BONE MASSIVE SPEAR HEADS IN THE MESOLITHIC OF WESTERN RUSSIA (TECHNOLOGICAL AND FUNCTIONAL STUDY)

Puntas de lanza de hueso masivas del Mesolítico de Rusia Occidental. Estudio tecnológico y funcional

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ABSTRACT Excavations of peat bog sites in Central Russia have brought to light a rich and highly developed bone industry, which played a very important role in subsistence strategies and everyday life of the Mesolithic population of the region. The present article, however, deals with only one aspect of this bone industry, namely bone heads of massive thrusting spears. From morphological point of view heads of thrusting spears are massive points with conical tip made from long elk bones. The article describes technology of their manufacture and use-wear traces. The latter indicate multiple hitting soft medium dirty material with hard intrusions (most probably hunted mammals) and occasional hitting the ground. Such traces are characteristic for projectile points studied by the author. Faunal remains and ethnographic data indicate the use of such massive spears for hunting elks.

Key words: Bone, spear heads, Mesolithic, Central Russia, traceological analysis.

RESUMEN Las excavaciones en yacimientos de turbera del centro de Rusia han sacado a la luz una industria ósea rica y altamente desarrollada que jugó un papel muy importante en las estrategias de subsistencia y en la vida cotidiana de la población mesolítica de la región. El presente artículo, sin embargo, se ocupa solo de uno de los componentes de esta industria de hueso, a saber, las puntas de hueso de enormes lanzas de empuje. Desde el punto de vista morfológico, las puntas de las lanzas de empuje son masivas, con un extremo apical cónico hecho de largos huesos de alce. El artículo describe la tecnología de sus marcas de uso y desgaste. Estas indican que golpearon material blando medio sucio con intrusiones duras (muy probablemente mamíferos cazados) y ocasionalmente golpearon el suelo. Tales trazas son características de las puntas de proyectil estudiadas por el autor. Los restos faunísticos y los datos etnográficos apoyan la sugerencia del uso de estas lanzas masivas para la caza de alces.

Palabras clave: Hueso, puntas de lanza, Mesolítico, Rusia Central, análisis traceológico.

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Fecha de recepción: 17-04-2016. Fecha de aceptación: 21-11-2016.

INTRODUCTION

Before the year 1990, the Mesolithic of the Volga-Oka interfluve was mainly represented by sites on dry land, where organic materials were not preserved. Several archaeological cultures, the most significant of which are known as Butovo and Ienevo, were identified and characterized based on of the flint industry recovered from dry land sites (Koltsov, 1989). Only three Mesolithic sites with bone artifacts were excavated in the region before 1989 (Kraynov & Khotinskiy, 1984; Koltsov & Zhilin, 1999). The situation has changed drastically since 1990, as more than thirty peat bog sites with Mesolithic find layers have been discovered and sixteen of them have been excavated (Zhilin, 2001, 2003, 2006a, b; 2007a, b; Zhilin *et al.*, 2002; Lozovski, 1996; Lozovski *et al.*, 2013). Altogether thirteen of the sites are associated with the Butovo culture, one with Resseta culture, one with Ienevo culture, while the cultural affiliation of one site is still not certain. Sites belonging to the Butovo culture have produced abundant finds, including faunal and floral remains and various artefacts made from stone, bone, antler, wood and other organic materials. Reliable stratification and good preservation of organic materials have enabled an extensive program of pollen analyses and ^{14}C-dating. As a result, we now have a good sequence of reliably dated sites and find layers covering the entire Mesolithic period (fig. 1), from the very beginning of the Holocene up until the early Atlantic period (Zaretskaya *et al.*, 2005; Zhilin, 2001, 2009).

Excavations of these sites have brought to light a rich and highly developed bone industry, which played a very important role in subsistence strategies and everyday life of the Mesolithic population of the region. The main categories of Butovo bone industry include various types of weapons, among them arrowheads, harpoon and spear heads, daggers and hunters' knives. Other tools include fishing hooks, knives for processing flesh, fish and hides; awls; needles and needle cases; various scrapers; axe blades, adze blades and sleeves for their mounting; chisels, gouges and wedges; beaver mandible tools used for carving, whittling and scraping wood and bone; picks; punches and pressure flakers; personal ornaments and figurines of animals and fantastic creatures (Zhilin, 1998, 2001, 2013, 2014, 2015, 2016; Lozovski, 1996; Lozovski *et al.*, 2013).

