 2. Fragments of glass vessels.
1 – No. 3; *2* – No. 4; *3* – No. 33; *4* – No. 32; *5* – No. 42.

using glass waste. In glass of group 4, as in glass of group 3, the content of oxides of cobalt, copper, and lead is less than 0.01 %.

Opushki cemetery is located 15 km east of Simferopol, in the central part of the sub-mountainous Crimea (see Fig. 1). The site became famous owing to the destruction by robbers in 2002. Its research has been carried out intermittently since 2003 by the archaeological expedition of the Crimean Federal University. 24 intact and fragmented glass vessels were found at the site. Most of them are described in a special publication (Shabanov, 2020). For analysis, 12 samples were selected, which are mainly cups of various types, a bowl, and two vessels of an indeterminate shape. In their composition, the maximum content of K_2O is 0.94 %, (average value 0.63 %), the maximum content of MnO is 0.91 % (average 0.59 %).

In this sample, noteworthy is one specimen—a fragment of the wall of a polychrome glass vessel with a moderately blue ornament, dated to the 1st century BC–1st century AD, which was made using the "core" technique (No. 37) (Ibid.: Fig. 1, *4*). In the laboratory, areas of blue transparent glass and light-blue opaque glass were analyzed separately. In both areas, CoO (0.05–0.1 %) and CuO (0.13–0.22 %) admixtures were recorded, giving the glass a blue-light-blue color. The specimen shows a slightly increased (relative to the previously described samples) content of P_2O_5 (0.1 %) and FeO (1.17–1.28 %). Light-blue opaque glass has a high content of PbO (12.1 %) and Sb_2O_5 (3.9 %). In the transparent blue glass of the specimen, Sb admixture is absent, Pb is 0.15 %. The presence

Table 2. **Averaged chemical composition of glass of the 4th century AD vessels from the described Crimean cemeteries, wt%**

Find No.	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	MnO	FeO	CoO	CuO	Sb_2O_5	PbO
Druzhnoe																
1–3	18.82	0.69	2.10	66.36	0.03	0.29	1.24	0.51	5.68	0.13	1.18	0.71	<0.01	<0.01	<0.01	<0.01
4	13.73	0.75	2.69	66.48	0.02	0.28	0.83	0.54	8.18	0.14	1.82	0.48	<0.01	<0.01	<0.01	<0.01
Neyzats																
6–11, 13–24, 27–29, 31, group 1	18.30	0.80	2.25	65.63	0.07	0.28	1.17	0.51	6.59	0.13	1.20	0.66	<0.01	<0.01	<0.01	<0.01
30, 34, group 2	19.60	0.77	2.05	64.75	0.04	0.31	1.24	0.44	5.86	0.13	1.03	0.82	<0.01	0.10	<0.01	0.42
12, 26, group 3	19.32	0.58	1.93	66.41	<0.01	0.37	1.22	0.48	6.22	0.08	0.02	0.46	<0.01	<0.01	0.60	<0.01
5, 25, group 4	18.94	0.71	2.14	64.95	<0.01	0.40	1.13	0.50	6.86	0.10	0.58	0.55	<0.01	<0.01	0.61	<0.01
Opushki																
35, 39–45, group 1	17.26	0.64	2.39	65.70	0.06	0.29	1.06	0.62	7.31	0.10	1.12	0.76	<0.01	<0.01	<0.01	<0.01
36, 38, group 2	18.65	0.46	1.74	69.83	<0.01	0.29	1.28	0.36	4.78	0.08	0.03	0.29	<0.01	<0.01	0.76	<0.01

of a large amount of technological admixtures in the blue opaque glass determines the lower content of the main components of glass, primarily oxides of sodium, calcium, and silicon.

Another specimen is a fragment of the lower part of a transparent brown glass balsamarium (No. 46), which is dated to the 2nd–the first half of the 3rd century AD and shows the absence of Co, Cu, Sb, Pb admixtures. The content of iron oxide is 0.31 %, manganese oxide 0.20 %, which can be assessed as low. At the same time, this glass is characterized by an increased content of phosphorus oxide (P_2O_5) – 0.13 %, Al_2O_3 – 2.56 %, SiO_2 – 68.48 %, CaO – 7.17 %.

According to the samples of vessels dated to the 4th century AD, two groups of glass can be distinguished (see Table 2): group 1 is manganese-decolorized glass; group 2 is antimony-decolorized glass.

In a sample of products made of group 1 glass (No. 35, 39–45), decolorized with manganese (average MnO content 1.12 %), there is no admixtures of Sb, Co, Cu. Lead was recorded only in the glass of cup No. 42 (PbO content 0.17 %) (see Fig. 2, *5*) (Ibid.: Fig. 2, *9*). This specimen shows a low content of sodium oxide (15.85 %) and an increased content of calcium oxide (9.61 %, which is the maximum content among all the analyzed glasses from the three cemeteries).

Group 2 glass (No. 36, 38) contains 0.5–1.1 % Sb_2O_5, 0.03 % MnO. It is characterized by a reduced content of K_2O, CaO, FeO, as well as phosphorus oxide (P_2O_5); oxides of cobalt, copper, and lead are less than 0.01 %.

Discussion

Glass from all the three sites was made on the basis of natural soda, which excludes the possibility of its production in workshops located on the territory of modern Iran, where at that time the ash from salt-marsh plants was used as a raw material. The most probable place for the manufacture of glass for the vessels under study were glass-making centers of the Syro-Palestinian area, northern Egypt, and Sinai. This is evidenced by the chemical composition of the analyzed samples. They belong to three groups of soda glass common in the 1st millennium AD on the territory of Europe and the Eastern Mediterranean: Levantine I, "HIMT" ("high iron, manganese, titan"), and "Roman" glass of the 1st–3rd centuries AD (Fig. 3) (Rumyantseva, 2015: 29).

The Levantine I group consists of the products of glass-making centers of the Levant dating back to the 4th–7th centuries AD. It includes one vessel from Druzhnoe, two from Opushki, and five from the Neyzats cemetery. All the vessels were found in burial complexes of the 4th century AD; this is the time of distribution of Levantine glass products.

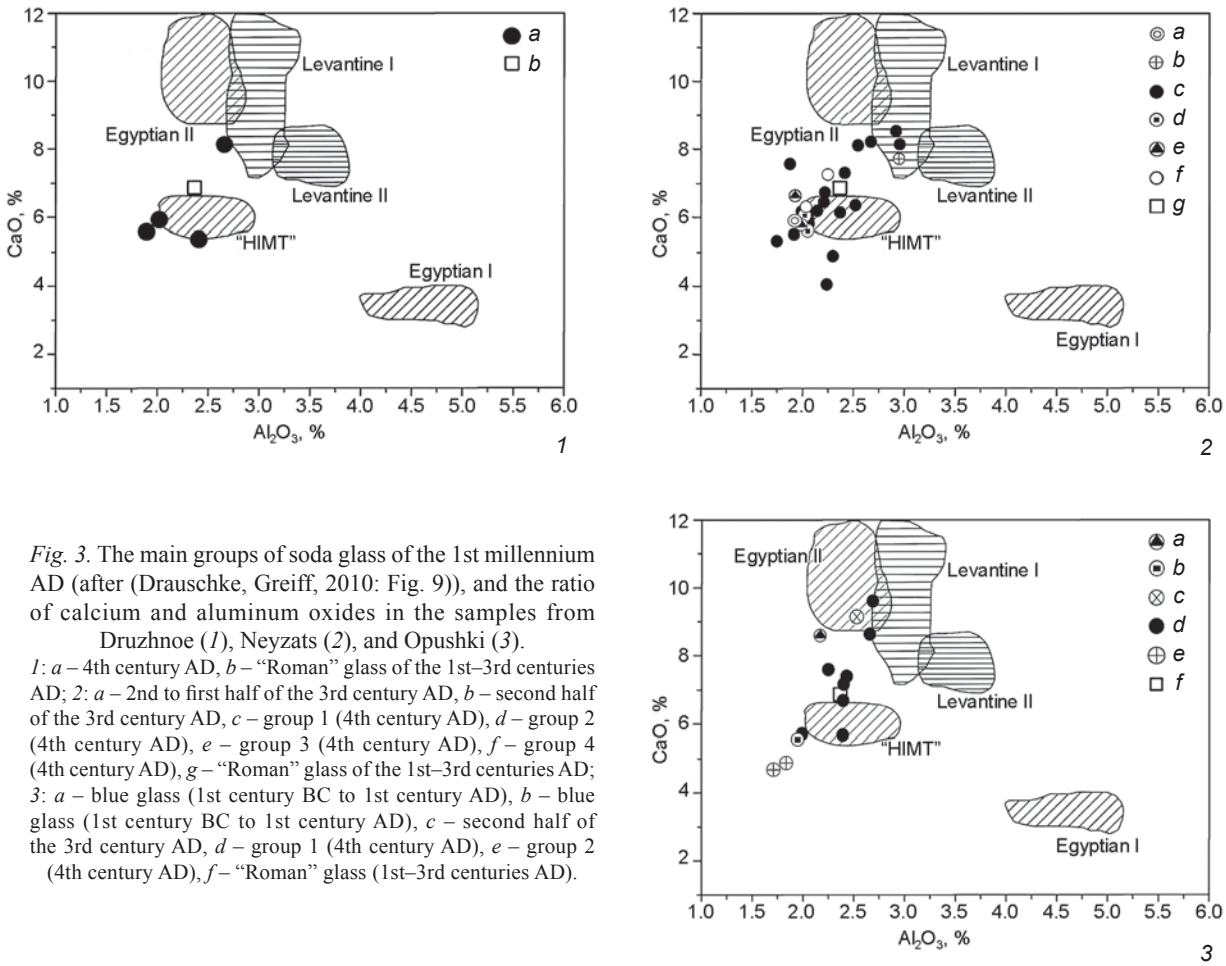

Fig. 3. The main groups of soda glass of the 1st millennium AD (after (Drauschke, Greiff, 2010: Fig. 9)), and the ratio of calcium and aluminum oxides in the samples from Druzhnoe (*1*), Neyzats (*2*), and Opushki (*3*).
1: *a* – 4th century AD, *b* – "Roman" glass of the 1st–3rd centuries AD; *2*: *a* – 2nd to first half of the 3rd century AD, *b* – second half of the 3rd century AD, *c* – group 1 (4th century AD), *d* – group 2 (4th century AD), *e* – group 3 (4th century AD), *f* – group 4 (4th century AD), *g* – "Roman" glass of the 1st–3rd centuries AD; *3*: *a* – blue glass (1st century BC to 1st century AD), *b* – blue glass (1st century BC to 1st century AD), *c* – second half of the 3rd century AD, *d* – group 1 (4th century AD), *e* – group 2 (4th century AD), *f* – "Roman" glass (1st–3rd centuries AD).

Most of the vessels from Neyzats (about 70 %) are probably made of glass of the "HIMT" group, which became widespread in Europe since the 4th century AD. The abundance of products made from this glass is explained, on the one hand, by a spike in the mass production of glassware ca 350 AD, changes in the quality of raw materials, technical features of the manufacture of glass products (Foster, Jackson, 2009: 194–195; Nenna, 2014: 186), and on the other hand, by the process of political instability in the empire, its collapse, which led to a change in the raw material base and, consequently, to the replacement of the chemical composition of glass (Nakai et al., 2014: 240). Researchers admit the possibility of competition between glass producers of the Levantine I and "HIMT" groups, in which the former apparently were losing (Nenna, 2014: 186).

The "HIMT" group was identified in the 1990s by the samples from Carthage and Aosta in northern Italy. In the 2000s, the collection was replenished with finds from the territory of France, Great Britain, Holland, Egypt, Cyprus, etc. (Ibid.: 177, 179). The glass of this group is characterized by a yellowish or olive color, a high concentration of Pb, Mn, and Ti. Unfortunately, it has not yet been possible to determine exactly where the glass of the "HIMT" group was made, but given the high concentration of Ti in its composition, which is a "stable characteristic" of the sands of northern Egypt and the Nile delta (Rumyantseva, 2015: 39), it can be assumed that it was Egypt.

The group of the so-called Roman glass of the 1st–3rd centuries AD consists of vessels of green-blue glass, quite homogeneous in chemical composition. It was manufactured with the use of manganese as decolorizer, although the admixtures of antimony found in the samples suggest the use of glass waste. In the search for a source of raw material for the workshops involved in the manufacture of glass of this group, the researchers raised questions about its homogeneous composition. The "Roman" glass was first believed to have appeared on the Levantine coast, but in the course of additional isotope analyses it was found out that such production centers could have been in the Western Mediterranean and Northwestern Europe

(Degryse, Schneider, 2008: 1998; Rumyantseva, 2015: 40–41). In the sample of glass vessels considered in this article, this group probably includes nine vessels from the cemeteries of Neyzats and Opushki, but none from Druzhnoe, which can be explained by the small number of vessels from this site. In the Opushki cemetery, "Roman" glass finds make up the majority of the analyzed vessels (almost equal in number to the vessels of the "HIMT" group). Apparently, this should be explained by the still small number of glass vessels from the 4th century AD complexes found at this cemetery.

Conclusions

The results of X-ray spectral microanalysis showed that the composition of glass of 46 vessels from the cemeteries of Druzhnoe, Neyzats, and Opushki, located in the sub-mountainous Crimea, corresponds to the main groups of glass that were distributed on the territory of the Roman empire and its periphery in the first centuries of the new era. The most likely place for the manufacture of glass for the vessels discussed in this paper can be considered the glass-making centers of the Syro-Palestinian area, northern Egypt, and Sinai. The analyses showed a high degree of consistency in the composition of glass from all the three cemeteries. Consequently, glassware came to people who made burials in the Crimean piedmont from the same workshops. The absence of fragments of "Roman" glass among the analyzed samples from Druzhnoe is probably due to the small number of the studied vessels from this necropolis.

Glassware, like other finds from barbarian burial grounds, is the evidence of close contacts between the Northern Black Sea region and other territories of the ancient world. Most likely, barbarians of the Crimean piedmont got the glass products not directly from the manufacturing centers, but through the Bosporan Kingdom and Chersonese. However, this can be asserted after obtaining the results of X-ray spectral microanalysis of composition of the glass from which the vessels found on the territory of the Bosporus and Chersonese states were made. A deep study of these findings will make it possible to identify common features and peculiarities in the chemical composition of certain categories and types of glass vessels; and the full introduction of all analyses into general circulation will ensure their use in solving problems of the origin and distribution of glass in the 1st millennium AD.

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A Set of Clothing Items from the Iyus Hoard

This study focuses on details of clothing, belonging to the Iyus hoard, incidentally found in Khakassia in the 1970s. As in most other hoards from southwestern Siberia, this one includes elements of belt sets—buckles, plaques, pendants, and rings, paralleled by similar artifacts associated with the Tes culture of the 2nd century BC to 2nd century AD. The context of the ornaments is described, and the assembly and ritual use of belt sets are reconstructed. The composition of the Iyus hoard mirrors the process of a new Xiongnu clothing tradition being adopted by native south Siberians in their ritual and everyday practices. The "Scythian" component of the Iyus hoard is represented by rarities—ancient artifacts worn by natives in later times, and by replicas of ancient ornaments, whereas the "Xiongnu" component was more adaptive and includes items commonly used in everyday life. The co-occurrence of "Scythian" and "Xiongnu" artifacts within the same ritual assemblage testifies to the symbolic use of belt sets, evidenced by mid-1st millennium BC sites in southern Siberia.

Keywords: *Iyus hoard, belt set, transcultural complex, Early Iron Age, Xiongnu-Xianbei period, rituals.*

Introduction

The Iyus hoard was discovered by S.A. Fefelov in the 1970s close to Lake Sarat, on the right bank of the Bely Iyus River in Khakassia. This hoard is rightly considered to be one of the richest finds associated with the Xiongnu-Xianbei period (Borodovsky, Larichev, 2011). Just like other hoards of the Chulym region (Fig. 1), which links Khakassia with the Upper Ob basin, this assemblage was formed as a set of ritual attributes of the 5th–1st centuries BC on the eve of the Xiongnu invasion in the southern regions of Siberia, and hidden in the late 1st millennium BC to early 1st millennium AD. The hoard reflects the processes of active interaction between various cultural traditions occurring in that period. Assuming that the composition of the hoard was assembled purposefully, it is an important and unique source for studying the outfit and ritual practices of the ancient population living in southern Siberia. The aim of this study is to analyze and interpret the set of clothing items revealed by the Iyus hoard.

Material

The Iyus hoard includes household and cultic items—271 specimens (Borodovsky, Larichev, 2013: 33). The set of clothing items comprises 216 specimens, amounting to 79.7 % of the total number of finds (Fig. 2, *1–16*).

The set is functionally homogeneous. Most of it consists of belt fittings: 14 buckles (5.17 % of the total number of finds), two clips (0.74 %), three tubular beads (1.11 %), seven belt plates and their fragments (2.58 %), 17 spoon-shaped, bracket-shaped, and other pendants (6.27 %), 18 rings (6.64 %), and five plaques (1.85 %). The hoard contains 150 beads (55.35 %), which could have also belonged to a belt set. Two whetstones (0.74 %) can also be considered as items hanging from the belt.

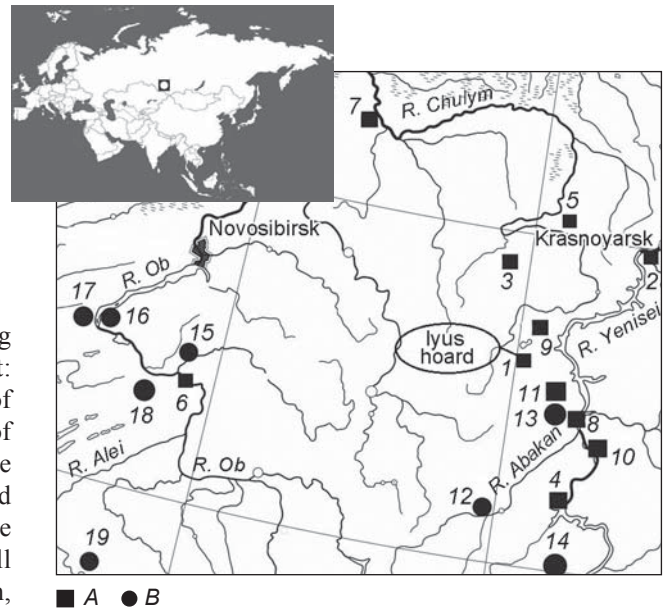

Fig. 1. Hoards (*A*) and archaeological sites with materials similar to the items from the Iyus hoard (*B*), in southern Siberia.
A: *1* – Iyus; *2* – Esaulsky; *3* – Kosogol; *4* – Sayanogorsk; *5* – Aidashinskaya Cave; *6* – Novoobintsevo; *7* – Burbinsky "hoard"; *8* – Askyrovka; *9* – Pervy Dzhirim; *10* – Lugavskoye; *11* – Znamenka. *B*: *12* – Esino; *13* – Chernoye Ozero I, "Blizhny"; *14* – Ala Tei; *15* – Novotroitskoye-1, -2; *16* – Bystrovka-2; *17* – Maslyakha-1; *18* – Rogozikha-1; *19* – Lokot-4a.

A.V. Davydova and S.S. Minyaev give the following description of various kinds of the Xiongnu belt set: "The most sophisticated set involved a large number of various items, including bronze ornaments—a couple of large plate-buckles, a couple of openwork rings, a couple of buttons, plaques, a couple or more of spoon-shaped clasps, as well as beads and various pendants made of minerals. Simpler belts were decorated with small bronze plaques and pendants. In the simplest version, there was only the iron buckle on the belt of the buried person" (2008: 49). If we assume that a complete belt set contained two buckles (this was not always the case with the evidence from the burial sites of the Scythian and Xiongnu-Xianbei periods), the set of things from the hoard under discussion must have belonged to at least seven rich belts. Given this assumption, eleven groups of interconnected items ("bundles"), which can be divided into several variants, deserve our special consideration.

The first variant is bundles of typologically homogeneous things: No. 75* – four bronze buckles; No. 79 and 80 – one ring each; No. 83 and 84 – two pendants each, and No. 85 – one pendant. The second variant is bundles of typologically heterogeneous things: No. 76 – one buckle, seven rings, one tubular bead, and two beads; No. 77 – pendant, votive mirror, and ring; No. 78 – ring and four spoon-shaped pendants; No. 81 – ring and tubular bead; No. 82 – two spoon-shaped pendants and plaque. It is possible that some of these bundles were formed as a result of the destruction of the initially more representative sets.

The quantitative and material composition of bundles in the Iyus hoard generally corresponds to elements of clothing and fittings of composite belts that were found in the Tes and other contemporaneous burial complexes (Fig. 2, *26–29*). For example, grave 3 in kurgan 7 at the Esino I site, in the south of the Minusinsk Basin, contained two pendants made of drilled animal teeth and a fragment of an iron ring found among the chest bones of a buried woman, which set is similar in composition to bundle No. 78 (Savinov, 2009: 163). A set of an openwork ring and two spoon-shaped pendants was found in grave 24 at Esino III; this set shows parallels with items from bundles No. 78, 83, and 84 (Ibid.: 157). Fragments of an iron ring were found on the left pelvic bone of a child buried in grave 3 of the Blizhny kurgan, which correspond to the composition of bundles No. 79 and 80 (Ibid.: 141). A set of three rings and one or two buckles from grave 10 of kurgan 1 at the Chernoye Ozero I cemetery is comparable in composition to bundle No. 76 (Ibid.: 124). A set of a bronze rectangular buckle, two rings, and two spoon-shaped pendants from grave 18 at the same site (Ibid.: 126) can be correlated with bundles No. 76, 78–80, 83, and 84.

The list of similar correspondences to the above-mentioned bundles can be continued (Ibid.: 161–162; Kuzmin, 2011: Pl. 75, 76). A series of bronze items from grave 30 at Esino III, which contained two buckles, a fragment of a spoon-shaped pendant, a wheel-shaped pendant, three rings, and four round button-plates, found outside the context of skeletal remains from several buried persons (Savinov, 2009: 161: pl. XLVII, *1–12*), can be compared to bundles No. 76 and 78. The belt set of a woman buried in grave 9 of kurgan 1 at Chernoye Ozero I included two bronze rings, one of which retained a leather strap, bronze tubular beads, two spoon-shaped pendants, and a round iron buckle (Ibid.: 122–124, pl. XXIV); that set shows parallels to bundles No. 76, 78, and 81.

Leather straps of the Iyus bundles were stitched, and resemble similar items made of organic materials not only from the Tes complexes, but also the Early Iron Age items found in the Altai (Shulga, 2008: 219, fig. 28, *2*, *2a*). Similar artifacts are also known from Tuva. Probably the most interesting among them was a female belt set found in burial 47 at the Ala Tei-1 cemetery. Traces of organic matter, two bronze buckles with figures of dragons

*Hereafter, the numbers of bundles and individual finds are given in accordance with the catalog from the monographic edition by A.P. Borodovsky and V.E. Larichev (2013: 101–103).

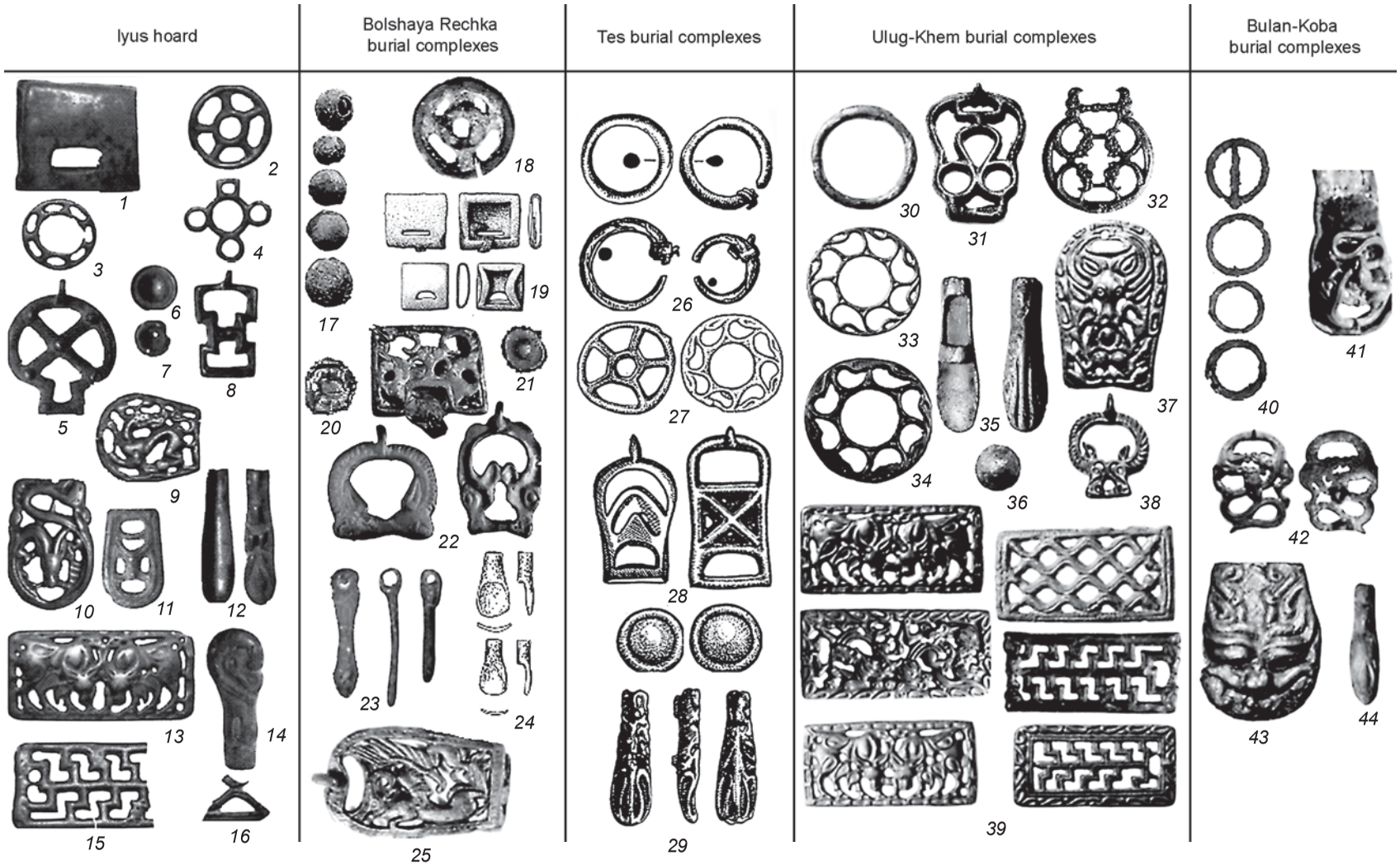

Fig. 2. Elements of belt fittings from the Iyus hoard (*1–16*) (after (Borodovsky, Larichev, 2013: Fig. 31)) and burial complexes of the cultures of Bolshaya Rechka (*17–25*), Tes (*26–29*), Ulug-Khem (*30–39*), and Bulan-Koba (*40–44*).

17–25 – collection of the Museum of Local History at the Altai State Pedagogical University (Shulga, 2003: 148, fig. 6; Shulga, Umansky, Mogilnikov, 2009: Fig. 115, 6, 7); *26–29* – (Savinov, 2009: Pl. XXIV, XXV, XLVII); *30–39* – (Kilunovskaya, Leus, 2018: Fig. 11, 12, 16); *40–44* – (Istoriya Altaya, 2019: Fig. 2.198).

(similar to the Iyus buckles) on the wooden base, bronze six-rayed plaques, as well as large number of tubular and regular beads, have been preserved from the belt (Kilunovskaya, Leus, 2018: 129–130). A representative set of beads was also found in a female belt set from grave 1 at Esino III (Savinov, 2009: 145).

Although the items from the Iyus hoard show similarity to the objects discovered in the burials (Fig. 2), in terms of their total number, the clothing items do not correspond to the standard set of items from the Early Iron Age Siberian burials with a large number of finds. However, in terms of the ratio of clothing items and things of other categories, the Iyus hoard is well comparable with the evidence from other Siberian hoards. For instance, the "hoard" from the settlement of Barsov Gorodok I/20 included a total of 54 items, 53 of which were clothing ornaments and a bead (Beltikova, Borzunov, 2017: 128). The Esaulsky hoard, discovered near the city of Krasnoyarsk, contained 116 artifacts, including 65 various pendants (72.41 %) (Nikolaev, 1961: 280–283). The Kosogol hoard contained about two hundred items, including 130 (65 %) plaques and buckles made in the animal style, and other ornaments (Nashchekin, 1967). The Ai-Dai (Sayanogorsk) hoard contained 277 items (archaic Scythian objects, items of Chinese appearance, and many Tes ornaments), including 172 (62.09 %) rings, spoon-shaped pendants, buckles, tubular beads, clips, openwork plaques, and button-plaques (Pshenitsyna, Khavrin, 2015: 71–72). The assemblage from Aidashinskaya Cave contained 111 items, including 66 (59.46 %) bronze plates, rings, tubular beads, fragments of bracelets, and various pendants (Molodin, Bobrov, Ravnushkin, 1980: 24–58). The Gornoknyazevsk hoard consisted of 25 items, including 11 objects that can be described as clothing ornaments (44 % including "plaque mirrors") (Fedorova, Gusev, Podosenova, 2016: 12–24). Ten (37.04 %) out of 27 items from the Novoobintsevo hoard, submitted to the Altai State Museum of Local History (in total, about 40 items have been identified), were probably related to clothing, primarily representing belt fittings (Borodaev, 1987). The Burbinsky "hoard" included 12 items presumably originating from a destroyed burial, of which at least 4 (33.33 %) can be reliably correlated with the clothing set (Borodovsky, Troitskaya, 1992). The Kholmogory hoard consisted of 193 items, including 58 (30.05 %) processed anthropomorphic and ornithomorphic representations with loops for fastening, rectangular belt plaque-plates, round plaques, and beads (Zykov, Fedorova, 2001: 96–113). The Raduzhny "hoard" included 245 items and their fragments, of which 40 (16.33 %) were clothing accessories and ornaments (belt onlays, epaulette-like clasps, anthropomorphic pendant, beads, fragments of silver plates and wire). In addition, some fragments of fur ware can be considered as belonging to the set of clothing items (Gordienko, 2007: 63).

Such hoards of the Middle Yenisei region as the Pervy Dzhirim, Lugavskoye, Askyrovka, etc. also contained the set of clothing items (Borodovsky, Oborin, 2018, 2021). It is important that despite the differences in the set of clothing items, these assemblages were similar in the presence of intact and fragmented elements of belt set, with a small number or total absence of personal ornaments*—earrings, hairpins, braid ornaments, bracelets, rings, or torques.

Artistic bronzes appearing in the assemblages, along with undecorated items (rings, tubular beads, and clips), make it possible to focus not only on their aesthetic characteristics, but also on specific aspects of assembling the hoard and the ritual use of belts.

Interpretation

As Borodovsky and Larichev observed, the set of items from the Iyus hoard reflected traditions of hoard assembly typical of the turn of the Late Scythian and Early Xiongnu periods (2013: 56). This conclusion was based on the cultural and chronological multicomponent nature of the assemblage under consideration. It is certainly difficult to interpret it, but it was not the only one of that kind. The hoard contained both "Scythian" and "Xiongnu" transcultural components (Ibid.: Fig. 31) relating to belt fittings.

The "Scythian" component of the hoard was not only the so-called Tagar bronzes (cauldron, pommels, mirrors), but also bronze slotted belt clips (Fig. 2, *1*), a conical bead, wheel-shaped "pendants" (Fig. 2, *2*, *3*), silver plaque (Fig. 2, *7*), and probably whetstones. According to the observation of A.I. Martynov (1979: 115), confirmed by later studies (Savinov, 2012: 15–25), leather belts with buckles and other ornaments were generally not typical of the Tagar culture.

The only silver umbo-shaped plaque No. 74 from the Iyus hoard (Fig. 2, *7*), showing parallels to the finds from the burial complexes dated to the 2nd century BC–1st century AD, was similar to archaic ornaments from the Novotroitskoye necropolis; it can be interpreted as decorative element of a belt set (Fig. 2, *20*, *21*) (Shulga, Umansky, Mogilnikov, 2009: Fig. 100, *3*).

Belt accessories also included slotted clips (Fig. 2, *1*) dated to the period from the 6th–5th to the 3rd centuries BC. Their parallels have been found in numerous burial complexes of the Scythian period in southern Siberia (Fig. 2, *19*), in the later Tes sites (grave 1 at Esino III

*The exceptions were the Znamenka hoard and a set of items from Aydashinskaya Cave, including torques, rings, and hairpins (Podolsky, 2002: Fig. 1; Molodin, Bobrov, Ravnushkin, 1980: 33). Notably, the Znamenka hoard was one of the few hoards discovered in Khakassia, which contained items made exclusively of precious metals (gold).

(Savinov, 2009: 145)), and in the Middle Yenisei hoards, such as the Pervy Balankul hoard found near Lake Balankul, north of the town of Askiz (Borodovsky, Oborin, 2021: Fig. 5).

Conical beads appear widely among the evidence from the burial grounds of the second half of the 1st millennium BC in southwestern Siberia (Shulga, Umansky, Mogilnikov, 2009: 315, fig. 115, *28*, *29*). They have also been a part of the same Pervy Balankul hoard (Borodovsky, Oborin, 2021: Fig. 5). Such items have been found in grave 3 (undisturbed) of kurgan 15 at the Novotroitskoye-2 cemetery (the Upper Ob region)—these were a part of a belt set without buckles along with a *kochedyk* bent wedge-shaped element (Fig. 2, 23), as well as ribbed and slotted clips (Shulga, Umansky, Mogilnikov, 2009: Fig. 77); and also in a grave near kurgan 17a at Novotroitskoye-1—these were a part of a belt set without buckles, but with a ribbed clip and metal belt hook stylized as the image of a griffin's head (Ibid.: Fig. 29).

Female burial complexes of the Scythian period included bronze wheel-shaped items interpreted as spindle whorls (Fig. 2, *2*, *18*, *27*). One such item, with the remains of a wooden rod in the central hole, was found in grave 2 of kurgan 5 at Novotroitskoye-2 (Fig. 2, *18*) (Shulga, Umansky, Mogilnikov, 2009: 79–80); another item of this kind was discovered at the Chekanovsky Log-2 burial ground in the area of Gilevo Reservoir (northwestern Altai) (Demin, Sitnikov, 1998: 95, Fig. 1, *6*), and another one in kurgan 7 at the Bystrovka-2 burial ground (Borodovsky, Larichev, 2013: 39). Wheel-shaped items appear among the evidence from the cemeteries of Rogozikha-1 (in the vicinity of the town of Pavlovsk), and Maslyakha-1 (located on the border of the Altai Territory with Novosibirsk Region) (Shamshin, Navrotsky, 1986: 105; Mogilnikov, Umansky, 1992: 80, Fig. 6, *9*). Such an artifact was a part of the Kosogol hoard found on the shore of Lake Kosogol near the town of Sharypovo in the Krasnoyarsk Territory (Martynov, 1979: Pl. 47, *35*).

Notably, "wheels" in the explored Bolshaya Rechka burials (Novotroitskoye-2, Bystrovka-2, Maslyakha-1) were usually located in the area of the belt, while ceramic whorls were located in the area of the head and femurs of the buried persons. "Wheels" could be placed into common receptacles together with other items (metal cauldron in the Iyus hoard) or separately (stone incense burner in Rogozikha-1). V.A. Mogilnikov observed: "By the 3rd–2nd centuries BC, the shape of the wheels had changed. Instead of spokes, marked holes in the disk appeared. The wheels could have been losing their cultic function, turning into the spindle whorl" (Mogilnikov, 1997: 87). The available sources point rather to the opposite process: at the turn of the eras, wheel-shaped discs, which had originally served as spindle whorls, began to be used as belt pendants (probably, as cultic items). This conclusion is indirectly supported by the similarity in the shapes of such disks with sectoral (ray-like, "solar") ornamentation on ceramic spindle whorls, which scholars consider to be one of the earliest (Frolov, 2000), as well as the data from the functional, classificatory, and chronological analysis of belt pendants of the Late Scythian period (Teterin, 2012: 120–121). Sectoral ornamentation, as an early form of decoration, appears in the chronological summary of the solar signs from the pre-Tagar and post-Tagar periods, compiled by Martynov (1979: 134–139, pl. 52). Simple wheel-shaped pendants similar to the items of the Bolshaya Rechka culture appeared earlier than more sophisticated multi-ringed and openwork pendants of the Bulan-Koba culture in the Altai, the Tes culture in the Minusinsk Basin, and the Ulug-Khem culture in Tuva, which were described in detail by Y.V. Teterin (2012: 122). Teterin has also proven that ring pendants might have been used as cultic-decorative and functional (suspensions, dispensers, buckles) elements of belt sets. In the context of our study, it is important that the Iyus hoard contained both more archaic "spindle whorl-pendants" (Fig. 2, *2*) and many-ringed and openwork pendants (Fig. 2, *3*, *4*), with parallels found in the Tes burial complexes and complexes contemporaneous with the Tes culture (Fig. 2, *27*, *33*, *34*) (Savinov, 2009: Pl. XLVII, 5; Kuzmin, 2011: Fig. 40, 41; Teterin, 2015: 53–55; Kilunovskaya, Leus, 2018: Fig. 16, *5–8*). Teterin also emphasized that ring-shaped pendants with the inner field decorated with two to five small rings and curls from the closed complex were known only from the Iyus hoard (2012: 122). According to Teterin, small rings on the inner field of the pendants repeated the rings that appeared on the frames of individual buckles; the prototypes of these figures were extremely stylized images of the heads of birds of prey, widely appearing in the Scythian Siberian animal style of the Late Scythian and Xiongnu periods (2015: 53–54).