The present article, however, deals with only one aspect of this bone industry, namely bone heads of massive thrusting spears. Sometimes in publications they are named lances or bear spears. The last term is based on ethnographic data, but faunal remains from Mesolithic sites of Central Russia indicate that bears played no significant role, while elks were main hunted mammals in the Mesolithic and early Neolithic of this area. From morphological point of view heads of thrusting spears are massive points with conical tip made from long elk bones. They are suitable for hafting to a massive shaft about 3 cm or more in diameter (fig. 2), what corresponds to ethnographic bear spears. These artifacts were widespread in the Mesolithic of Eastern Europe and Trans-Urals, most of them are dated to early and middle Mesolithic. They were found in Zveinieki 2 (Zagorska, 1980, 1993; Zagorska & Zagorskis, 1989), lower find levels of Zvidze and Osa (Loze, 1988) in Latvia; Pulli

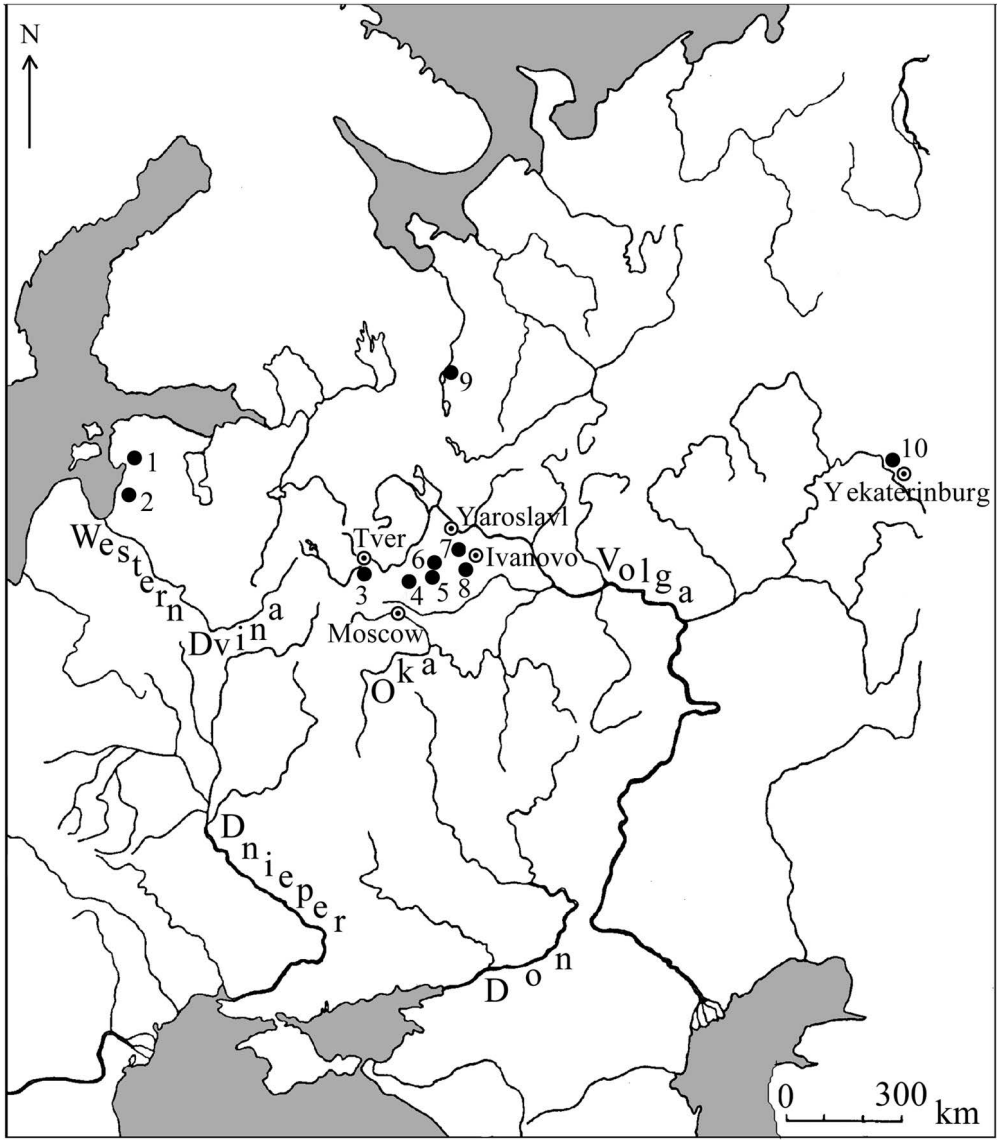


Fig. 1.—Mesolithic sites with bone massive spear heads mentioned in the text: 1, Pulli; 2, Zveinieki 2; 3, Ozerki 5, 16 and 17; 4, Okayomovo 5 and Zamostje 2; 5, Chernetskoye 8; 6, Ivanovskoye 3 and 7; 7, Stanovoye 1 and 4; 8, Sakhtysh 2a and 14; 9, Veretye 1; 10, Shigir peat bog.

(Jaanits L. & Jaanits K., 1975, 1978) and Kunda Lammasmagi (Indreko, 1948) in Estonia; Veretje 1 (Oshibkina, 1989) in the Russian North; Ozerki 5 and 17 (Zhilin, 2006b), Zamostje 2 (Lozovskiy, 1996), Ivanovskoye 3 and 7, Chernetskoye 8, Stanovoye 4, Sakhtysh 2a and 14 (Zhilin, 1993, 2001); in the Volga-Oka interfluve; Shigir peat bog (Savchenko *et al.*, 2015) in the Trans-Urals.