According to L.M. Pletneva, whetstones were left in both male and female burials in the Scythian period (2017: 73). The whetstones from the Iyus hoard can be typologically identified as rod-shaped, with straight top and oval bottom, or oval top and bottom (Ibid.: Pl. 1). According to the evidence collected by Pletneva, similar items have been found in the areas of the Bolshaya Rechka and Tagar cultures.

The "Scythian" component of the Iyus hoard includes a set of rarities—ancient artifacts used at a later time, and rare replicas—items made according to archaic models, that is, items from the preceding period preserved in a collective owing to commemorative cultic practices or obtained from grave looting.

The Xiongnu artistic bronzes in the Iyus hoard are represented by buckles with fixed prongs (Fig. 2, *5*, *8*), plates with figures of opposing bulls (Fig. 2, *13*), fragments of plates "with snakes" and lattice ornamentation (Fig. 2, *15*, *16*), buckles with a dragon and

a standing predator (Fig. 2, *9–11*) whose head is turned back, a buckle with representation of bull's heads, spoon-shaped and bracket-shaped pendants (Fig. 2, *12*, *14*), and hemispherical buttons (Fig. 2, *6*) (Borodovsky, Larichev, 2013: 39). Parallels to the above finds appear in a number of hoards from the steppes of the Middle Yenisei region (Ibid.: 39–44). Similar items include a fragment of buckle with dragon figure, and several bracket-shaped pendants from the Pervy Dzhirim hoard (Borodovsky, Oborin, 2018: Fig. 5, *9*). Many similar things have been studied (Devlet, 1980; Dobzhansky, 1990). Items similar to those from the Iyus hoard have been discovered in the Tes (Fig. 2, *28*, *29*), Ulug-Khem (Fig. 2, *31*, *32*, *35–39*), and Bulan-Koba (Fig. 2, *41–44*) burial complexes. Burials usually contained one belt buckle, rarely two; often, as in the hoard, they have survived in fragments. The closest examples can be found among the finds from graves 1 and 30 at Esino III (Savinov, 2009: 145, pl. XLVII), grave 5 in kurgan 1 at Chernoye Ozero I (Ibid.: 122, pl. XXIII, *10*), and graves 2, 15, 23, 42, and 43 at the Ala Tei-1 burial ground (Kilunovskaya, Leus, 2018: Fig. 11, *1*, *3*, *6*, *7*; 12). It is important for establishing the functional purpose of the items that burial C in grave 19 of kurgan 1 at Chernoye Ozero I contained three buckles; one of them, according to D.G. Savinov, belonged to the belt that tied the legs of the buried person (2009: 127), or to an unfastened belt laid along the buried body with the buckle turned to the feet.

In grave 23 at the Ulug-Khem site Ala Tei-1, a bronze buckle with a full-face representation of a bull (Fig. 2, *39*), similar to the item from the Iyus hoard (Fig. 2, *13*), was on the belt of a buried woman 20–25 years of age (Kilunovskaya, Leus, 2018: 128). Rectangular buckles depicting wiggling snakes (Fig. 2, *39*) have been found in female burials 1 and 43 at the same cemetery (Ibid.: 137). Openwork belt buckles and spoon-shaped pendants, similar to the items in the Iyus assemblage, have been discovered at the Terezin burial ground (Fig. 2, *35*) (Ibid.: 142–144). Common features have been revealed by metallographic analysis of the Terezin and Iyus finds (Borodovsky, Larichev, 2013: Pl. 2; Khavrin, 2016: Pl. 1). In the Tes female burials, openwork plates have been found in grave 3 of the southern complex of graves at the Novye Mochagi cemetery located 12 km west of the city of Sayanogorsk (Kuzmin, 2011: 281, pl. 75).

The Iyus hoard included the most numerous series of spoon-shaped pendants (11 items) and plates (7 items) in southern Siberia, with representations of a pair of bulls and dragons; this was discovered in a single individual complex (Borodovsky, Larichev, 2013: 43). We should mention that in the Kemerovo Region, such items appear in small numbers (Bobrov, 1979) in the burials at the cemeteries of Utinka (kurgan 5), Grishkin Log I, and in the Early Iron Age kurgan of Razliv III: at best, one or two items (Devlet, 1980: 37, pl. 1) or fragments.

Spoon-shaped pendants (Fig. 2, *12*), similar to the Iyus pendants, have been found in both male and female burials of the Tes kurgan 1 at Chernoye Ozero I (Savinov, 2009: 122–127, pl. XXIV, *4*; XXV, 3, 4) and grave 24 at Esino III (Ibid.: 157) (Fig. 2, *29*). At the Ala Tei-1 site in the Upper Yenisei basin, they appeared only in male burials (Fig. 2, *35*) (Kilunovskaya, Leus, 2018: 135, 143).

If we take into account similar horn items from the earlier sites—for example, from grave 1 in kurgan 1 at the Lokot-4a burial ground (Fig. 2, *24*) (Shulga, 2003: Fig. 6)—spoon-shaped pendants may be dated to the 6th–3rd (2nd) centuries BC (Borodovsky, 2012: 379; Borodovsky, Larichev, 2013: 43).

Another category of belt fittings of the Xiongnu period, represented in the hoard, was bronze rings (Borodovsky, Larichev, 2013: 43–44). Their parallels have often been found in the Tes (Fig. 2, *26*), Ulug-Khem (Fig. 2, *30*), and Bulan-Koba (Fig. 2, *40*) burial complexes (for example, Esino III, graves 24 and 30 (Savinov, 2009: 157, pl. XLVII, *6–8*), Chernoye Ozero I, kurgan 1, graves 3, 5–7, 9, 10, and 18–20 (Ibid.: Pl. XXIV; pl. XXV), Ala Tei-1, graves 38 and 47 (Kilunovskaya, Leus, 2018: Fig. 16, *1*, *2*)). In burials, they occur both together with other elements of composite belts and separately (Chernoye Ozero I, kurgan 1, graves 3, 5–7, and 10 (Savinov, 2009: Pl. XXIII, *4*, *9*, *11*)). Bronze rings were a part of both male belts (Ibid.: 124, 126) and, judging by the evidence from grave 3 (Ibid.: 141) and burial 3 in grave 20 (Ibid.: 129) of the Blizhny kurgan, female belts. A ring was the only element of the children's belt in grave 6 of kurgan 1 at the Chernoye Ozero I cemetery (Ibid.: 123). Rings have also been found at natural features with the cultic role, such as Maslyakhinskaya Sopka now located in the water area of the Novosibirsk Reservoir (Golovchenko, Besetaev, 2021: 83, fig. 1).

Burials of the Xiongnu period typically contained rich belt sets including numerous silver items (Borodovsky et al., 2005: 12). Metallographic analysis has revealed a significant admixture of silver in the composition of individual items of the Iyus hoard, such as pendant No. 51, consisting of contiguous rings, and belt hemispherical umbo-shaped plaque No. 74 (Fig. 2, *7*) showing parallels from the earlier sites of the Upper Ob region (Fig. 2, *20*, *21*).

The "Xiongnu" component of the Iyus hoard is represented by the items of adaptive forms (homages), with traces of active use. The surfaces of many items are polished; images are strongly smoothed or virtually erased in the process of using the things. The closest parallels have been found in the Tes (Fig. 2, *28*) and Ulug-Khem (Fig. 2, *31*, *32*, *37*, *39*) sites, as well as contemporaneous sites of the Bulan-Koba culture (Fig. 2, *41–43*), identified in the Altai Mountains (Teterin, 1995: 134). Items from the Iyus hoard show similarities with the evidence from

the Dyrestui burial ground (Minyaev, 2007: Pl. 6, 12, 50, 57, 80, 84, 86, 91, 104).

Thus, the Iyus hoard includes a representative series of belt fittings whose syncretic composition marks the processes of incorporation of a new, Xiongnu, set of clothing items into the cultic and everyday practices of the local population of southern Siberia. A.V. Davydova and S.S. Minyaev have suggested that the number of artistic bronzes, as well as the nature and size of the constituent parts of a belt, depended on the social status, sex, and age of the buried person (2008: 49). For example, belts with rich sets of bronze ornaments have been most frequently found in burials of elderly women (Davydova, Minyaev, 1988: 231).

The analysis has made it possible to identify the conventional features of the set of clothing items. The "male" component may be represented by a slotted clip and conical beads, pendants of certain types probably related to military paraphernalia, as well as household and cultic whetstones (Pletneva, 2017: 74). The "female" component of the hoard most likely included mirrors, beads, wheel-shaped pendants, as well as individual elements of belt fittings from the Xiongnu period (buckles and pendants).

The content of the Iyus hoard, as has been mentioned above, is determined by the presence of single and serial items, and bundles of things, as well as a few fragments of items, primarily openwork plaques (Fig. 2, *15*, *16*). The presence of broken things in the hoard prompts us to consider the practice of cultic destruction of elements of a belt set using the evidence of the Xiongnu-Xianbei period. When analyzing burial complexes of the Early Iron Age from the Upper Ob region, Mogilnikov noted: "…it is possible that belts with removed buckles were usually placed into burials in accordance with the canons of the funeral ritual" (1997: 71). He also drew attention to the fact that tradition of placing belts or parts of belts without buckles into the graves in the Sayan-Altai persisted until the Middle Ages (Ibid.). I have already discussed the problem of interpreting a phenomenon manifested by the evidence of the Bolshaya Rechka culture—placement of unfastened male belts into burials (Golovchenko, 2021). The intentional unfastening (destruction) of a belt or its elements can be viewed as an event-oriented sacralization of a thing in the context of ritual actions. For example, unfastening a belt during the funeral, that is, the removal of a thing from its direct functional state, could have been a symbolic act reflecting the concept of the "inverted world", according to which a damaged or broken thing would acquire lost qualities in a new posthumous life.

Manifestations of ritual destruction of belt set components have also been observed in the Tes burials. Broken buckles have been found in graves 7, 9, and 18 in kurgan 1 at Chernoye Ozero I (Savinov, 2009: 123) and in burials of levels B and C in grave 13 at Esino III (Ibid.: 152–153). A fragment of a lamellar ring was discovered in burial A of grave 20 in kurgan 1 at Chernoye Ozero I (Ibid.: 128); a fragment of a bronze ring was in a burial of level B in grave 13 at Esino III (Ibid.: 152) and a burial of level A in grave 18 at Esino III (Ibid.: 155); a fragment of an iron ring appeared in grave 3 of kurgan 7 at Esino I (Ibid.: 163) (Fig. 2, *26*); broken spoon-shaped pendants were in grave 24 at Esino III (Ibid.: 157). Additional evidence of using event sacralization in the Tes burial practice may be the presence of unprocessed and "defective" (short pour, uncut gates) items in the burials, as well as their occurrence in non-standard contexts; for example, placement of a *kochedyk* bent wedge-shaped component of a belt set under the humerus bones of a woman buried in grave 17, kurgan 1, at Chernoye Ozero I (Ibid.: 126).

Discussion

Most of the hoards found in the basin of the Middle Yenisei River contained "defective", unprocessed, damaged (with the signs of wear), or broken (fragmented) items (Borodovsky, Oborin, 2018, 2021). Some scholars considered the presence of such "scrap" in the set to be direct evidence that the hoard belonged to a caster.

According to N.P. Makarov, the main argument in favor of identifying the Iyus hoard as a hoard of a caster was the presence of metal scrap in its composition, which even included small metal grains (2013: 80). Objecting to the researcher, A.P. Borodovsky and V.E. Larichev pointed to the small number of such items in the collection under consideration (2013: 58).

The initial interpretation of the Iyus hoard as a set of "shamanic" paraphernalia (Larichev, Borodovsky, 2006: 59) (which corresponds to the traditional understanding of large collections of bronze sculptures (Spitsyn, 1906; Bobrov, 2002)) was based on statements about the presence of a large number of various pendants in the hoard, which, according to most scholars, had both utilitarian and ritual purposes, as well as bundles of things (Borodovsky, Larichev, 2013: 45), and a combination of "male" and "female" components in the same complex.

There are some examples of such interpretation of items in the literature. For example, G.V. Beltikova considered the hoard discovered at Barsova Gora as a set that included a leather belt and a breastplate with onlays, clasps, pendants, and tubular beads—attributes of a shamanic outfit (2002: 206). V.A. Borzunov suggested that these items could have been cut from a ritual outfit and buried for memorial (commemorative) purposes next to the burial (Beltikova, Borzunov, 2017: 130). V.A. Burnakov observed that in the Khakass tradition, both male and female clothing that was used in everyday life could also perform a ritual function (magical healing,

prognostic, protective, sacrificial, or other) in some situations (2012: 259). The most sacralized elements of clothing traditionally included a belt with fittings. There was an opinion that universality of archetypes in archaic ideological systems, which was preserved in shamanism, created ample opportunities for their hypothetical application to archaeological artifacts (Cheremisin, Zaporozhchenko, 1996: 30). However, such interpretations always cause heated discussions.

According to Borodovsky and Larichev, the very fact of hiding a set of things in the ground may be closely connected with burial and memorial ritual practices in ancient times (2011: 204). However, the redundancy of things for one individual burial does not make it possible to consider the Iyus hoard as a set of items from a single specific outfit or series of outfits, since it does not include complete belt sets.

Analyzing cauldrons and hoards of the Early Iron Age from the Middle Yenisei region, Borodovsky and Oborin suggested interpretation of the Iyus hoard as a large collection of things hidden during the seasonal ritual of "abandoning the inventory" (2021: 130). They took into consideration that the hoards that included a set of clothing items differed from the hoard-caches with sets of tools (Borodovsky, Oborin, 2018: 96). In this context, the very fact of hiding the hoard assemblage in a cauldron was probably of special importance. Placement of miniature cauldron-shaped pendants, which were used as elements of belt fittings, into female burials in the period under consideration had similar semantics (Teterin, Mitko, Zhuravleva, 2010; Golovchenko, 2019). Vessels, as elements of funeral rites and rituals of abandonment of inhabited territories, are well known from the evidence from ritual complexes of various chronological periods (Tkachev, 2014; Sotnikova, 2015a, b).

Conclusions

The combination of "Scythian" and "Xiongnu" belt fittings in a single assemblage, and their use in the same ritual action of concealment, testify to the evolving practice of symbolic treatment of belt sets, which appeared at the sites of southern Siberia in the mid-1st millennium BC. Ritual treatment of belts, exemplified by their placement as ornaments into hoards, may also be identified along with destructive manipulations (unfastening the belt, symbolic breaking of ornaments, or use of defective items) observed in the evidence from the burials. Concealment of a large collection of belt fittings might have been a variation of the ritual of "abandoning the inventory". In essence, it constituted sacrificing ornaments to the spirits of the area in order to ensure the well-being of seasonal or emergency migration.

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Monumental Wooden Statues from the Ust-Voikary Fortified Settlement, Northwestern Siberia: A Multidisciplinary Analysis

This article presents the results of a comprehensive study of two unusual large wooden statues with anthropomorphic faces. They were excavated from the Ust-Voikary stratified site, in the southwestern Yamalo-Nenets Autonomous Okrug. The site dwellers were native Siberians (Ugro-Samoyeds), who lived there from the Middle Ages to the recent centuries. This is one of the few sites in the region with frozen habitation deposits. The statues are unique in terms of attribution, size, preservation, and integrity of archaeological context. They were part of dwellings, being situated in the foundations of the walls near the entrance. Their faces are modeled in bas-relief. Iconographically, they conform to the Ob Ugrian sculptural tradition. The analysis of the architectural context of the location of the statues and certain details suggests a secondary use. Initially, they might have belonged to the frame supporting the roof. The statues are made of Siberian larch (Larix sibirica Ledeb.). The dendrochronological analysis has allowed us to estimate the date when the trees were felled—the late 17th century. A retrospective analysis of data on the ritual art of the northern Khanty and Mansi suggests an interpretation of the Voikary statues in comparing them with wooden sculptures representing menkvs—forest spirits. Thus, their ritual role was mostly to protect the home.

Keywords: *Ust-Voikary fortified settlement, northwestern Siberia, northern Khanty, dendrochronology, anthropomorphic sculpture.*

Introduction

The Ust-Voikary fortified settlement appeared on the archaeological map of the Yamalo-Nenets Autonomous Okrug relatively recently, after survey works in Shuryshkarsky District in 1993 (Kosinskaya, Fedorova, 1994: 58–59). In 2003–2008, the site was studied by a team from the Institute of History and Archaeology of the Ural Branch of the RAS and the Shemanovsky Museum-Exhibition Complex, under the leadership of A.G. Brusnitsyna and N.V. Fedorova (Brusnitsyna, 2003; Fedorova, 2006). The studies continued in 2012–2016 by a team from the IAET SB RAS under the leadership of A.V. Novikov (Novikov, Garkusha, 2017). In the course of works, it has been established from the dendrochronological data (Gurskaya, 2008) that the site was a settlement, which developed from the turn of the 13th–14th centuries until the 19th century.

The history of the Voikary settlement is associated with the indigenous population living in the north of the Lower Ob region. The question of the ethnic composition of the settlement inhabitants remains open. In the context

of the ethnic history of the region, the population can be tentatively described as Ugrian-Samoyed, with some presence of a Komi-Zyryanka component. Active contacts between the representatives of these ethnic communities in the Middle Ages – Modern Period resulted in the emergence of the northern group of the Khanty. One of its divisions settled in the valley of the Voikar River (Martynova, 1998: 82; 2005; Perevalova, 2004: 231–233). The site under discussion is located near the mouth of this left tributary of the Malaya Ob River.

Monumental statues: Context, description, interpretation

An unusual development during the study of the buildings was the discovery of two massive anthropomorphic sculptures. The presence of permafrost in the cultural layers of the site ensured unique preservation of the artifacts. The sizes and iconography of the statues were similar. The context of their location in the structure of the building was also the same: they were found in the foundations of the front walls. The buildings were of two types of structures: frame-and-post and ground log buildings. The presence of hearths makes it possible to interpret them as residential buildings.

Each artifact was made of a log hewn on two opposite long sides; the two remaining sides retained their natural roundness. In the Russian-language archaeological literature (probably since the publication of the study by S.A. Semenov on woodworking in the ancient Altai (1956: 206–207)), calling timber processed in this way *plakha* ('wood slab') has become widespread. However, it is doubtful that such a definition should be considered successful or as correctly describing this type of timber. In fact, *plakha* is a half log, split in the longitudinal direction (Pluzhnikov, 1995: 101), and this term is used by researchers of Russian wooden architecture in that sense (Zinina, 2019: 50; Popov, 2019: 166; and others). In carpentry, a log hewn on two sides is usually called "double-rounded" or a "double rounded log", or else "a round-round log", in Russian *polubrus* or *lafet*. In the traditional vocabulary of Russian wooden construction, the word *lezhen* could be used to designate this type of building material (Syshchikov, 2006: 218). In the future, when describing the objects under consideration, the term "double-rounded log" (*polubrus*) will be used (Mylnikov, 2008: 37).

The first artifact was made of a log with a diameter of about 20 cm (Fig. 1, *1*). Its length was 2.72 m; the width in between the hewn surfaces was 10 cm. In its archaeological context, it was oriented to the east.

A stylized representation of a human face in bas-relief was made on one of the flat surfaces covering its entire width. The length of the area with the face was 42 cm. The protruding elements of the image, which rendered the nose and eyes, formed a T-shaped figure. The eyebrows and mouth were marked by indentations (Fig. 1, *2*). The end of the double-rounded log above the face had a rectangular notch 10.0–10.5 cm deep and 10.5–11.0 cm wide. Due to this design, the bas-relief looked like the image of a human face crowned with "horns". At a distance of 60–61 cm from the top of the "horns", under the face, there were two longitudinal narrow and shallow grooves 27 and 34 cm long; the distance between them was 7 cm. This was probably the method used for indicating the arms.

The reverse side of the double-rounded log was flat and did not have any images. The far end was hewn onto a wedge. A longitudinal narrow groove triangular in cross-section, about 33 cm long (Fig. 1, *3*), went up from this end on one of side surfaces. Another similar groove about 22 cm long was also located there,

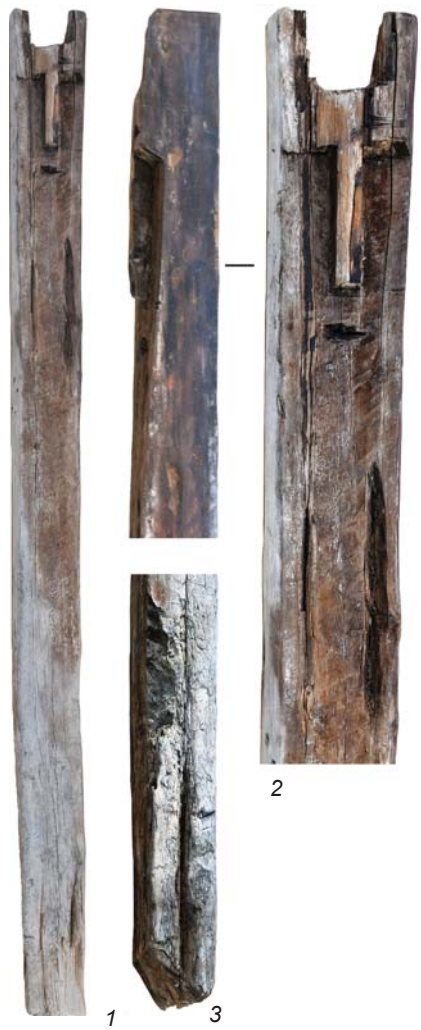

Fig. 1. Statue 1.
1 – general view; *2* – image of the face; *3* – section of the sculpture with the groove.

Fig. 2. Position of statue 1 after discovery (remains of logs from a late cribwork structure can be seen in the background).

Fig. 3. Location of the area with the face (statue 1) relative to the corridor (top view).

80 cm from the end. In the archaeological context, this surface of the object was oriented upwards. Usually, grooves of this configuration were made for attaching parts using the *zaplot* wall assembling technique (when horizontal rows of beams or planks were held together using grooves in vertically set posts). A cut went directly through the groove. This context suggests that it was produced after the groove was made. A group of four shallow, rectangular holes with sides of 1.0–1.2 cm was located 105 cm from this end on the same surface. A traced, closed wavy line was visible at a distance of about 45 cm from the holes, closer to the face. A pair of similar recesses was located across the long axis on the opposite side surface, 67 cm from the same end; the distance between them was 3.3 cm.

This double-rounded log was found in building 7/1*, which had a frame-and-post structure. The artifact was found at an angle, so originally it was placed on a narrow, untreated surface (Fig. 2). The statue was aligned with the doorway and the corridor adjacent to it from the outside (Fig. 3). With this placement, the face was turned outward.

Judging by its context, the double-rounded log was a part of a lower horizontal row of several logs placed end-to-end. The remains of vertically installed stakes were found on both sides of the row. It may be assumed that the stakes were the remains of poles used for

*Hereafter, the numbering of buildings corresponds to the one used during the works of 2012–2016.

restraining the movement of the horizontal parts of the wall, and were tightly placed on both sides of the wall. One of the ways to fasten the vertical parts together could have been relatively short wooden bars with holes (retainers) through which symmetrically located poles were passed. This method is known from buildings of the ethnographic period in northwestern Siberia, and was reconstructed from the evidence of the Nadym fortified settlement (Mitina, 2010: 41–42; Kardash, 2009: 54–55). Another possible interpretation of the presence of these poles is that they remained from posts that immobilized the building material that was laid one on top of the other (the so-called method of building walls "*v pryaslo*" (Mylnikov, 2008: 21)). Thus, in addition to its obvious ritual purpose, the double-rounded log with the representation was directly associated with the structure of the building.

A log with noticeable tapering (gradual natural change in its cross-section) was used for the second artifact. Over the length of 2.42 m of the double-rounded log, the diameter of the original log went from 19 to 15 cm (Fig. 4, *1*). The anthropomorphic representation was placed at the end of the log base. In the archaeological context, it was oriented to the south.

The bas-relief image of the face was located on one of the flat surfaces across the entire width. The length of the section with the bas-relief was 26 cm. The eyes, nose, and eyebrows were shown in a highly stylized manner similar to the image of the first face. The mouth was not marked (Fig. 4, *2*).

An unhewn section 8 cm long was left on the surface opposite the image, directly at the end of the artifact. In side view, it is perceived as the back of anthropomorph's head. A small cup-shaped depression with sloping walls on both sides, corresponding to the flat surfaces, was made in the end. The height of the wall on the side of the bas-relief is 4.0–4.5 cm less than on the opposite wall (Fig. 4, *2*; Fig. 5). The opposite end was hewn onto a wedge. A longitudinal groove about 33 cm long, similar in configuration to those observed on the first statue, was made at a distance of about 80 cm on one of the untreated surfaces (see Fig. 4, *3*).

This artifact was found in the process of unearthing the lower layer in the logwork of structure 9A, built on the ruins of a frame-and-post dwelling. The artifact was laid flat, face up, in a prepared longitudinal recess directly under the wall of the logwork. The double-rounded log was located under the middle part of the wall and occupied the area under the doorway (Fig. 6). In this context, the artifact was not a structural element of the dwelling, but its direct connection with the dwelling was quite obvious. Its location suggests that the ritual aspect was the only important factor in placing the statue.

Both items were found in buildings distinguished by their large size as compared to other structures explored

Fig. 4. Statue 2.
1 – general view; *2* – image of the face; *3* – section of the sculpture with the groove.

Fig. 5. View of the end of statue 2.

Fig. 6. Location of statue 2 under the wall of the log house.

at the site. Stratigraphically, they belong to the common structural horizon of one of the later stages in the history of the settlement. A street-based layout of the settlement has been reconstructed for that stage (Shein, Garkusha, Novikov, 2017). Building 7/1 closed the line of the street, while building 9A stood in a row of buildings on one side of the street.

The surfaces of both double-rounded logs were more carefully processed than other items used in ordinary construction. For instance, all the branches were neatly cut off. Noteworthy is the design of the ends where the representations were located. In the first case, there was a relatively deep rectangular notch; in the second case, there was a concave area with rounded bottom. Thus, the presence of a recess is a common feature in the design of both ends. This solution, evoking associations with a face crowned with horns, was not typical for wooden anthropomorphic sculptures of the northern groups of the Khanty and Mansi (Ivanov, 1970: 61–62). To be fair, it should be mentioned that such an image was assigned to only one character—the Ob Old Man, who was one of the key figures in the Ob-Ugric pantheon. His description appears in the writings of the early 18th century, which mentions "small horns on his head" (Novitsky, 1941: 59). However, this description is associated with a more southern group of population living in the Middle Ob region.

Such a design is absent from the described Late Medieval anthropomorphic representations found during the excavations at the Nadym and Polui promontory fortified settlements (Kardash, 2009: 272–274; 2013: 269). These sites with a frozen cultural layer are so far virtually the only representative archaeological source of information on wooden images of the ancient population inhabiting the Lower Ob region. Moreover, according to the existing tradition of wooden sculpture among these peoples, the differences were precisely in the shape of the head. Male representations had pointed heads (imitation of a heroic helmet), while female representations had rounded heads (Gemuev, Sagalaev, 1986: 82; Baulo, 2013: 54).

The presence of such elements on the Voikary sculptures might have been due to utilitarian goals, associated with a different functional purpose of these double-rounded logs than the one observed in this context. Notches in the ends seem logical for objects that were set vertically and were a part of a set of posts supporting the covering structure. The notches would have been intended for safe fastening of the frame supporting the elements of the covering. It is possible that the sculptures were a part of the enclosure around the central room*. Consequently, the context of the statues' location that was observed during the excavations could have been secondary.

This assumption also fully applies to the statue from building 9A. It could have been extracted when dismantling a frame-and-post dwelling found under the logwork. Such a possibility is supported by the tradition of tiered development of buildings in this area. Such a tradition is distinguished by continuity in the boundaries

*Frame-and-post dwellings of large size have been reconstructed as two-partite structures consisting of a central enclosed room and a corridor located along the perimeter. Previously, such a layout was established for a part of the buildings in the Nadym and Polui promontory fortified settlements (Kardash, 2009: 56–57; 2013: 107–108).

of new buildings and by some common basic principles of organizing the internal space. For example, entrance openings and hearths were made in the same places at different levels. Importantly, this principle was also used in changing the structure of the dwelling. A single context for the location of the Voikary sculptures is in line with the continuity in the house-building tradition and the associated ritual activities.

The next argument in favor of the suggested secondary use of the sculptures is presence of grooves on their sides, which were typical for attaching the aligning elements in the *zaplot* wall-making technique. The cut passing through the groove in the first statue makes it impossible to securely fix the double-rounded log in a vertical position exclusively in the *zaplot* technique. This could have been achieved only if the statue was previously dug into the ground, and the groove was at least at the level of the layer in which the statue was placed. The presence of grooves on only one side of the artifacts suggests that they were not a part of the closed contour of a frame structure. It is logical to assume that the sculptures were initially longer. These arguments are certainly indirect, but their totality gives grounds for the hypothesis of the secondary use of the statues.

It may be added that regardless of this assumption, the discovered statues were stationary, were an integral part of the dwellings, and were not moved during seasonal migrations. The stationary position of the sculptures, combined with their monumentality, makes it possible to consider them as one of the variants of "public idols" (Ivanov, 1970: 17), which were revered by large groups of the population.

According to the archaeological evidence, we know of two more monumental images with faces made in the manner similar to the Voikary statues (T-shaped line of superciliary ridges and straight nose). Both sculptures come from the Nadym fortified settlement, from the layers dated to the 17th–first third of the 18th century. Only parts of the objects have become available for research. Judging by the described images, double-rounded logs were the basis for making the Nadym sculptures (Kardash, 2009: 275).

A fragment of the head part of one statue was discovered by a local historian G.M. Dmitriev-Sadovnikov, when he visited the Nadym site in 1916, in one of the largest of the depressions that he saw. Judging by his description, the object was located in the uppermost part of the filling, possibly almost on the surface (Dmitriev-Sadovnikov, 1918: 42). "The shaitan carved in the middle of a split log" had longitudinal grooves on the sides, similar to those that are used to hold horizontal parts in the *zaplot* technique. Based on this feature, O.V. Kardash suggested that the statue could have been a part of the building frame (2009: 56, 275). At the same time, the top of the head part did not have a depression.

Another sculpture was represented by its lower part. The face on this object was made at the base of the statue. Such a placement suggested that it was a fragment of a so-called many-faced sculpture. The statue was set among the posts of the fence that marked the area of one of the residential quarters (Ibid.: 189–190). Thus, another context for placing monumental sculptural images on the territory of settlements has been identified.

Dendrochronological studies

The Voikary artifacts had an excellent degree of preservation and natural surfaces with minimal mechanical damage. This made it possible to use the method of dendrochronology for identifying the time of felling the trees*. Samples for measurements were taken in the form of cores using a manual drill along two radii of the tree trunk.

The species of timber was established from the distinctive features of its anatomical structure. The double-rounded log was obtained from the trunks of the Siberian larch (*Larix sibirica* Ledeb.). Its features, present in the transverse section, included a distinct boundary between annual layers, a pronounced five- to six-angle structure of the early tracheids, and a fairly sharp transition from early wood to late wood (Benkova, Schweingruber, 2004: 72, 73, 77).

The width of the annual rings was measured using a LINTAB-6 semi-automatic unit (with an accuracy of 0.01 mm) connected to a computer with the TSAP specialized software for dendrochronological studies (TSAP-Win Professional version) (Rinn, 2013). Dating of the measured growth series with the width of the annual rings was carried out according to the standard method using a combination of graphical cross-dating and cross-correlation analysis with the TSAP-Win Professional software. The data obtained were verified using the COFECHA software, which is widely applied to assessing the results of cross-dating and quality of dendroscales (Holmes, 1983). For establishing the synchronization degree of the measurement series, the following standard statistical coefficients used in the TSAP software were employed: Gleichläufigkeit (Glk) (Multilingual Glossary…, 1995: 162–163) (corresponds to the synchronicity coefficient (Cx) (Kolchin, Chernykh, 1977: 22)), TV (Student's t-test), TVBP (t-value according to Baillie and Pilcher (1973)), and cross-date index (CDI).

Calendar dating of individual growth series employed a generalized (non-indexed) chronology built on larch samples from the settlement buildings, selected in the course of works in 2012–2016. At this stage, the length

*The dating was conducted by Y.N. Garkusha at the IAET SB RAS.

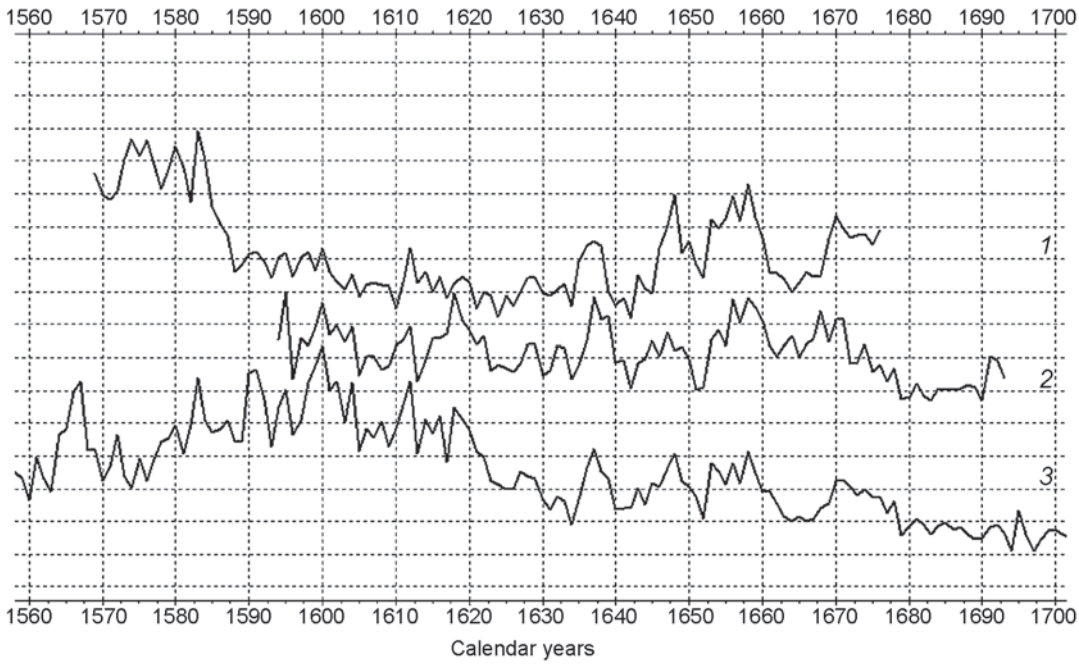

Fig. 7. Cross-dating of samples from statues 1 (*1*) and 2 (*2*), with the generalized calendar Voikary chronology (*3*).

of the chronology was 446 years*. In the absence of a publicly available long-term chronology for living trees from the area of the site location, a long-term absolute chronology "Yamal" for the Siberian larch from the International Tree-Ring Data Bank (ITRDB) was used for calendar referencing of the Voikary dendroscale. It was built on the basis of wood samples originating from the southern part of the Yamal Peninsula, and covered the period from 774 BC to 2005 (Briffa et al., 2013). Previously, this chronology has been already used by M.A. Gurskaya as an additional tool for dating the wood from a fortified settlement located in the northern part of the taiga zone (2006).

According to the results of cross-dating using the "Yamal" chronology, the boundaries of the Voikary dendroscale were established as 1302–1747. The degree of synchronization is characterized by statistically significant values: Glk – 69 %; TV – 11.6; TVBP – 14.7, and CDI – 100. Checking the quality of dating in the COFECHA software confirmed the reliability of the results: the correlation coefficient was 0.55.

Individual chronologies for each item were obtained by averaging the measurement data of the width of annual rings according to the radius. The length of the series was 108 years for the first statue and 100 years for the second statue. There was no pith on the cores obtained.

The experience of dendrochronological studies shows that it is better to work with transverse cuts. One may choose the most convenient radius for measurements, and it is easier to identify dropped-down rings and the last annual (subcrustal) ring. Cores significantly limit these possibilities due to their small width (4–6 mm). Nevertheless, the endings of the rows of annual rings measured in different directions in each item fell on the same year. This makes it possible to reasonably assume that the last measured rings were subcrustal. They were fully formed; therefore, the time of tree felling was at the end of the growing season.

The next step was cross-dating of individual chronologies with the Voikary dendroscale, which had a calendar reference. The best statistical indicators were obtained for the sample from the second item: Glk – 71 %; TV – 7.2; TVBP – 10.8, and CDI – 67. These correspond to the year of 1693.

The statistics obtained for the sample from the first item were generally satisfactory (Glk – 73 %; TVBP – 6.8; CDI – 25), although the TV value was very low (1.7). This data correspond to the year of 1676. The date obtained was additionally confirmed by the results of cross-dating with other dated individual chronologies from the Voikary series. The date of the sample from the first item also came to 1676 in cross-dating with a group of Voikary chronologies. The degree of synchronization was characterized by values of Glk from 70 to 75 %; TV – 6.7–15.2; TVBP – 6.2–7.2, and CDI – 22–27.

The check performed using the COFECHA software has shown that the correlation coefficient for the chronology was 0.54 for the first item and 0.73 for the second item. Therefore, the statistical indicators obtained

*The results of the dendrochronological dating of buildings are being prepared for publication.

were sufficient for reliable dating of both items. Thus, the felling date of the log used for the first statue was autumn 1676–winter 1677; that for the second statue was autumn 1693–winter 1694 (Fig. 7).

The ritual role of wooden monumental statues

According to the dendrochronology data, the functioning time of the building where the first statue was found covered the last third of the 17th century to the late first third of the 18th century. During that period, there were several instances of local repairs. After one of them, the statue became an element of the front wall. Notably, the date of the adjacent part of the wall set was the same as that of the double-rounded log with the face, while the dates of the vertical poles reinforcing the wall corresponded to the first years of the 18th century. Based on the logic of construction, it can be assumed that the statue became a part of the wall structure at that time. The observed scatter in dates is another indirect argument in favor of the hypothesis on the secondary use of the double-rounded log with the face. The dwelling with the second statue was built in the early 18th century, which is also later than the date of felling the wood for making the sculpture. Nevertheless, the connection of the item with the log building is obvious, naturally pointing to the secondary use of the statue.