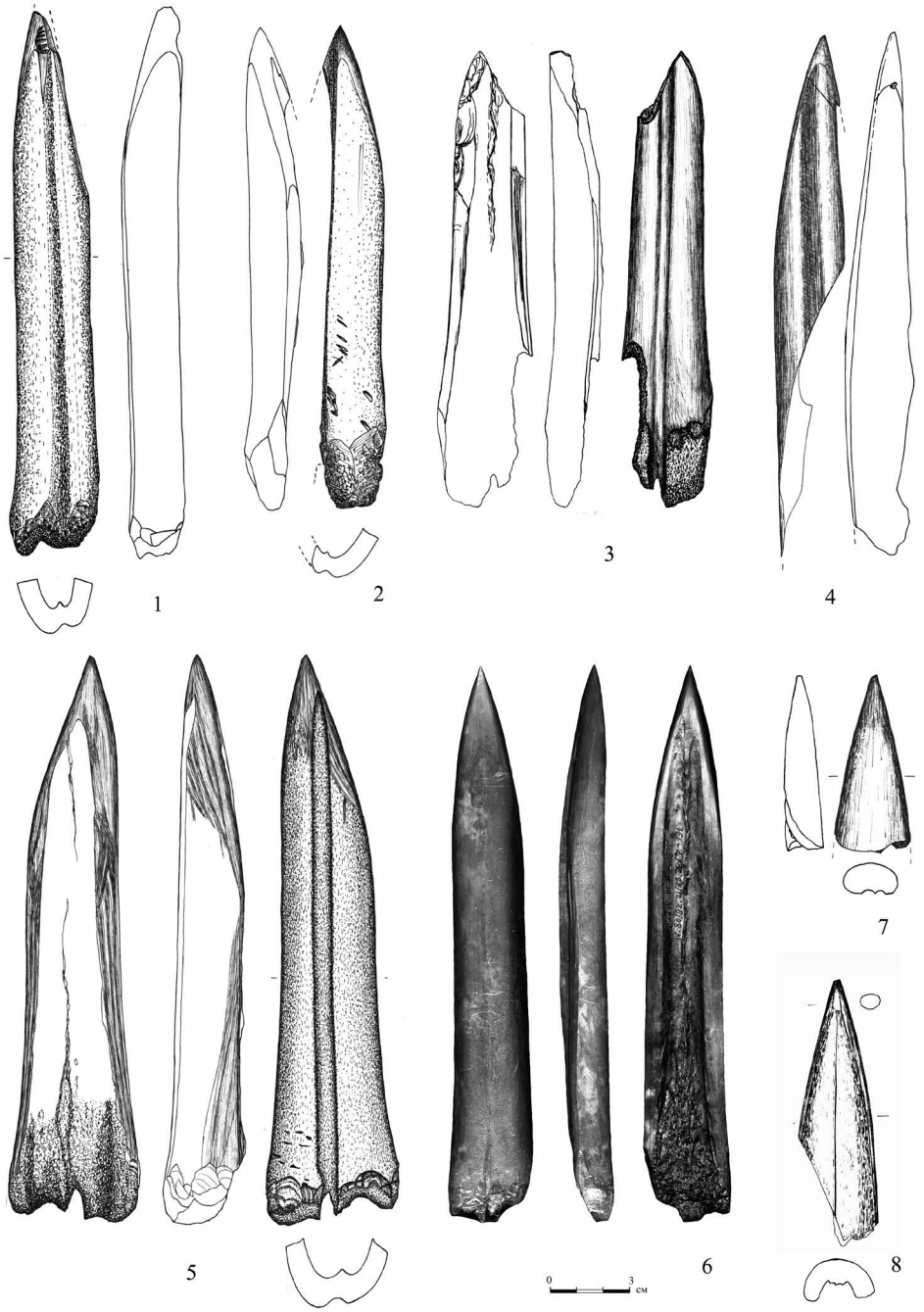


Fig. 2.—Bone massive spear heads from Mesolithic sites of Central Russia: 1, Ivanovskoye 7, find level IIa; 2-3, Ivanovskoye 7, find level IV; 4, 7 and 8, Ozerki 17, find level IV; 5, Stanovoye 4, find level III, trench 2; 6, Sakhtysh 14, find level IV.

MESOLITHIC SITES WITH BONE SPEARHEADS IN WESTERN RUSSIA

Most part of Mesolithic sites in Western Russia with good preservation of bone artifacts are situated at large peat bogs, which developed as a result of the paludification of ancient lakes.

Podozerskoye peat bog (fig. 1:7)

This site is located between the cities of Ivanovo and Yaroslavl. This peat bog emerged when a glacial lake about 5 × 3 km in size was overrun by vegetation, as indicated by the spread of gyttja deposits under the peat. The River Lakhost' connects it with the Upper Volga via the Kotorosl' River. Four Mesolithic sites were discovered in the area of the bog. The site Stanovoe 4 occupies a gentle slope of a promontory at the outlet of the river flowing out from the bog (an ancient gulf of a lake) and a boggy area just below it. An area of about 450 square meters was excavated there under the direction of M.G. Zhilin in 1992-2002. The lower (IV) layer at the site is the earliest known site belonging to the Butovo culture. Pollen data place this layer to the end of the Younger Dryas (Aleshinskaya 2001), and ^{14}C-dates range from 10300±70 BP (GIN-10112 II) to 9690±230 BP (GIN-10112 I). However, the majority of the ^{14}C-dates fall between 10060±120 BP (GIN-10127 I) and 9741±40 BP (KIA-39317). They assign the lower (IV) layer of the site to c 9600–9200 calBC (Zaretskaya *et al.*, 2005; Hartz *et al.*, 2010; all dates in this paper are calibrated using OxCal v. 3.9; Bronk Ramsey, 2003). A typical tanged point, burins, scrapers, inserts and a series of fragments of partly polished axes and adzes were found. Bone and antler artifacts include long narrow arrowheads, most with slots for insets along one or both sides; fragments of massive spearheads, an antler dagger with grooves for insets along both sides; massive antler tine points; broad knives made of elk shoulder blade; awls; bone polisher; beaver mandible tools; antler axe and adze blades and two adze sleeves (one with a fragment of a wooden shaft in a shafthole); an antler pressure flaker; antler wedge; preforms and cut bones.

Layer III in trench 3 at Stanovoye 4 is dated to the second half of the Pre-boreal period by pollen (Aleshinskaya, 2001), and between 9413±50 BP (KIA-35154) and 8799±44 BP (KIA-35158) by radiocarbon, or *c*. 8800–7700 cal BC. Various bone and antler artifacts were found, among them numerous arrowheads: needle shaped; with biconical head or base; with a leaf-shaped head; narrow flat, mostly with slots for inserts along one or both sides; asymmetric two-winged with slots for inserts; with barbs near the tip or along one side. Barbed points are scarce, with sparse or dense fine teeth. Fragments of harpoon heads are also scarce. Slender slotted spearheads and massive spearheads were found. Straight or slightly curved daggers are supplied with microblades, mounted in one or two slots with the help of the gray glue. Fragments and waste from fishing hooks indicate their wide use. Numerous bone and antler tools were used for various domestic activities: knives, scrapers, perforated plates for dragging sinew; awls, needle case, chisels-knives-

scrapers made of beaver mandibles; antler axe and adze blades and sleeves for their mounting, narrow bone chisels, punches and a pressure flaker. One adze sleeve was found with a chert core adze still preserved in the groove at its working edge. Butt end of a broken antler adze was preserved in the groove of the other. A sleeve for an axe had a fragment of a wooden handle in a shafting hole. Many items are decorated with engraved geometric designs. Personal ornaments include various teeth pendants and flat rectangular perforated pendants.

The same layer in trench 2 id dated to the first half of the Boreal period and between 8700±70 BP (GIN-8854) and 8540±60 BP (GIN-8853) (Zaretskaya *et al.,* 2005; Zhilin, 2009; Hartz *et al.,* 2010). Bone and antler tools are numerous and impressive, among them various arrowheads: needle shaped; with biconical head and a long stem; needle shaped with a biconical base; narrow flat, the same with slots along one or both sides; asymmetric two-winged with slots for inserts. Fragments of harpoon heads or barbed points and spearheads were found, accompanied by massive spearheads made of elk tubular bones and daggers with slots for inserts along one or both sides. It is worth noting, that some slotted artifacts had regular unretouched microblades preserved in their original position in slots, fixed by the same dark gray glue as in cut 3. Many bone artifacts were ornamented by engraved geometric designs. Fishing tools include intact hooks and sinkers. Bone and antler domestic activity tools include various knives, scrapers, awls, needle and needle case, chisels-knives-scrapers made of beaver mandibles; antler axes, adzes and sleeves for their mounting, bone chisels and gouges; digging tools; punches and pressure flakers. Personal ornaments are represented by various animal teeth pendants with grooves and flat rectangular perforated pendants, made of split ribs. Another site – Stanovoye 1 is situated at 300 meters from the previous. The lower layer is dated to the second half of the Boreal period. It yielded one fragment of a massive spearhead.