The suggested changes in placement of sculptures might have resulted in transformation of their ritual function. Despite the common context of location of the statues, there were nuances that affected the visual perception of the artifacts by the inhabitants of the settlement. If in the former case, the image was most likely accessible for viewing by a person who entered the dwelling, in the latter case, the statue was completely hidden.

The first descriptive studies on the indigenous population with a pronounced ethnographic orientation appeared in the 18th century. Information about the sculptural images of "public idols" in the sources of this period is extremely scarce (Ivanov, 1970: 18). The sources do not contain reliable data on the sizes of representations and their placement in space. Nevertheless, judging by the information provided, it is more likely that those sculptures were either mobile or were placed in sanctuaries outside settlements.

Parallels to the Voikary monumental anthropomorphic figures can be suggested using sources no earlier than the 19th century. It is necessary to discuss in some detail their unusually large size, use of statues as construction elements, and the functions of idols.

The first thing worth noting is the unusually large size of the sculptures. In the ritual practice of the northern groups of the Ob Ugrians, such examples were rare. Usually, the length of wooden anthropomorphic statues varied from 60 to 170 cm (see, e.g., (Ivanov, 1970: 29–30; Gemuev, Sagalaev, 1986: 32–34, 80, 85)). An exception were the poles reaching 3 m in length, with anthropomorphic faces near the ends, laid on the ground at the Mansi sacred site of *Khalev-oyki**. The participants of the ritual when stepping over them threw a coin as a sacrificial gift. In addition, at this place, the central attribute was a post with a four-meter pole tied to it, on the top of which a birch bark "hat" was set. A circular belt denoting the neck was carved below it. A bird was depicted on the obverse side of the head rendered in this way (Gemuev, 1990: 83).

If we turn to the mythological beliefs of the Ob Ugrians, large sizes were typical of the forest spirits (*menkvs*). According to the evidence collected by A. Kannisto, these were very large ("three *sazhens*", "so tall that its head touches the sky") and strong spirits. The Mansi believed that *menkvs* lived like people, had wives and children, and slept on bear skins. They were imagined as tall spruce trees or in the guise of tall people with a pointed head, Russian-style bowl hair cut, and no facial hair. The *menkvs* were believed to have had great physical strength; when they approached, the sound of footsteps was heard from afar, trees creaked. branches broke and the wind began to howl (Kannisto, Liimola, 1958: 207, 212–218).

There are several direct parallels to the use of wooden anthropomorphic figures as construction elements in dwellings. The first information belongs to Priest A. Tveritin, who in June 1868 traveled for missionary purposes to the Ostyaks and Samoyeds living along the banks of the Ob River below Obdorsk. When crossing to the left bank to the Ostyak nomad camp of Syanzy, which consisted of seven yurts, he noticed a building on an elevated hill. The priest was told that it was a pagan sanctuary. Tveritin gave a detailed description of it: "The external appearance of the sanctuary shows no difference from an ordinary yurt: the entrance to it is through a narrow open corridor… there is not a single window in the whole building, except for a hole in the top of the roof… from the entrance—right through the doors—an elevated seat for an idol was made similar to Voltaire armchairs; this place was empty at this time—there was no idol; the vault or roof (there is no ceiling) is supported by eight posts; an image of a person is carved on each of them; the place for offering sacrifices is arranged in the middle of the sanctuary; a fire is made there, and as can be seen, two cauldrons are hung. In the winter, honored idols are

*Located on the Posol channel, which flows from the right into the Northern Sosva River, not far from the village of Aneevo in Berezovsky District of the Khanty-Mansi Autonomous Okrug–Yugra.

brought from different places once every three years… to this temple; the gathering of people is very great at this time; the celebration lasts for over ten days, and the deer sacrifice comprises from 40 to 50 or more animals" (Putevye zhurnaly…, 2002: 105–106).

In 1898–1899, during a trip to the Obdorsk Territory, J. Papai described the design of the walls in the "yurt of spirits": human faces were carved on each of the roof-bearing beams at a height of one meter above the ground, and colorful ribbons and copper rings were fastened around them (see (Karjalainen, 1995: 14; 1996: 68)). K.F. Karjalainen believed that these idols were made for protecting the deity whose image stood against the back wall (1995: 46).

A photograph of the image of a patron spirit in the sacred hut of the Ostyaks in Berezovsky Uyezd of the Tobolsk Governorate was taken by S.I. Rudenko in 1909–1910 (Fig. 8). The representation was carved on a massive wooden post reaching the roof or supporting a horizontal plank in a manner typical of idols with the T-shaped protruding line of eyebrows and nose. Judging by the angle of the picture, this image was most likely turned towards the entrance to the hut. A deep longitudinal groove was made on the side in the area of the idol's neck, into which the end of a transverse log was inserted. Under the groove, a second face with a beard shown by grooves was carved (Na grani mirov…, 2006: 40).

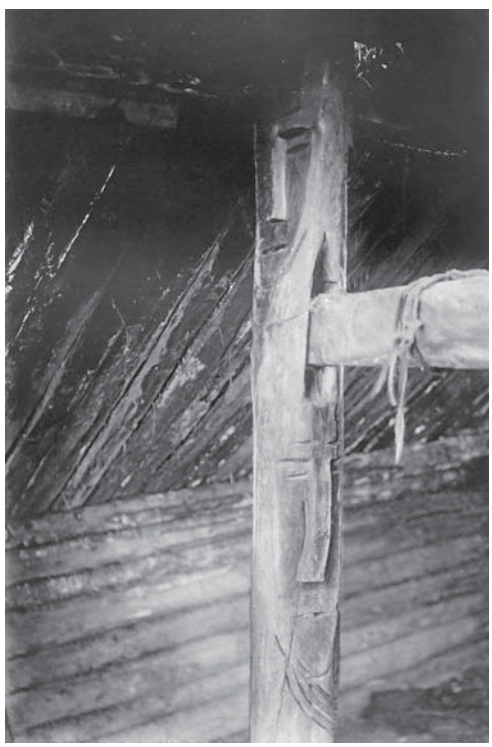

Fig. 8. Image of a patron spirit in the sacred hut of the Ostyaks from Berezovsky Uyezd of the Tobolsk Governorate (after: (Na grani mirov…, 2006: 40)).

Wooden anthropomorphic statues serving as an external part of a structure—a cultic barn or hearth—are also known from scholarly literature. A good example is the sanctuary *Lepla-tit-oyki* (*Lep-tit-oyki*, *Lepla-sunt-oyki*) located on the left bank of the Lepla River, which flows into the Northern Sosva River from the right. In 1935, V.N. Chernetsov described the barns located there: they stood on two supports; the side walls were assembled into angled vertical posts with a slot*; the tops of the posts were made in the form of anthropomorphic faces. These idols were called *avi-sunt-uvry-menkv* (*avi sunt* – 'door threshold'); they served as guardians of the threshold (Istochniki…, 1987: 201). *Lep-tit-oyka* belongs to the group of Mansi patron spirits living in the upper reaches of the Lozva and Northern Sosva Rivers. He had two brothers: the older brother *Yakotil-oyka* – 'The man of the middle of the river' and the younger brother *Lussm-talakh-oyka* – 'The man from the upper reaches of the Lozva'. According to Kannisto, the brothers belonged to the category of forest spirits; *menkvs* stood on both sides of the door in front of their dwellings (Kannisto, Liimola, 1958: 218).

The forming of the upper ends of the side posts in cultic barns as *menkv* heads was also described at the sacred site of *Ner-oyka* and *Chokhryn-oyka* on Lake Turvat (Berezovsky District of the Khanty-Mansi Autonomous Okrug–Yugra). There were three barns at different times there. They had *menkv* figures about 110 cm high (Fig. 9, 10), set in two rectangular grooves, which were cut in the bottom board of the roof and a small transverse log, on which the main structure was located. The representations of the *menkvs* were made of thin cedar trunks using an axe and were finished with a knife. The Mansi called them *aras-ovyl-menkv-oika* (literally, 'the *menkv*-old man of the edge of the hearth') and considered them guardians: when the patron spirits went about their business, the *menkvs* remained to guard the dwelling (Gemuev, Baulo, 1999: 6–9).

An important element in the sacred places of the Ob Ugrians was the fire place—the habitation of the *nai-otyr* fire spirits. In a number of cases, the faces of "fire guardians" were carved for them at the upper ends of stakes. According to Kannisto, on the Sosva River, it was customary to carve images of faces of the guardian spirits related to the *menkvs* and called the "mangy old woman and old man" on the posts of the fire next to the barn (Kannisto, Liimola, 1958: 226). At the sacred place of *Paul-urne-oyki*, near the village of Verkhneye Nildino, in the Berezovsky District of the Khanty-Mansi Autonomous Okrug–Yugra, stakes served as supports for the wooden spit used for hanging a pot. The faces of *menkv-pyrishes* (sons of *menkvs*) with a sloping forehead,

*With high probability, this describes the *zaplot* construction technique.

Fig. 9. Wooden *menkv* figure—structural detail of a Mansi cultic barn. *Photo by A.V. Baulo, 1990.*

Fig. 10. Mansi cultic barn with *menkv* figures. *Photo by A.V. Baulo, 1990.*

straight protruding nose, eyes and mouth in the form of an oval were carved in the upper parts of the stakes (Ibid.: 107). A similar tradition is described at the sanctuaries of *Takht-kotil-aki-pyga* on the Yalbynie River (Ibid.: 105) and *Sat-menkv* near the village of Nizhneye Nildino (Fig. 11) (Baulo, 2013: 57)*.

Conclusions

Examples of monumental sculpture of the northern Khanty were obtained during the excavations at the Ust-Voikary fortified settlement. The statues were dated by the dendrochronological method from the last third to the late 17th century. This period preceded the stage of large-scale Christianization of the indigenous peoples of Western

Fig. 11. Support in the form of a *menkv* figure at the sacred site of the Mansi. *Photo by A.V. Baulo, 2010.*

*Both sanctuaries are located in the Northern Sosva basin.

Siberia, accompanied by a focused search and destruction of traditional ritual images (Perevalova, 2004: 65–66). Therefore, the discovery of these sculptures is of particular importance. The images are also unique in terms of their size, relative integrity, excellent preservation, and context indicating their position *in situ* in the structure of a stationary dwelling.

The rarity of such finds does not make it possible to judge how widespread the presence of this type of "public idol" was in settlements and in dwellings. We largely owe the fact of their discovery to the presence of permafrost in the cultural layers, which even in the north of Western Siberia occurs only at isolated archaeological sites.

On the basis of the context of the location of massive sculptures found in the Ust-Voikary settlement, their functional purpose can be suggested by analogy with the ritual role of wooden images of the forest spirits *menkvs*. To the greatest extent, it comes down to protection of the dwelling place or higher deities. We should recall that the first statue was aligned with the corridor, and its face was turned towards the outside. Therefore, this idol could have guarded the entrance to the dwelling. The second statue was aligned with the doorway, and could have served as a guardian of the threshold.

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The Aul-Koshkul-1 Cemetery in the Baraba Forest-Steppe: Findings of a Multidisciplinary Study

We present the results of aerial photographic and magnetometric studies at Aul-Koshkul-1, a group of mounds in the Baraba forest-steppe. Photogrammetry proved highly efficient for constructing orthophotographic plans and digital models of outward features at archaeological sites. Data were processed with an original approach, generating a map of relative heights, decreasing the effect of natural relief and highlighting altitudinal anomalies of an anthropogenic origin. Aerial photography is highly efficient for revealing archaeological features that are hard to locate by visual analysis of the surface (mounds destroyed by tillage, shallow ditches, etc.). Orthophotographic plans constructed by aerial photography in oblique sun rays at sunset present the most contrastive representations. Aerial magnetometry revealed most mounds at Aul-Koshkul-1, although the site was surveyed with minimal accuracy because magnetic anomalies caused by archaeological features were rare. Our multidisciplinary study yielded new information about the mounds previously registered by ground-based magnetometry, and discovered new features, leading to a revision of the cemetery's reconstructed boundaries and composition. The study demonstrates the great potential of a joint use of aerial magnetometry and aerial photography for locating and studying archaeological sites at a new, sophisticated level.

Keywords: *Aerial magnetometry, aerial photography, unmanned aerial vehicles, photogrammetry, archaeological and geophysical research, burial mounds.*

Introduction

Ground-based magnetometry has been successfully used in archaeology for more than 50 years (Neubauer, 2002; Fassbinder, 2019). At the present stage, the development of miniature unmanned aerial vehicles (UAVs) makes it possible to bring it to a new level of performance and to map large areas (up to several hectares in one working day) without losing horizontal resolution. Aerial magnetometry in archaeological research is not yet widely used; however, the first results, obtained mostly on the territory of Russia, show undoubted prospects for

this direction (Epov et al., 2016; Goglev, 2018; Firsov et al., 2018; Balkov et al., 2019; Schmidt, Becken, Schmalzl, 2020). Unlike aerial magnetometry, aerial photography through the use of UAVs is increasingly used to search for and study archaeological sites (Bykov et al., 2012; Risbol, Gustavsen, 2018; Balkov et al., 2020; Brooke, Clutterbuck, 2020; Alvarez Larrain, Greco, Tarragó, 2020). The orthophotographic plans and digital elevation models obtained as a result of aerial photography have a high degree of detail and, in some cases, provide no less significant information about archaeological sites than magnetometry (Vavulin et al., 2021). Thus, the use of aerial photography, together with a set of geophysical methods, makes it possible to obtain maximum information about the site, without violating its integrity (Bakhshiev, Noskevich, Nasretdinov, 2018). Taking into account the current trends in the development of archaeology, which involve the widespread use of non-destructive methods, the development of this trend, along with its testing in various natural and landscape conditions, are very relevant.

This article discusses the results of archaeological and geophysical work at the cemetery of Aul-Koshkul-1, where the combined use of aerial photography and aerial magnetomrtry from UAVs, in addition to research from previous years, made it possible to obtain new information about the boundaries and composition of the archaeological site. The purpose of the research was not only to test and demonstrate the capabilities of the above methods, but also to develop approaches to material processing for the most informative visualization of data. The obtained results contribute to the development of the methodology of archaeological and geophysical research, and significantly increase the efficiency of work based on the application of the magnetometry method.

The site and its research to date

The Aul-Koshkul-1 archaeological site is located in the Chanovsky District of the Novosibirsk Region, 2 km north of the Chany village. It is located on a slightly elevated area at the edge of a vast lake floodplain. The cemetery was discovered by the local residents in 2010. Six mounds 7–14 m in diameter and 0.28–0.47 m high were visually identified in the area of the site (Fig. 1, *a*). Ditches are recorded around mounds 3 and 4, one of which (mound 4) encircles the area with a diameter of 30 m. Similar to the last one is a ditch (possibly from an unfinished building structure) surrounding the area of 35 × 45 m, in the southern part of the site. The finds discovered in the destroyed mound 3 made it possible to date the burial site to the Old Turkic period (Molodin et al., 2010).

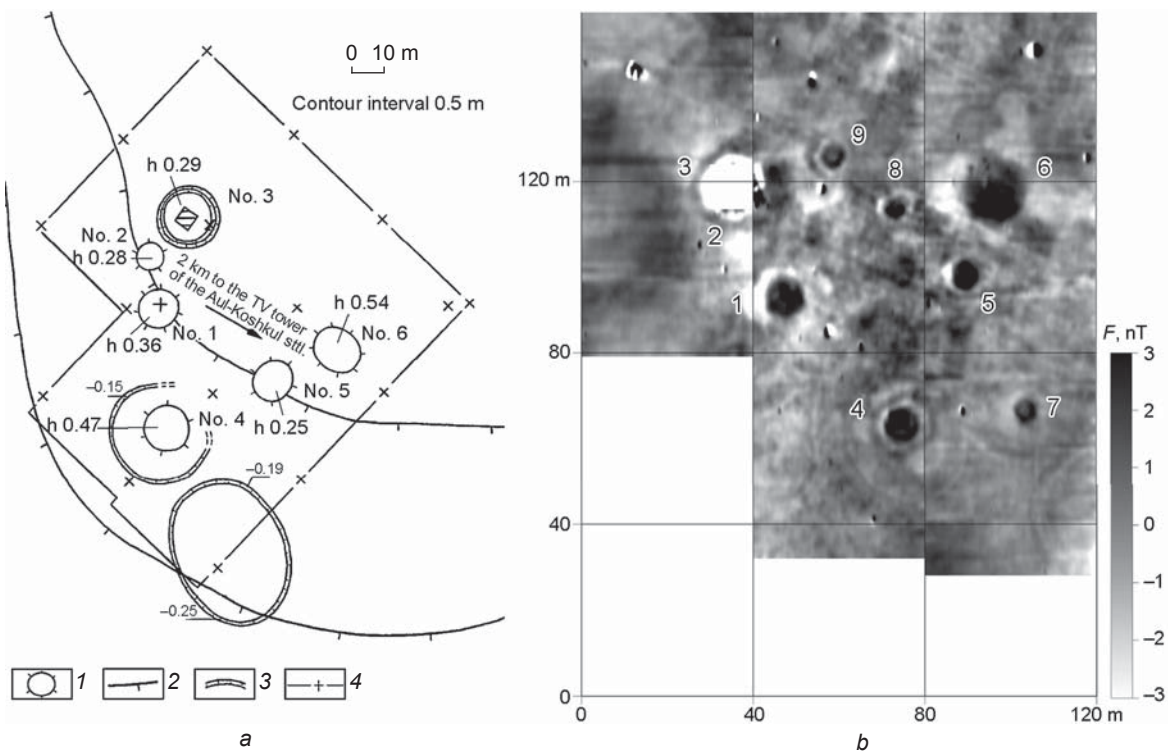

Fig. 1. Plan of the Aul-Koshkul-1 cemetery before the start of geophysical work (*a*) and map of distribution of the magnetic field gradient in the studied area (*b*) (after (Molodin et al., 2010: Fig. 3, 6)).
1 – mound; *2* – contour interval; *3* – ditch; *4* – boundaries of geophysical marking.

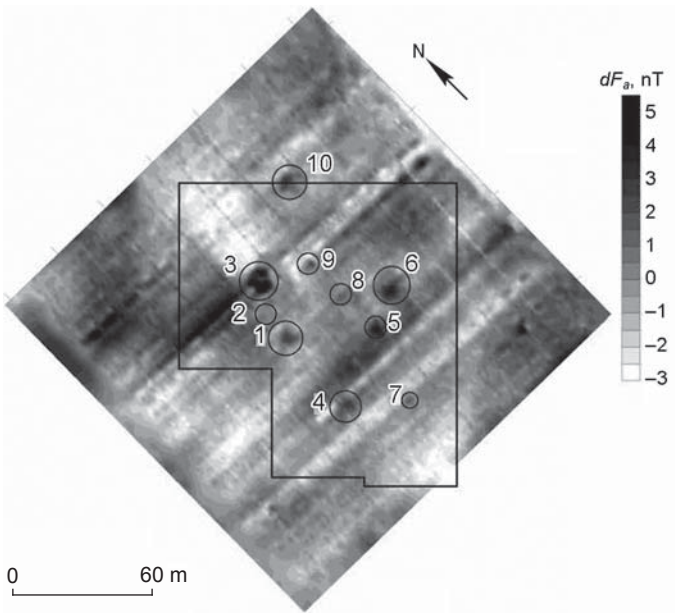

Fig. 2. Map of distribution of the anomalous magnetic field, based on the results of the aeromagnetic survey of the Aul-Koshkul-1 cemetery in 2016 (after (Firsov et al., 2018: Fig. 3, *a*)).