Ivanovskoye peat bog (fig. 1:6)

This site is located about 150 km to the northeast of Moscow, in the midstream of River Nerl', which during the Stone Age ran through a large lake, connecting it with the Klyaz'ma River (the left tributary of the Oka River). Ten sites have been discovered in the bog. Peat bog part of Ivanovskoye 7 has been excavated on two occasions: first by D.A. Kraynov, who excavated 106 square meters in 1974-75 (Kraynov & Khotinskiy, 1984); followed by M.G. Zhilin in 1992–97 with excavations that covered a total area of 332 square meters (Zhilin *et al.*, 2002). The site has three Mesolithic and two Neolithic cultural layers. The Mesolithic settlements occupied a low promontory during lake regressions, which was submerged during transgressions. The lower, Early Mesolithic (IV) layer at Ivanovskoye 7 is dated by radiocarbon between 9650±110 BP (GIN-9520) and 9640±60 BP (GIN-9516), the calibrated range being *c*. 9200–8800 cal BC (Zaretskaya *et al.*, 2005). Pollen dating places it to the first half of Pre-boreal period, before its optimum. About 300 bone and antler artifacts were found. Among arrowheads long needle-shaped are most numerous,

some with a slot for insets; one with a relief belt near the tang is treated in a turning lathe manner near the belt and in the middle of the stem. Other types include long with regular biconical ornamented head; narrow tanged slotted with microblades preserved in slots at both sides, fixed by a dark glue; asymmetric two-winged with a slot for insets opposing the wing, and a small barbed one for shooting pike. Unilateral barbed points with sparse or dense teeth and massive harpoon heads, massive lance heads, fragments of slotted spearhead, intact and slotted daggers were found together with intact fishing hooks and a short double pointed rod, which served as a hook for catching big pike and pike-perch. Of special interest is a spearhead, made of obliquely cut tubular bone of reindeer, richly ornamented with geometric designs over the whole surface. Other tools include hollow end scrapers; side scrapers made of tubular elk bones; wide elk scapula knives and fish scaling knives made of split ribs; awls; needles and a needle case; beaver mandible tools; antler axes, adzes, chisels and gouges; perforated antler sleeves for mounting axe and adze blades; punches and pressure flakers; animal teeth pendants. Several pebble sinkers with traces of plant binding were met, one with concave sides.

During the middle Pre-boreal transgression that took place approximately 9600–9500 BP, the site was submerged and the find level was sealed with a layer of gyttja. (Kraynov & Khotinskiy, 1984; Zhilin, 2001, 2003, 2009; Zhilin *et al*., 2002). The next occupation, which left the middle Mesolithic (III) find level, is dated to the second quarter of the Boreal period by pollen. ^{14}C dates of this layer are: 8780±120 BP (GIN-9383), 8550±100 BP (GIN-9366), 8530±50 BP (GIN-9373 II), 8290±160 (GIN-9372). Bone artifacts include arrowheads – needle-shaped, with biconical head, narrow flat and long with a barb near the point; a short unilateral flat finely barbed point and fragments of two other points – with sparse and dense teeth; fragments of daggers, one with a slot for insets; two waste pieces from fishing hook production; a wide elk scapula knife; a fragment of a hide polisher; awls; beaver mandible tools and a side scraper, made of beaver upper incisor; an antler axe blade; a fragment of an "ice-pick"; a pressure flaker made of bear fang; and a wedge. Ornaments are represented by elk incisor and wolf fang pendants and several flat rectangular perforated pendants made of split ribs. Of special interest is a small bone figurine, representing a merganser head (defined by A. A. Karhu) with a long beak in a very realistic manner. Another figurine is made of wood, the head is broken, it represents, probably, a swimming swan, judging by a long neck and short massive body. Such images of waterfowl are met at Neolithic petroglyphs and pottery. Several pebble sinkers with preserved bog plat binding were found in this layer, accompanied by fragments of pine wood splinters from fish traps.

About 8500 BP this settlement was submerged again. The terminal Mesolithic settlement (find level IIa) emerged at this site during the next regression in early Atlantic period as defined by pollen analysis. Peat with cultural remains is dated by ^{14}C between 7530±150 BP (GIN-9361 I), and 7320±190 BP (GIN-9369 I). Bone and antler artifacts include arrowheads: short and long needle-shaped, one with a short slot, filled with glue with imprint of a microblade; long with a leaf-shaped blade with a barb at one side and a slot with glue on the other; symmetrical two-winged with

a hollow for a flint point at the end and two massive blunt for fur hunting. Several unilateral points with sparse barbs; massive lance head; fragments of flat narrow slotted daggers and a dagger with oblique blade; intact fishing hooks with slender or thick stem were also met in this layer. Other tools include narrow knives made of split ribs and various knives of bone splinters; rib side scrapers; awls; beaver mandible tools; "ice-picks"; a chisel; antler adzes and fragments of axes; wedges; fragments of a punch and a pressure flaker; an antler spoon; pendants made of elk and beaver incisors. Of special interest is a sculpture of a fantastic creature (Zhilin, 2010).

The site of Ivanovskoye 3 is situated on a small island 2 km to the southeast of Ivanovskoye 7. A Late Mesolithic and several Neolithic find levels were excavated there in an excavation trench of about 160 square meters (Kraynov & Khotinskiy, 1984). Fragments of two massive spearheads were found in the Mesolithic find level of this site.

Berendeyevo peat bog (fig. 1:5)

This site is located 120 km to the northeast of Moscow and 30 km to the south of the peat bog of Ivanovskoye. The River Trubezh starts from its northern part and connects it with the Upper Volga, while River Kirzhach starts from its southern part and connects it with the Oka River via the Klyaz'ma River. Eighteen Mesolithic and Neolithic sites have been discovered in the bog. Chernetskoye 8, situated at its southern shore is dated to the middle Mesolithic. It produced flint and bone artifacts typical for Butovo culture among them a fragment of a massive bone spearhead (Zhilin, 2001).

Sakhtysh peat bog (fig. 1:8)

This site is located 40 km to the southwest of the city of Ivanovo at the source of River Koyka, which connects it with the Klyaz'ma River, which in turn is the left tributary of the Oka River. Several Mesolithic sites have been excavated at this bog. The site of Sakhtysh 14 occupies a place in a peat bog at the foot of a very gentle slope of a promontory, which is part of a terrace formed by a late glacial lake. During the early Mesolithic the settlement was placed at a lake beech near the outlet of the river, and later at a peat shore of a swamping lake. Four find levels reflecting successive stages of Butovo culture were excavated here in 1999-2006 at a square about 300 square meters. Radiocarbon dates of worked wood from the lower (IV) find level are between 9550±60 BP (GIN-11616) and 9320±40 BP (GIN-11619). Elk bones are dated to 9350±40 BP, GIN-11179 and 9200±90 BP, GIN-11181. Samples of gyttja with finds were ^{14}C dated between 9550±40 BP (GIN-11609) and 9250±210 BP (GIN-11177). Bone artifacts include needle shaped arrowheads; massive spearheads; a fishing hook, a knife made of tubular bone; chisel-knife made of beaver mandible, fragments of shallow spoons, longitudinally cut elk tubular

bones; fragments of broad elk scapula knives; a fragment of a side scraper made of tubular bone; awls; hollow edge gouges; bear fang pendant, fragments of tools and preforms.This layer was submerged during the lake transgression.

The III find level, separated from the former by a streak of gyttja produced the following ^{14}C datings; 9010±60 BP, GIN-11053 (worked wood); 8800±100 BP, GIN-11180 (elk bone). ^{14}C dates of gyttja, incorporating finds of the III layer are: 9280±50 BP, GIN-11607 II; 9150±50 BP, GIN-11607 I. Pollen data place this layer into the first half of the Boreal period. Bone and antler artifacts are represented by a short massive needle shaped arrowhead with glue preserved on its basal part; fragment of a flat intact dagger; fragments of a slotted daggers; broad knives made of elk shoulder blades; fragment of a knife made of elk tubular bone; denticulate endscraper; beaver mandible tools; antler adze; hollow edge gouge; bone chisel; fragments of shallow spoons, one ornamented; antler punch; elk teeth pendants and a flat rectangular perforated pendant.

For about 500 years the place was covered by swamp. The II find level is embedded in peaty forest soil which produced ^{14}C dates: 8240±40 BP, GIN-11602; 8310±60 BP, GIN-11050; 7990±50 BP, Gin-11601 (upper part of the layer almost without finds). This layer is placed into the second half of the Boreal period by pollen analysis. Bone and antler tools include neddle-shaped slotted arrowhead with gray glue preserved in the slot; massive needle shaped spearhead; side scraper made of elk rib; broad elk scapula knives and a knife made of split tubular bone; chisels-knives-scrapers made of beaver mandibles; pendants made of a brown bear and a small predator fangs and a flat oval pendant with 10 perforations along perimeter. The rise of water level resulted in overlapping of this soil by a swamp peat. The last Mesolithic cultural layer (Ib) is also embedded in similar soil, which was formed under rather arid conditions. It is dated by ^{14}C slightly younger than 7220 BP. The lake shoreline at that time retreated, indicating rather deep regression (Zaretskaya *et al.*, 2005; Zhilin, 2003, 2009). The site Sakhtysh 2a lies at a distance about 2 km to the south from Sakhtysh 14 and is situated at a bank of a small peat bog through which River Koyka flows. The peat bog part of the site was excavated in 1999 by M.G. Zhilin and in 2004 and 2015 by E.L. Kostyleva. About 40 square meters were excavated. The site produced several Neolihic and two Mesolihic find levels, the lower of which yielded a fragment of a massive bone spearhead (Averin *et al.*, 2009).