Fig. 3. Unmanned aerial vehicles used for aerial photography. *a* – mini drone DJI Mavic Air (China); *b* – Geoscan 401 (Russia).

In the same year, under the agreement on scientific cooperation between the Institute of Archaeology and Ethnography SB RAS and the German Archaeological Institute, ground-based magnetic survey was carried out on the site, under the direction of J.W.E. Fassbinder. On the constructed magnetic map (Fig. 1, *b*), traces of plowing were clearly visible. The mounds of mounds stood out as positive anomalies of a rounded shape, while mounds 2 and 3 appeared as a negative anomaly, which allowed us to assume the presence of a less magnetic, clay soil in its composition. The results of magnetic survey confirmed the absence of ditches around most of the mounds; and near mound 4, another inner ditch was revealed. In the space between structures No. 1, 4–6, three more mounds were revealed (No. 7–9) with diameters of approx. 5 m, which did not appear on the surface (Ibid.).

In 2016, at the Aul-Koshkul-1 site, experimental and methodological work was carried out to test aerial magnetometry from UAVs. The correlation with the ground-based magnetometric data showed that it was possible to detect seven of the nine previously identified mounds (Fig. 2), using aeromagnetic mapping. Near the northwestern boundary of the ground survey area, mound 10 was found, comparable in size to the largest structures of the site (Firsov et al., 2018).

Thus, thanks to the ground-based and aerial magnetometric surveys, it was possible to determine the features of mounds' construction and to identify in the space between them the archaeological features that were not visible externally. A large amount of additional information was obtained, and the total number of structures reliably identified within the archaeological site increased to 11.

New research cycle (methods, equipment, and software)

In 2020, as part of the Russian Foundation for Basic Research integration project, the Aul-Koshkul-1 mound cemetery was chosen as a testing ground for modern methodological tools using unmanned aerial vehicles. Aerial photography was carried out using a mini drone DJI Mavic Air (DJI, China) and a professional complex Geoscan 401 (Geoscan, Russia) (Fig. 3). In the course of work with the DJI Mavic Air equipment, Drone Harmony Plus software (Drone Harmony Infrastructure digitalization, Switzerland) was used for flight planning. The photogrammetry data were processed using Metashape software (Agisoft, Russia). Processing, design, visualization of the digital relief models and maps of relative heights were performed using Surfer software (Golden Software, USA).

When processing aerial photography data, an original approach was used; it consisted in constructing a map of relative heights. This reduces the influence of the natural terrain and emphasizes the altitudinal anomalies

of anthropogenic origin, which increases the efficiency of the analysis of the digital elevation model.

Work on high-precision aeromagnetic survey was carried out using a Geoscan 401 Geophysics quantum magnetometer (Fig. 4). The final processing of the obtained data consisted in subtracting from them the daily variations of the magnetic field, regional anomalies, and in smoothing the data.

After a preliminary analysis of the results of the work of previous years, as well as satellite images of the site, several plots were selected for research (Fig. 5). On the largest of them (about 70 ha), aerial photography was carried out by the Geoscan 401 magnetometer. The data obtained were used to develop a detailed orthophotographic plan and a map of relative heights. Aerial magnetometry was carried out on a plot of approximately 12 hectares. The area of the aerial photographic survey (with the mini DJI Mavic Air drone) was more than 4 hectares.

Fig. 4. Geoscan 401 Geophysics complex for high-precision aeromagnetic survey.

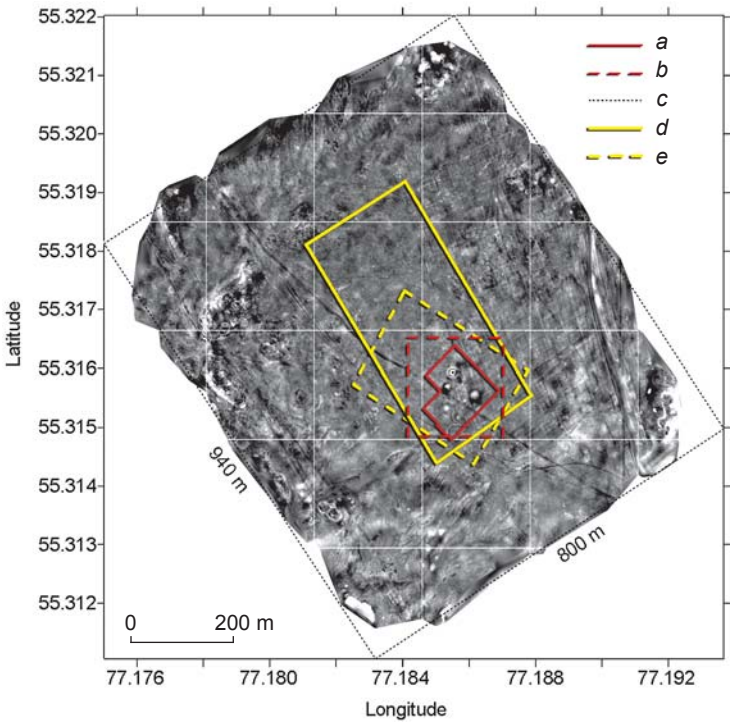

Fig. 5. Map of relative heights of the Aul-Koshkul-1 cemetery, and contours of the sites studied in different years (2010–2020).
a – boundary of ground-based magnetometry (2010); *b* – boundary of aerial magnetometry (2016); *c* – boundary of aerial photography (Geoscan 401, 2020); *d* – boundary of aerial magnetometry (Geoscan 401, 2020); *e* – boundary of aerial photography (Mavic Air, 2020).

Orthophotographic plans and elevation maps

Aerial photography by the professional Geoscan 401 magnetometer was carried out in the middle of the day, with the most intense sunlight. This made it possible to get the highest quality data for building a digital elevation model. However, the final orthophotographic plan, despite its high resolution, did not provide sufficient information about the archaeological sites. Therefore, with the help of the DJI Mavic Air drone, a detailed evening survey was carried out in the area of concentration of the mounds, in the slanting sunlight. It better reflects and emphasizes the features of the terrain (Fig. 6).

The most effective for the search and detailed analysis of archaeological sites turned out to be the data of a digital elevation model. For example, on a fragment of the map of absolute heights, visualized in the form of an illuminated colored 3D-surface, all visually fixed mounds were clearly visible, with the exception of mound 2 (see Fig. 1; 7). Mounds 8 and 9, identified with the help of ground-based magnetometry, are not distinguished, since they are located in the zone of intense plowing, which was designated on the map of absolute heights as an area with a pronounced linear microrelief. It is very clearly seen that the northeastern edge of mound 4 was also plowed up. This is also confirmed by the situational plan of the site, where the ditch surrounding the mound is not marked. It is clearly recorded that mound 7 was plowed up almost completely (only the western segment of the ditch has been preserved). Probably for this reason, it was not possible to distinguish it visually, although the mound is very well read on the map of absolute heights, and its spatial parameters and structure are quite clearly identified.

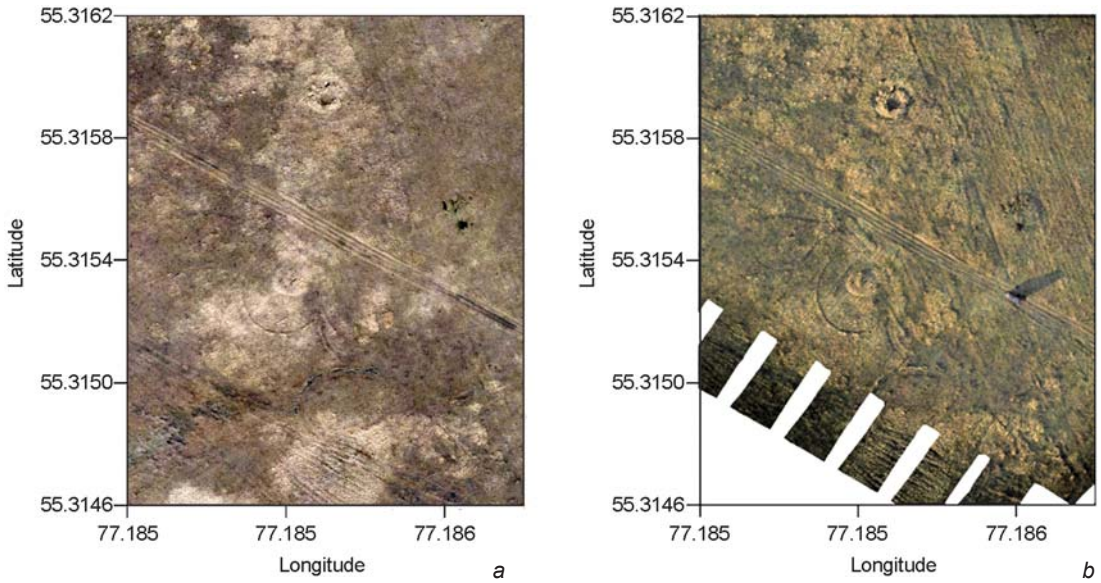

Fig. 6. Fragments of orthophotographic plans based on the data of aerial photography taken in the middle of the day (*a*) and in the evening (*b*).

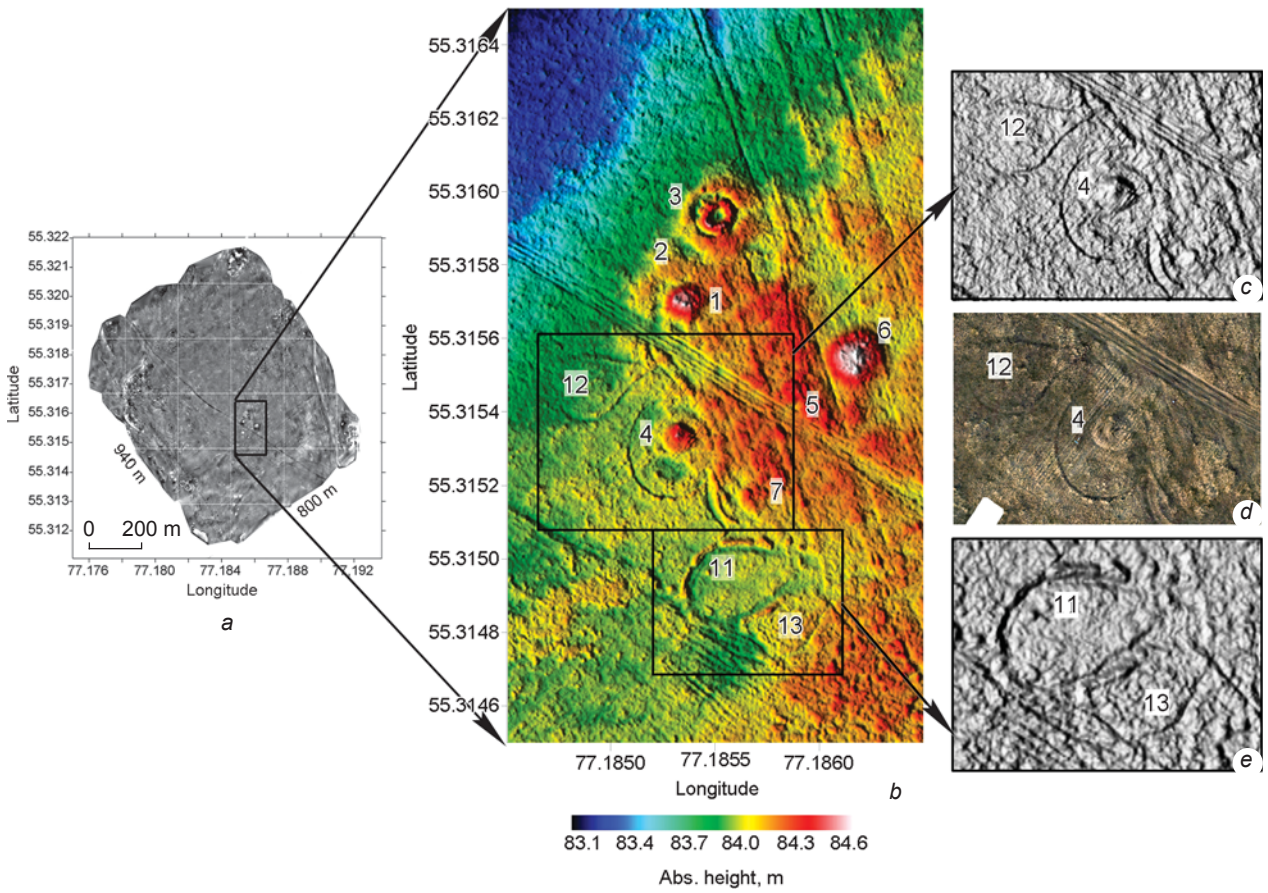

Fig. 7. Fragments of maps of absolute and relative heights.
a – total study area; *b* – fragment of the map of absolute heights; *c*, *e* – fragments of the shadow map of relative heights, illumination angle 183° horizontally and 45° vertically; *d* – fragment of the orthophotographic plan in oblique rays.

According to the digital relief model data, three drop-shaped structures are also clearly recorded (No. 11–13). Object 11 was identified at the initial stage of research and was tentatively interpreted as an unfinished structure. Findings of aerial photography made it possible to correct the idea of its shape and spatial orientation (see Fig. 1; 7). It is adjoined by object 13, which was not previously discovered. Object 12 is quite well visible on the ground-based magnetometry map, but it became possible to distinguish only after analyzing the orthophotographic plans and elevation maps. All these structures are best emphasized by choosing the angle of illumination when building a grayscale shadow map using the Surfer software (see Fig. 7). Notably, a very similar situation is observed on the orthophotographic plan built according to the data of evening shooting in oblique rays (see Fig. 6, *b*). The color of vegetation can also emphasize the relief of the surface and reflect the mounds' structural features. In places of depressions, where moisture accumulates, vegetation is denser and shows intense green color. On flat areas and uplands, the vegetation cover is not as dense and is characterized by lighter shades. This is clearly seen in the example of mound 4 (see Fig. 7).

As a result of the analysis of the APS data, several more new objects were identified to the south of the originally designated area of the Aul-Koshkul-1 cemetery. They are confined to the highest point of the studied area and are similar in their parameters to the drop-shaped structures described above (Fig. 8). Objects 15 and 16 are heavily disturbed by plowing, and their original shape and size are unclear. The ring structure 14 is weakly expressed in the relief (height difference no more than 10 cm) and is almost invisible on the orthophotographic plan; however, it is well detected on the detailed fragment of the elevation map. It is very likely that all these objects are artificial and constitute the funeral and ritual complex. In this case, the boundaries of the site should be significantly expanded.

Aerial magnetometry

Ground-based and aerial magnetometry carried out earlier on the territory of the Aul-Koshkul-1 cemetery revealed a rather low intensity of anomalies associated with the archaeological features. This is also confirmed by the results of the 2020 aerial magnetometric surveys conducted at an average height of 5 m with a satellite positioner of sub-meter accuracy. The described factors that complicate the identification of anomalies

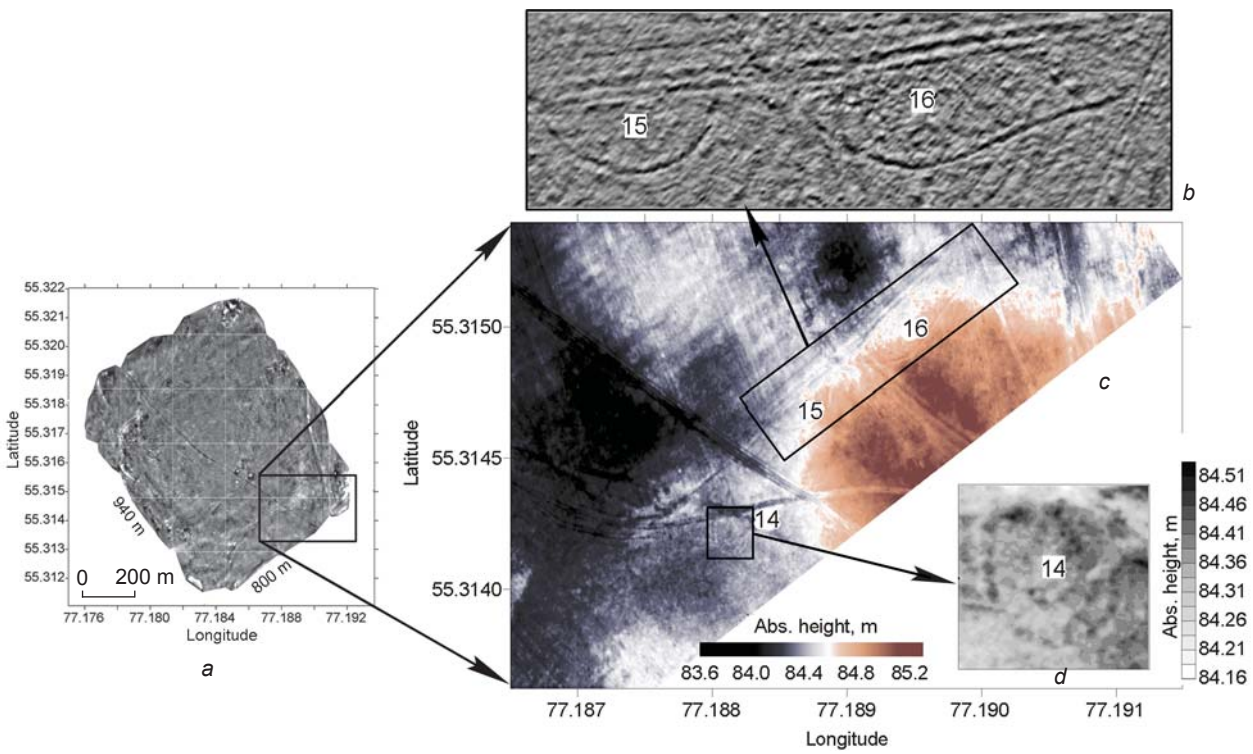

Fig. 8. Fragments of maps of absolute and relative heights on the southern periphery of the cemetery.
a – total study area; *b* – fragment of the shadow map of relative heights, the angle of inclination of the light source is 142° horizontally and 31° vertically; *c* – fragment of the map of absolute heights; *d* – fragment of the map of absolute heights.