Ozerki peat bog (fig. 1:3)

This site is situated at 20 km to the south from Tver. About 20 sites were discovered in the western part of this peat bog, three of them contain Mesolithic layers with good preservation of organic materials (Zhilin, 1999, 2001, 2006a,b). The site Ozerki 17 was situated at the outlet of a small river, starting from a lake. The lower (IV) cultural layer of the site belongs to the middle stage of Butovo culture and is dated by ^{14}C to 8830±40 BP (GIN-6655 - pine fish trap fragments) and 8840±50 BP (GIN-7474 - birch stake) and to the first half of the Boreal period

by pollen. 67 square meters were excavated there. Finds include flint tanged points and bone arrowheads: needle-shaped, with biconical head, asymmetrical one-winged and one blunt-headed for fur hunting; fragments of massive spearheads, elk scapula knives, awls, antler scraper, "ice-pick", elk and beaver incisors pendants and a small perforated disk. Of special interest is an intact fishing hook with remains of a line, attached to its head by a knot. The line is a twisted cord 1mm in diameter, made of some plant fibre. A small fragment of a fishing net, made of similar line with a cell 2 × 2 cm was found, accompanied by a half of an elongated rhomboidal pine bark float, perforated in the middle. A series of net sinkers include large pebbles, bound in the middle with a strip of lime bark or some bog grass (Zhilin, 2006 a, b; 2007 a, b). The site Ozerki 16 was situated at 150 m from the previous one, the lower (II) cultural layer is dated by ^{14}C to 8770±40 BP (GIN-6654 - pine fish trap fragments) and to the first half of the Boreal period by pollen. Finds include a pine bark perforated float, pebble sinkers, one with hollows at sides and lime bark binding preserved, a fragment of a massive spearhead, and two long bone arrowheads with biconical head. The site Ozerki 5 was situated in 50 m from Ozerki 17, on the opposite side of the ancient river, at its outlet from the lake. About 220 square metres were excavated there. The lower (IV) cultural layer of the site belongs to the terminal stage of Butovo culture and has the following ^{14}C dates: 7410±90 (GIN-6659 -charcoal); 7310±120 (GIN-7218 - worked log); 7190±180 (GIN-6660 - charcoal); 7120±50 (GIN-7217 - worked log) and is dated to the beginning of the Atlantic period by pollen. Collection includes more than a thousand of lithic and about two thousands of bone and antler artefacts, fragments of wooden tools, rope and cord fragments, worked birch bark. All groups and most types of late Mesolithic bone and antler artefacts are met at this site. Arrowheads include needle-shaped, short with irregular biconical head, with wide flat head, asymmetric one-winged, blunt massive and others; barbed points and harpoons; daggers, intact fishing hooks; various knives, scrapers, awls, chisels, antler axes and adzes, chisels-knives-scrapers made of beaver mandibles, antler punches, pressure flakers, numerous pendants made of mammals teeth and others (Zhilin, 2006 a, b; 2007 a, b).

Dubna peat bog (fig. 1:4)

This site is situated about 100 km to the north from Moscow in the middle flow of the river Dubna, the right tributary of the Upper Volga. About 40 sites were discovered there, 15 of them have Mesolithic layers with good preservation of organic materials (Zhilin, 1993, 1999, 2001; Lozovskiy, 1996; Lozovski *et al.*, 2013, 2014). Okayomovo 5 is situated at a small islet near old river bed. 52 square meters were excavated there. Its lower (III) find level containing artefacts of the late stage of Butovo culture is dated by ^{14}C to 7910±80 BP (GIN-6191 - gyttja from lower part of find level) and 7730±60 BP (GIN-6192 - gyttja from upper part of find level) and to late Boreal period by pollen. Collection includes about 140 bone and antler artefacts, among them arrowheads: short needle-shaped, with an irregular biconical

head, symmetric two-winged with barbs and asymmetric one and two-winged (some of the latter with grooves for flint insets) and others; barbed points; massive intact and flat composite daggers with slots for flint insets; a series of intact and composite fishing hooks; broad elk scapula knives and narrow fish scaling knives made of split ribs; rib side scrapers; awls; fragments of antler axes and adzes; a series of beaver mandible tools; "ice-picks", antler punch and a number of elk and beaver incisors pendants. Wooden artefacts are represented by various fragments, among them a paddle blade is of special interest. It is long, rather wide near the shaft and very gently narrowing towards the tip, with 3 longitudinal ribs in the centre of the blade and along its sides in the wider part. Such paddle is perfectly suited for moving in a dugout in boggy surroundings and exhibits a lot of skill of Mesolithic fishers (Zhilin, 2004; 2006 a, b; 2007 a, b). The site Zamostje 2 is situated about 15 km upstream from Okayomovo 5. It was excavated by V.M. Lozovski and O.M. Lozovskaya from 1989 to 1996 and from 2010 to 2014. The site has two late Mesolithic layers, the lower is dated between 7900 and 7600 BP, the upper – between 7380 and 7050 BP. The question about the third layer attributed to the final Mesolithic is open, because the same dates between 7000 and 6850 BP were obtained on samples of wood from the find level without ceramics, and on food crust on early Neolithic pottery. This site yielded abundant finds including lithic, bone antler and wooden artefacts, among them an impressive series of massive spearheads (Lozovski *et al.*, 2013, 2014).