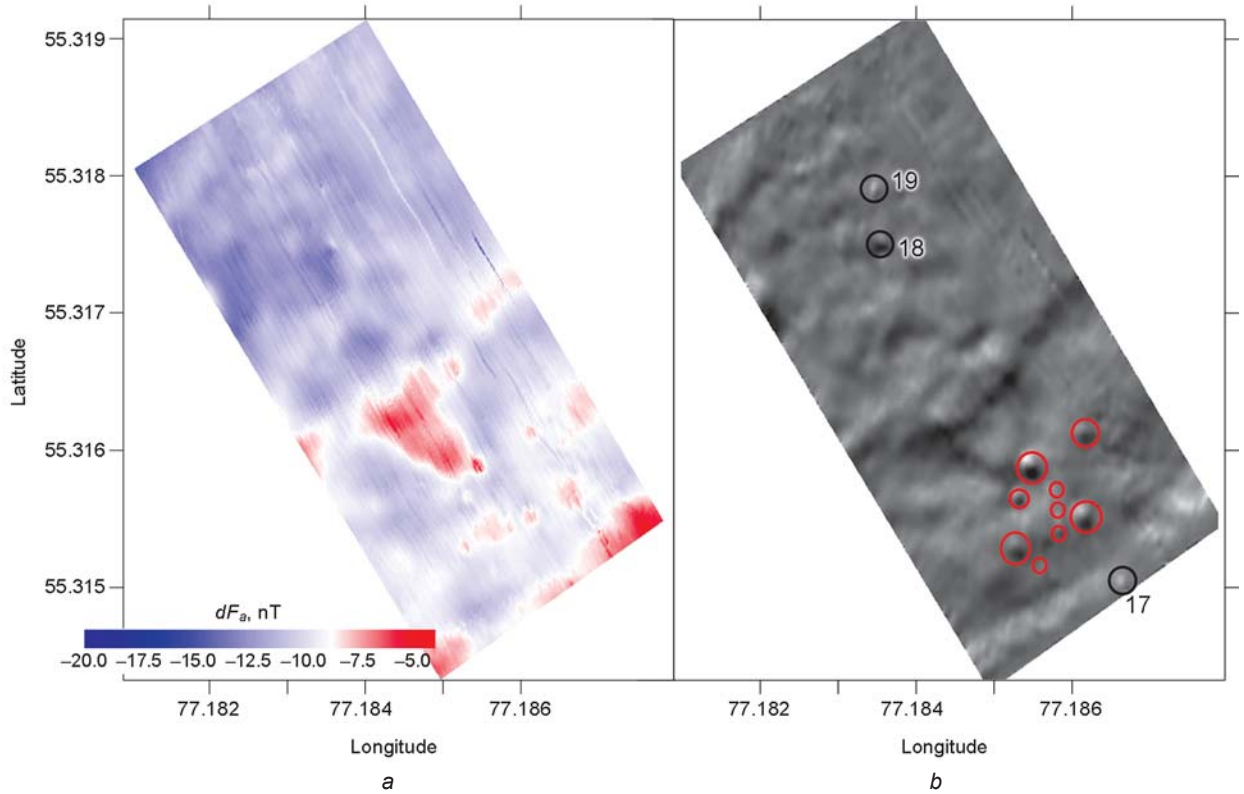

Fig. 9. Maps of the modulus of the total magnetic field vector, corrected to diurnal variations (*a*) and the first derivative (angle 308°) of the anomalous magnetic field (*b*).

from archaeological features were supplemented by a pronounced structure of complex regional anomalies (Fig. 9, *a*). Nevertheless, the constructed magnetic maps contain anomalies of low intensity, which can be associated with archaeological structures (Fig. 9, *b*). Of the ten mounds identified earlier, only six stand out (No. 1, 3–6, 10). The rest of the mounds, as well as the drop-shaped features (No. 11–13) discovered with the help of aerial photography, were not recorded by aeromagnetic surveys. Thus, according to the results of the work carried out, it was possible to identify only fairly large structures consisting of relief mounds.

Outside the areas of earlier magnetic surveys, only one anomaly can be tentatively interpreted as a mound (No. 17). It is located on a hill southeast of the main complex. The absence of relief features can be explained by the location of this object in the plowing zone. Two more magnetic anomalies (No. 18, 19) are identified to the northwest of the burial ground. Since the natural relief of the area here becomes significantly lower, they cannot be confidently associated with archaeological structures. Perhaps, the source of these anomalies are metal items lying in the ground.

Conclusions

The studies have clearly demonstrated the high efficiency of the integrated approach in the archaeological and geophysical research. The results obtained are a very good example of how the understanding of the composition and boundaries of an archaeological site can change. Through visual fixation, only six mounds and one (possibly unfinished) structure were identified at Aul-Koshkul-1. Ground-based magnetometry made it possible to obtain the actual plan of the site and to discover three new burial mounds that were not expressed in relief. The first experimental work on the application of the aerial magnetometry method has not only demonstrated how to increase the efficiency of magnetic prospecting, but also revealed another mound outside the ground-based magnetometry area. Thus, as a result of magnetic surveys, the total number of structures found at the cemetery increased to 11.

Thanks to the complex use of aerial photography and aerial magnetometry, it was possible to obtain a large amount of additional information. The high efficiency of constructing orthophotographic plans

and digital elevation models for detailing the relief structures and clarifying their spatial characteristics has been demonstrated. The aerial photography method proved to be highly effective primarily in identifying archaeological features poorly expressed in relief, which are hard to locate by visual analysis of the surface (mound 7, objects in the form of shallow ditches). Notably, orthophotographic plans built according to aerial photography data in the oblique rays of the setting sun provide for the presentation of photographic information about archaeological complexes in the most advantageous way. At the same time, digital elevation models derived from shooting at noon can capture even the very weakly expressed features.

The aeromagnetic survey of the burial mound of Aul-Koshkul-1 was carried out at the limit of accuracy of the method owing to the low intensity of magnetic anomalies associated with archaeological structures. Nevertheless, most of the mounds managed to be identified. With a greater degree of contrast between archaeological features and the host environment, the information content of the survey would be higher (Balkov et al., 2019). It is also worth noting that with the high performance of the magnetometer and the UAV carrier, navigation tools served as a significant limitation. It is necessary to introduce differential means for taxiing and positioning using real-time kinematic (RTK GNSS). In this case, it will be possible to carry out a high-performance aerial survey at a low altitude (about 1 m), comparable in quality and data density to the ground-based magnetometry. It is important to emphasize that aerial magnetometry, in combination with aerial photography, helps solving the archaeological issues on locating and studying sites at a new, sophisticated level. Both methods are highly productive and can be used for prospecting large areas within a short time. Since they involve essentially different characteristics of archaeological features (relief and magnetic), the information obtained will be more complete and relevant.

At a new stage of archaeological and geophysical studies of the Aul-Koshkul-1 cemetery, five new objects were identified with the help of aerial photography, and presumably three more with aerial magnetometry. Analyzing the totality of information, one can question not only the expansion of the initially established boundaries of the site, but also the simultaneity of formation of its parts. All objects in the form of shallow ditches are confined to the very edge of the terrace; they have no absolute parallels. These are very similar to the outer ditch of mound 4, which is also situated here and is very close in its structure to the burial mounds of the Early Scythian era. The rest of the objects are different in their structure and are located in the depths of the terrace, including partially destroyed mound 3, whose materials attribute the cemetery to the Old Turkic period. Importantly, the composition of the site can be expanded in the future, since five more objects were identified so far on its southern periphery, according to the aerial photographic data. However, their man-made nature is not so obvious; therefore, analysis of these objects requires the use of other research methods and the additional interpretation of data.

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Chronic Maxillary Sinusitis Recorded in Archaeological Samples: Geographical Distribution and Predisposing Factors

The study explores social and climatic factors affecting the occurrence of chronic maxillary sinusitis (CMS) in ancient and historical samples of Europe, North and South America, Asia, and Africa. The main database consists of 23 cranial samples. According to the results of univariate (correlation analysis and Wilcoxon-Mann-Whitney test) and multivariate (principal component) analyses, only climatic factors reveal a statistically significant effect on the frequency of CMS. The principal factor is temperature, which shows a negative correlation with CMS at the world level: the higher the mean annual temperature and the maximal temperature of the three hottest months, the lower the occurrence. At the regional level, significant correlation was also found between CMS and the number of rainy days per year. Rather than direct dependence, however, this result suggests that the correlation between climatic variables is different in Europe and North America. None of the socio-economic factors that we analyzed (sex, urban versus rural residence, subsistence strategy) demonstrated significant correlation with the prevalence of CMS at the world level. Assessing the effect of social status evaluated by archaeological criteria was impossible because of the complex nature of stress-inducing factors.

Keywords: *Chronic maxillary sinusitis, climate, bioarchaeology, paleopathology, respiratory tract diseases.*

Introduction

Chronic sinusitis or chronic maxillary sinusitis (hereinafter—CMS) is a long-term (more than 12 weeks) inflammation of the mucosa of the maxillary sinus (Khronicheskiy rinosinusit…, 2014: 11). This pathology is manifested as nasal breathing obstruction, headaches, general weakness, and at exacerbations is accompanied by nasal discharge and fever. Today, CMS is one of the most widespread chronic otolaryngologic (ENT) diseases worldwide (Slavin, Sheldon, Bernstein, 2005; Brook, 2009). The crucial factors affecting its spread at present are various anthropogenic air pollutions, iatrogeny, the presence of concomitant diseases, and climatic conditions (Mercer, 2003; Kaur, Nieuwenhuijsen, Colvile, 2005; Peled et al., 2005; Roberts, 2007). But deciphering the actual role of any of those

factors is difficult for several reasons. First, the information regarding the way of life of the patient is typically not collected in clinics at diagnosis. Second, various types of anthropogenic air pollution interfere, and it is quite challenging to determine which of them has the main effect. Third, the role of iatrogeny in the etiology of odontogenic chronic sinusitis has greatly increased with the advance in new technologies for deep filling of tooth canals (Koshel, 2017: 9; Patel, Ferguson, 2012: 25). Finally, most studies of the influence of the environment on the development of the disease employ samples of patients from a single hospital, which do not represent any population nor can even be considered a random sample. No comparison with the results obtained for other samples is typically carried out.

Archaeological skeletal samples have, despite the lesser consistency of diagnostics, some advantages for the study of CMS epidemiology as compared to clinical data. First, the influence of the iatrogenic factor is virtually absent in such samples, and the morbidity pattern is not "blurred" by the use of modern remedies. Second, the level of variability of environmental stressful factors in ancient populations is expected to be lower than in modern groups. In addition, archaeological cranial collections fit better to the criteria of a random sample than patients of a single hospital, and they provide both people affected by CMS and healthy individuals (control group) for the study. Despite these advantages, there have been only a few works on the epidemiology of CMS in ancient and historical populations. No consensus exists regarding the morbid factors of CMS. It was pointed out that the prevalence of this pathology could be related to air pollution (which differed between rural and urban areas) (Lewis, Roberts, Manchester, 1995), to the social status of individuals (Roberts, 2007), or to the frequency of dental diseases (Panhuysen, Coenen, Bruintjes, 1997; Zubova et al., 2020). It was suggested that females had a higher risk of the developments of CMS owing to sex-differences in lifestyle (Roberts, 2007).

As well as for the modern population, no statistical exploration of the influence of various factors on the prevalence of CMS has ever been performed for archaeological groups. The most geographically broad bioarchaeological survey was carried out by C. Roberts, who compared 14 samples from Europe, North America, and Africa (Ibid.). Of all the populations, only two North American samples exhibited statistically significant sexual differences (Ibid.: Tab. 5). No differences were detected between either urban vs. rural groups, or agriculturalists vs. hunters-gatherers. Despite this apparent lack of associations, the author postulated lesser morbidity in the rural and hunter-gatherers populations, as well as the importance of anthropogenic pollution for the spread of CMS (Ibid.: 804).

The aim of the present study was a statistical analysis of the environmental factors influencing the prevalence of CMS in ancient and historical populations of Europe, North and South Americas, Asia, and Africa. To these ends, we analyzed the association between the frequency of CMS and temperature and humidity conditions and the geographic locations of the studied groups. The study also sets out to test the previously formulated hypotheses regarding the influence of various social and cultural factors on the spread of the disease in different parts of the globe.

Material and methods

This study employs the published frequencies of CMS in 21 samples from North America, Europe, Africa, and India, alongside with authors' own data on two South American groups (Table 1) studied via computed tomography (CT) at the Bekhterev Psychoneurological Research Institute (see (Zubova et al., 2020: 146) for methodological details).

Owing to the relatively small number of analyzed samples, the non-parametric Wilcoxon-Mann-Whitney (Wilcoxon Matched Pairs) test was used for pair-wise comparisons between males and females, urban and rural groups, hunter-gatherers and agriculturalists. The association between the prevalence of CMS and the climatic and geographic variables was assessed using parametric Pearson's (worldwide/intercontinental sample, 23 groups) or non-parametric Spearman-Kendall's (continental sub-samples) correlation coefficients. The set of climatic variables included the mean annual temperature, mean minimal temperatures of the three coldest months, mean maximum temperatures of the three warmest months (Fahrenheit scale), annual

Table 1. **Frequency of CMS in the samples employed in this study**

Sample	Continent	Country	Date	Frequency of CMS*						Source
				Males		Females		Total		
				n (N)	%	*n (N)*	%	*n (N)*	%	
Rurka	Europe	Poland	13th–15th AD	…	…	…	…	57 (79)	72.2	(Teul et al., 2013)
Sigtuna	"	Sweden	10th–16th AD	93 (93)	100	38 (40)	95	155 (157)	98.7	(Sundman, Kjellström, 2013)
Spitalfields (London)	"	England	18th–19th AD	34 (192)	17.7	37 (202)	18.3	71 (394)	18	(Roberts, 2007)
Chichester (Sussex)	"	"	12th–16th AD	46 (84)	54.8	26 (47)	55.3	72 (131)	55	(Ibid.)
Fishergate House (North Yorkshire)	"	"	12th–16th AD	29 (56)	51.8	24 (53)	45.3	53 (109)	48.6	"
Raunds (Northamptonshire)	"	"	8th–10th AD	36 (68)	52.9	19 (41)	46.3	55 (109)	50.5	"
St.-Helen-on-the-Walls (North Yorkshire)	"	"	12th–16th AD	37 (49)	75.5	45 (65)	69.2	82 (114)	71.9	(Lewis, Roberts, Manchester, 1995)
Wharram Percy (North Yorkshire)	"	"	10th–19th AD	43 (97)	44.3	43 (72)	59.7	86 (169)	50.9	(Ibid.)
Maastricht-1 (Boschstraat)	"	Netherlands	7th–8th AD	…	…	…	…	7 (28)	25	(Panhuysen, Coenen, Bruintjess, 1997)
Maastricht-2 (Servaas)	"	"	6th–10th AD	…	…	…	…	29 (67)	43.3	(Ibid.)
Maastricht-3 (Nunnery)	"	"	13th–17th AD	…	…	…	…	13 (31)	41.9	"
Inamgaon	Asia	India	10th–7th BC	…	…	…	…	1 (62)	1.61	(Mushrif-Tripathy, 2014)
Kodumanal	"	"	4th BC – 3rd AD	…	…	…	…	3 (7)	42.86	(Ibid.)
Aleuts	North America	USA	16th AD	4 (13)	30.8	11 (22)	50	15 (35)	42.9	(Roberts, 2007)
Harding Village (Kentucky)	"	"	16th–17th AD	4 (16)	25	13 (17)	76.5	17 (33)	51.5	(Ibid.)
Indian Knoll	"	"	26th–15th BC	18 (49)	36.7	19 (47)	40.4	37 (96)	38.5	"
Illinois	"	"	8th–12th AD	12 (42)	28.6	15 (28)	53.6	27 (70)	38.6	"
South Dakota	"	"	Late 16th – early 19th AD	8 (48)	16.7	7 (39)	18	15 (87)	17.2	"
Moatfield (North-York, Ontario)	"	Canada	14th AD	15 (24)	62.5	13 (14)	92.9	28 (38)	73.7	"
Uxbridge	"	"	15th AD	14 (17)	82.35	11 (13)	84.6	25 (30)	83.3	"
Pucará de Tilcara	South America	Argentina	8th–15th AD	4 (12)	33.3	1 (7)	14.3	5 (19)	26.3	(Zubova et al., 2020)
Lima	"	Peru	10th–17th AD	…	…	…	…	0 (9)	0	Present study
Kulubnarti	Africa	Sudan	6th–15th AD	8 (45)	17.7	14 (56)	25	22 (101)	21.8	(Roberts, 2007)

*n – number of pathological cases, N – number of individuals.

Table 2. **Climatic, geographic, and socio-economic variables**

Sample	Mean annual temperature, ˚F	Mean minimal temperatures of the three coldest months, ˚F	Mean maximum temperatures of the three warmest months, ˚F	Annual relative humidity, %	Number of rainy days per year	Latitude*	Longitude**	Subsistence type	Settlement type
Maastricht-1 (Boschstraat)	51.22	33.43	72.4	76.08	118	50.52	5.41	Agriculture	Rural
Maastricht-2 (Servaas)	51.22	33.43	72.4	76.08	118	50.52	5.41	"	Urban
Maastricht-3 (Nunnery)	51.22	33.43	72.4	76.08	118	50.52	5.41	"	"
Wharram Percy (North Yorkshire)	48.99	35.17	65.63	79.92	113	54.07	–0.69	"	Rural
St. Helen-on-the-Walls (North Yorkshire)	48.99	35.17	65.63	80.00	113	53.95	–1.08	"	Urban
Raunds (Northamptonshire)	49.47	35.2	66.67	79.25	103	52.35	–0.53	"	Rural
Fishergate House (North Yorkshire)	48.99	35.17	65.63	79.91	113	53.95	–1.08	"	Urban
Chichester	51.37	36	69.5	78.33	126	50.84	–0.78	"	"
Spitalfields (London)	51.37	36	69.5	78.33	126	51.49	–0.09	"	"
Sigtuna	45.08	26.1	61.87	79.00	91	59.62	17.72	"	"
Rurka	50.19	30.1	57.83	74.00	97	53.41	14.88	"	Rural
Kodumanal	81.17	68.6	98.24	61.00	92	11.01	78.16	"	"
Inamgaon	75.75	60.52	96.2	60.42	96	18.94	76.35	"	"
Uxbridge	47.67	20.83	75.6	70.75	119	44.11	–79.13	"	"
Moatfield (North York, Ontario)	47.67	20.83	75.6	70.75	119	43.75	–79.44	"	"
South Dakota	48.18	18.43	84.63	53.83	72	43.20	–100.20	Hunting-gathering	"
Illinois	59.12	32.0	87.87	66.00	85	40.21	–89.17	"	"
Indian Knoll	56.51	29.3	85.4	67.00	93	37.27	–86.98	"	"
Harding Village (Kentucky)	56.51	29.3	85.4	67.25	93	38.43	–82.57	Agriculture	"
Aleuts	38.58	19.93	60.87	77.00	108	52	–174	Hunting-gathering	"
Lima	66.08	58.1	76.77	80.25	32	–12.02	–77.01	Agriculture	Urban
Pucará de Tilcara	51.71	38	65.2	45.83	131	–22.92	–65.72	"	"
Kulubnarti	79.44	51.9	103.3	28.33	0	21.05	39.5	"	Rural

*Positive sign – north latitude, negative sign – south latitude.
**Positive sign – east longitude, negative sign – west longitude.

relative humidity, and the number of rainy days per year (Table 2).

Unfortunately, it was not possible to obtain detailed climatic data for the time of existence of the studied archaeological sites; thus, modern values of the variables were compiled from the open source (https://ru.climate-data.org/). The geographic coordinates of the locations of the sites were employed in the analyses as well. The coordinates of an area rather than a single geographic point were used for the sites lacking the data on the exact location, as well as for composite samples.

In order to obtain cumulative descriptors of climate, a principal component analysis (PCA) was carried out for all the climatic variables, and the PCA values were then employed in the correlation analyses. The frequencies of CMS were calculated for sex-combined samples except for the analysis of sexual dimorphism.

Results

As a first step, the differences between various demographic and socio-economic cohorts hypothesized in previous studies were tested.

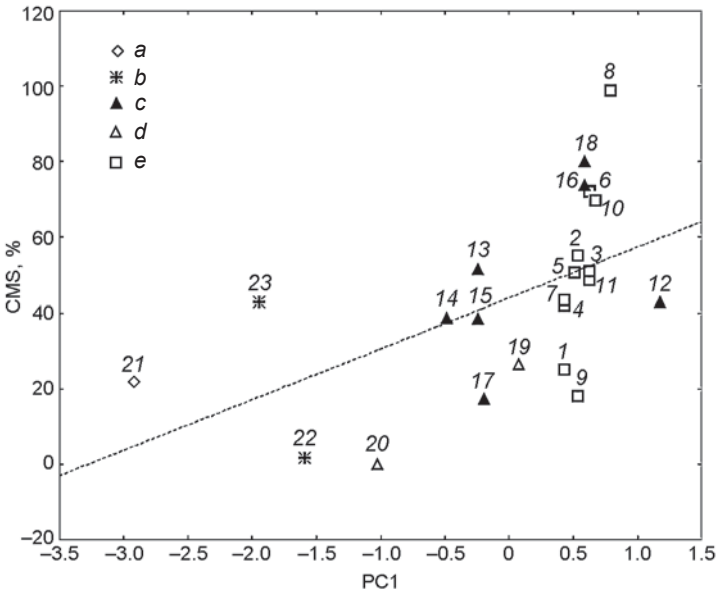
Sex difference in the prevalence of CMS. Seventeen samples were analyzed: one African, seven European, seven North American, and two South American (see Table 1). At the intercontinental level, the differences between males and females were not significant: Wilcoxon-Mann-Whitney $Z = 1.55$, $p = 0.12$. The same is true for the European samples: $Z = 0.676$, $p = 0.499$. But in the New World, females exhibit a high incidence of the disease. The difference is statistically significant: male mean 38.75 %, female mean 53.79 %; $Z = 1.96$, $p = 0.05$. Notably, this trend is highly dependent on one "influential" North American sample from Harding Village, displaying a difference higher than 50 % (see Table 1). No similar pattern is observed in other groups; moreover, in the South American female skulls, only one case of CMS was detected. Thus, except for the Harding Village sample, no significant sex-difference in the prevalence of CMS was observed. Consequently, the unequal occupational stress experienced by males and females does not seem to influence the frequency of the disease at either a global or a continental scale.

Prevalence of CMS in different socio-economic groups. Urban vs. rural and hunter-gatherer vs. agriculturalist groups were compared (see Table 2). No statistically significant differences between the urban and rural samples were detected either at the global scale ($Z = 1.613$, $p = 0.1$) or in Europe or North America ($Z = 0.8$, $p = 0.42$). Separate analyses for Asia, Africa, and South America were not carried out owing to their low sample-sizes. No statistically significant differences between the agriculturalist and hunter-gatherer groups were detected at the intercontinental scale ($Z = 1.29$, $p = 0.19$), likely as a result of the low number of the latter (only four samples). The only continent where such comparison was possible was North America, showing a marginally significant level of association ($Z = 1.96$, $p = 0.0495$). However, the North American agriculturalist groups inhabited colder areas than the hunter-gatherers from the same continent; thus, this apparent difference might be explained by climatic rather than social factors. On the basis of the results of the present analysis, an influence of social or economic factors on the epidemiology of CMS, in general, cannot be completely ruled out; but, according to these results, there is no relation between this and the studied socio-economic cohorts.

Associations of the prevalence of CMS with climate. As a first step, the correlation of the climatic variables with the geographic differentiation of the compared samples was explored via a PCA. The analysis has shown that only PC1 is statistically significant, and explains 67.8 % of the total variance. All the climatic variables display high loading on PC1, though these are positive for the features of humidity and negative for the temperature markers (Table 3). Negative values

Table 3. **Loading on PC1 and PC2 of the analysis of climatic variables**

Variable	PC1	PC2
Number of rainy days per year	0.749	–0.267
Minimal temperature	–0.760	–0.618
Mean temperature	–0.959	–0.258
Maximal temperature	–0.893	0.130
Humidity	0.730	–0.55
Eigenvalue	3.39	0.84
Proportion of variance described	0.678	0.168



The frequencies of CMS and PC1 coordinates in the 23 cranial samples employed in this study.
1 – Maastricht-1; *2* – Chichester; *3* – Fishergate House; *4* – Maastricht-3; *5* – Raunds; *6* – Rurka; *7* – Maastricht 2; *8* – Sigtuna; *9* – Spitalfields; *10* – St. Helen-on-the-Walls; *11* – Wharram Percy; *12* – Aleuts; *13* – Harding Village; *14* – Illinois; *15* – Indian Knoll; *16* – Moatfield; *17* – South Dakota; *18* – Uxbridge; *19* – Pucará de Tilcara; *20* – Lima; *21* – Kulubnarti; *22* – Inamgaon; *23* – Kodumanal.
a – Africa; *b* – Asia; *c* – North America; *d* – South America; *e* – Europe.

of PC1 are found for the populations from the warmest and driest climates (Sudan and India), while positive values are typical for the North and Western European groups, Canada and the Aleutian Islands. The rest of the American samples display intermediate values (see *Figure*).

The proportion of the total variance described by PC2 is substantially less than that of PC1. The eigenvalue of PC2 is also less than 1, which means that this vector explains less variation than any of the raw variables. Thus, the results for PC2 are not considered further.

The correlation analysis between PC1 coordinates, raw climatic variables, and CMS frequencies carried out across three continents has shown significant (though moderate in factor values) associations: negative between temperatures and frequency, and positive between

Table 4. **Pearson's correlation coefficients between the frequency of CMS, raw climatic variables, and the integral climatic factors (PCs) (23 samples)**

Variable	Latitude	Longitude	Number of rainy days per year	Minimal temperature	Mean temperature	Maximal temperature	Humidity	PC1	Frequency of CMS
Latitude	1.000								
Longitude	0.064	1.000							
Number of rainy days per year	0.258	0.013	1.000						
Minimal temperature	***–0.578***	***0.623***	–0.405	1.000					
Mean temperature	***–0.525***	***0.481***	***–0.605***	***0.878***	1.000				
Maximal temperature	–0.343	0.159	***–0.579***	***0.528***	***0.844***	1.000			
Humidity	***0.442***	–0.009	***0.525***	–0.272	***–0.570***	***–0.670***	1.000		
PC1	***0.521***	–0.317	***0.749***	***–0.760***	***–0.959***	***–0.893***	***0.730***	1.000	
Frequency of CMS	***0.527***	–0.001	0.367	***–0.516***	***–0.504***	***–0.471***	0.372	***0.544***	1.000

Note. Italicized are significant correlations ($p < 0.05$).

PC1 scores and frequency (Table 4). The latter correlation is higher than those for the raw climatic variables, i.e. their combination summarized with PCA is associated with climate more than single variables.

It is of note also that PC1 is positively correlated with latitude, while the latter is associated with the prevalence of CMS as well (Table 4). This observation confirms the dependence of climatic conditions on the geographic location of the populations, which suggests to an extent that the use of modern climatic data has not affected the outcome of the analyses. As the geographic locations of the groups have not been changing with time, the simultaneous correlation of latitude with climate and morbidity confirms the significance of the association between these.

In order to obtain a more detailed picture of the association between various climatic variables and the prevalence of CMS at the continental level, three more analyses were performed: for Europe, for the New World in a broad sense, and for North America separately. In Europe, the strength and sign of the correlations between the frequency of CMS on one hand, and latitude, annual and maximal temperature, on the other hand, remain the same. In addition, a negative correlation between morbidity and the number of rainy days per year was detected (Table 5).

In the New World (including the continental part of the Americas and the Aleutian Islands), the pattern is different. A significant correlation with morbidity was only detected for latitude, but not for any other variable. The coefficients for the annual average number of rainy days and mean temperature were higher than at the intercontinental level (Table 6). But unlike Europe, precipitation in the New World was positively associated with morbidity. If the South American samples are excluded, the loading on the annual number of rainy days becomes significant (Table 7). Also, the correlation between morbidity and longitude increases strongly, but still does not reach significance owing to the small number of analyzed samples.

The results for the North American groups should be in general treated cautiously because of the low sample size. Nevertheless, the results of all the analyses lead to the preliminary conclusion of the importance of climatic conditions for the epidemiology of CMS. But the moderate values of the correlation coefficients demonstrate that the association between climate and morbidity is far from being absolute, and can be affected by the influence of non-climatic factors.

Table 5. **Spearman-Kendall's rank correlation coefficients between the frequency of CMS and climatic and geographic indicators (Europe)**

Variable	Latitude	Longitude	Number of rainy days per year	Minimal temperature	Mean temperature	Maximal temperature	Humidity	Frequency of CMS
Latitude	1							
Longitude	–0.042	1						
Number of rainy days per year	***–0.779***	–0.268	1					
Minimal temperature	–0.272	–0.756	0.545	1				
Mean temperature	***–0.911***	0.07	***0.848***	0.393	1			
Maximal temperature	***–0.826***	0.014	***0.791***	0.223	***0.716***	1		
Humidity	***0.614***	***–0.721***	–0.239	0.437	***–0.615***	–0.38	1	
Frequency of CMS	***0.552***	0.055	***–0.701***	–0.311	***–0.608***	***–0.803***	0.271	1

* See note to Table 4.

Table 6. **Spearman-Kendall's rank correlation coefficients between the frequency of CMS and climatic and geographic indicators (New World)***

Variable	Latitude	Longitude	Number of rainy days per year	Minimal temperature	Mean temperature	Maximal temperature	Humidity	Frequency of CMS
Latitude	1							
Longitude	–0.567	1						
Number of rainy days per year	0.185	0.353	1					
Minimal temperature	***–0.824***	0.655	–0.119	1				
Mean temperature	***–0.773***	0.269	–0.627	0.797	1			
Maximal temperature	–0.303	–0.235	–0.627	0.237	0.712	1		
Humidity	0.377	0.042	–0.135	–0.034	–0.135	–0.304	1	
Frequency of CMS	***0.65***	–0.05	0.588	–0.387	–0.555	–0.151	0.259	1

*See note to Table 4.

Table 7. **Spearman-Kendall's rank correlation coefficients between the frequency of CMS and climatic and geographic indicators (North America)***

Variable	Latitude	Longitude	Number of rainy days per year	Minimal temperature	Mean temperature	Maximal temperature	Humidity	Frequency of CMS
Latitude	1							
Longitude	–0.071	1						
Number of rainy days per year	0.546	0.618	1					
Minimal temperature	–0.655	–0.291	–0.111	1				
Mean temperature	***–0.873***	–0.000	–0.666	0.778	1			
Maximal temperature	***–0.873***	–0.000	–0.666	0.778	1	1		
Humidity	0.667	0.234	***0.881***	–0.220	–0.771	–0.771	1	
Frequency of CMS	0.464	0.750	***0.873***	0.073	–0.436	–0.436	0.739	1

*See note to Table 4.

Discussion

Our analyses have shown that the interpopulation differences in the prevalence of CMS can depend on climate. While the employment of modern values of climatic variables evokes a conservative interpretation of the obtained results, the main trends seem fairly robust. At the global scale, the prevalence of CMS in warm regions is significantly lower than in colder areas. The apparent association between the number of rainy days per year and morbidity at the regional level is likely a statistical effect related to the correlation between various climatic indicators, most importantly between

temperature and precipitation. The contradictory nature of the correlation between the number of rainy days and temperature in Europe and the Americas suggests this.

On the basis of the value of the correlation coefficient between the frequency of CMS and PC1 scores, climate explains only slightly more than a half of the morbidity variation at the global level. This observation means that the etiology of CMS is multifactorial, and there are other non-climatic factors influencing its prevalence. But as the social and economic factors employed in this study were not found to be associated with the frequency of CMS, a detailed bioarchaeological analysis of each of the samples is warranted for detecting the influence of those non-climatic factors. None of our analyses has revealed a significant difference in morbidity between the rural and urban groups. One possible explanation of this is the archaeological application of the term "city", whereas not only industrial centers in the modern sense but also large ancient settlements with a high population density, an architectural layout, and a system of defensive fortifications are considered cities. Such settlements clearly did not suffer from the air pollution typical for industrialized cities.

Increased prevalence of CMS in ancient "cities" might be hypothetically expected as a result of a poor epidemiological situation due to the increase in population density. But the absence of significant CMS differences between "rural" and "urban" groups argues against such a hypothesis as well.

Historical sources suggest that the level of household anthropogenic pollution arising from the use of fossil fuels, insufficient ventilation of dwellings, etc. was not substantially different between urban and rural settlements before the 17th–19th centuries AD, and thus could not seriously affect the prevalence of CMS. When the ciliated epithelium of the sinus functions normally, the airborne pollutants are removed to the nasal cavity with liquor and do not accumulate in the sinus. The accumulation of the polluting particles begins in case of the already existing outflow violation, which may be related to infectious diseases or allergic reactions, or in case of very strong pollution. The latter triggers the development of CMS and pneumoconiosis in miners and workers in the metallurgical industry (Artemova et al., 2016: 37). But such conditions are extreme, and the morbidity of these professional groups does not depend on their urban or rural habitation.

The social status of the deceased is traditionally thought to be an important factor of the epidemiology of CMS (Roberts, 2007), though it seems impossible to determine its actual influence at the global or even at a regional scale. The status is typically determined by archaeologists based on the differences in grave goods, which only rarely reflect the level of biological stress experienced by the population. Thus, directly opposite patterns of morbidity are often observed in archaeological populations of a similar social status. For instance, the prevalence of CMS in several groups from North Yorkshire fits well to the theoretical expectations based on their levels of welfare. Three archaeological samples were studied there: Fishergate House, Wharram Percy, and St. Helen-on-the-Walls. In the latter sample, the frequency of CMS is the highest, which is logically explained by the poverty of the part of the city's population buried in this cemetery (Lewis, Roberts, Manchester, 1995: 501). However, for medieval Maastricht, an opposite situation is observed. In the earliest sample from that city (Maastricht-1; 7th–10th centuries AD), which, according to archaeological data, belonged to a low-status rural population (Panhuysen, Coenen, Bruintjes, 1997: 611), fewer cases of CMS were detected than in the later samples representing urban citizens of middle to high social status. In this case, as well as in many others, it is problematic to determine what the main cause of the increased morbidity in the higher-status group was. The list of possible factors might include fluctuations of climatic conditions, local pandemics, warfare, and other occasional events, which cannot be accounted for in statistical analysis. Ideally, instead of dealing with a general social status, it would be more productive to consider single stressors and their various combinations.

In order to assess the influence of social factors on the prevalence of CMS, not only the total number of affected individuals should be estimated, but the proportion of various forms of the disease needs to be taken into account: rhinogenous, associated with respiratory disorders; odontogenic, caused by the penetration of dentoalveolar infections into the maxillary sinuses; and hematogenous, caused by specific diseases such as measles, scarlet fever,

or influenza, the complications of which may be CMS (Fedorova, 2011). Each of these forms can be related to a separate group of stress factors. Ambient temperature and humidity are important causes of rhinogenous sinusitis, while diet and the associated status of dental health are influential factors of the odontogenic form.

At present, a thorough wide-scale analysis of the aspect mentioned above is not possible owing to the lack of precise diagnostics of various forms of CMS. Hematogenous and rhinogenous sinusitis cannot be differentiated using only cranial data, and a reliable diagnosis of the odontogenic form requires a CT study of all the employed samples. Such a study so far has only been carried out for the Peruvian (present publication) and Argentinean (Zubova et al., 2020) samples, while the other populations were only the subject of a conventional macroscopic examination. Thus, it is not possible to determine the main sources of infections, nor the pathogenic factors involved.

Conclusions

The main outcome of the preliminary statistical analysis carried out in the present study is that of all the possible pathogenic factors considered, only the climatic variables are significantly correlated with the prevalence of CMS at the global scale. The strongest association was detected with temperature.

No correlation was detected between the frequency of CMS and the anthropogenic factors—air pollution, social status, and others, which have previously been suggested as possible causes of the disease (Mercer, 2003; Kaur, Nieuwenhuijsen, Colvile, 2005; Peled et al., 2005; Roberts, 2007). Moreover, the influence of these factors cannot productively be discussed at present, owing to the lack of relevant information in the anthropological literature. Such an influence can only be considered at the level of single populations, since the combination of the stress factors is unique to each of them. Thus, in each case, a comprehensive bioarchaeological investigation of the skeletal sample should be carried out as a first step, and precise methods of instrumental diagnostics must be employed for the differentiation of various forms of CMS. We are unaware of any studies of this type published to date, and this remains a very promising direction for future research in the fields of paleopathology and bioarchaeology of ancient and historical populations of the world.

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AN SSSR – USSR Academy of Sciences

BAR – British Archaeological Reports

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IAE NANA – Institute of Archaeology and Ethnography, Azerbaijan National Academy of Sciences (Baku)

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

IEA RAN – Institute of Ethnography and Anthropology, Russian Academy of Sciences (Moscow)

IIFF SO AN SSSR – Institute of History, Philology and Philosophy, Siberian Branch of the USSR Academy of Sciences (Novosibirsk)

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

IIYaL UFIC RAN – Institute of History, Language and Literature, Ufa Scientific Center of the Russian Academy of Sciences (Ufa)

IPOS SO RAN – Institute of Northern Development, Siberian Branch, Russian Academy of Sciences (Tyumen)

IV RAN – Institute of Oriental Studies, Russian Academy of Sciences (Moscow)

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

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

MAE RAN – Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences (St. Petersburg)

MIA – Materials and Investigations on Archaeology in the USSR

OIGGM SO RAN – United Institute of Geology, Geophysics and Mineralogy, Siberian Branch of the USSR Academy of Sciences (Novosibirsk)

RGIA – Russian State Historical Archive

RGNF – Russian Foundation for the Humanities

SAI – Collection of Archaeological Sources

UrO RAN – Ural Branch of the Russian Academy of Sciences

YaNAO – Yamal-Nenets Autonomous Okrug

YuNC RAN – Southern Scientific Center, Russian Academy of Sciences (Rostov-on-Don)

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