Pollen data, floral and faunal remains as well as artefactual evidence indicate that Mesolithic inhabitants of Central Russia were hunters, fishers and gatherers of temperate forest zone of Eastern Europe, and hunting large mammals accompanied by fishing and fowling played the main role in their economy (Zhilin, 2004, 2014).

RESEARCH METHODS

All of the bone artifacts from Mesolithic sites mentioned above (except Zamostje 2) including fragments, preforms and blanks were studied by the author with a help of a stereomicroscope (MBS-10, with a magnification range from 3.6x to 119x). Most traces from manufacture and use were clearly visible under magnifications from 6x to 40x. Stronger magnifications were useful for investigating details of use-wear traces, for example, very fine linear traces embedded inside broader ones, or for studies of the surface inside linear traces. A DCM 800 camera-ocular was used for taking photos through the microscope.

A series of experiments based on traceological observations was also carried out together with S.N. Savchenko during 2003-2015. The aim of these experiments was to study technological process of spearhead and arrowhead production, use of projectile heads and research of technological and use-wear traces. Long bones of an elk taken in a previous year and fresh elk long bones served as raw material. Replicas of flint archaeological tools from Mesolithic sites of Central Russia and Urals were made by M.G. Zhilin and used in these experiments. The process and results were carefully documented (Savchenko, 2010; Zhilin, 2006 c).

Broad scars with flat very even surface, as if inflicted by iron knives were observed upon many Mesolithic projectile heads coming from reliably dated find levels of stratified peat bog sites of Eastern Europe and Urals. This indicates that bone was substantially softened before being worked. It is much easier to work softened bone by scraping, grooving, carving, whittling, sawing or drilling with stone tools. Based on archaeological and ethnographic data, researchers have suggested that the bone was softened by soaking (Zhilin, 2001; Savchenko, 2010), soaking and heating (Gurina, 1956; Semenov, 1965), and/or chemical treatment (Malinova & Malina, 1988). The best results were achieved by soaking the bone in water mixed with ash for two months. Following that, preforms made from cattle long bones could be easily worked by whittling with an iron knife, as if one was whittling wood (Serikov & Tupikov, 2015). Our experiments were conducted in summer 2015 and involved soaking long elk bones for one month in water mixed with ash from a campfire. The experiment demonstrated that it was much easier to process bone with flint tools after such treatment. Longitudinal grooves for splitting a long bone into halves were cut at a depth of 2/3 to ¾ of the thickness of bone with a flint burin fixed in a wooden handle several times quicker than working fresh or dry bone. Whittling of softened elk bone with a burin made on broken flint blade fixed in a wooden handle when the side of a burin scar was used as a working edge of a whittling knife produced very regular, wide long flat scars as if the bone was worked with a steel knife. Similar traces of whittling, observed on some preforms and finished massive spearheads from described sites suggest that similar treatment of bone could also have been used at Mesolithic sites in Eastern Europe and Urals.

Our experiments showed that a broken blade in a wooden handle is perfectly suitable for grooving elk long bones. Short and narrow burin scars often appear as a result of wearing out during the work, and not intentional treatment of a burin. After about half an hour of grooving, the working edge of a broken blade becomes dull, and more effort is needed to continue work. This typically results in removing a very narrow burin spall from the working edge and formation of a burin scar. When this happens, the burin works much better, but the shape of the cross-section of the groove changes from V-shaped into trapezoidal. It usually took about 2 hours to make a groove along one side of dry elk long bone suitable for splitting it successfully, while such groove was produced on softened bone in about 40 minutes. When grooves were finished, the long bone was split into two halves with the help of a stone, bone or antler wedge. Such wedges are also a common find at Mesolithic sites of Western Russia. Their working edge is smashed, small steep or semi steep facets overlapping each other are observed at the working edge, and scarce short striations running from the working edge along the tool axis are sometimes also observed. The butt end of wedges is also smashed when a hard hammer was used, or only slightly rounded if the wedge was used with a wooden hammer. We used in our experiments a wedge made from a splinter of elk long bone similar in size and shape to wedges from Mesolithic sites of the Volga-Oka interfluve. When grooves were deep enough (3/4 of thickness of bone or deeper) a long bone was easily split into halves, but if grooves were 2/3 of thickness of bone or less the bone could break

during splitting. Fragments of such long bones with shallow grooves transversally or obliquely broken during splitting are a common find at sites mentioned above.

Scraping and whittling of softened bone in our experiments were several times more effective than working fresh or dry bone. But grinding bone softened in this manner produced poor results because of sliding of wet bone over a grindstone. Dry bone was much better for grinding. The same was observed during working elk bone by direct percussion with a hammerstone. Softened bone was more elastic and resistible to blows, while dry elk bone could be chipped like slate or similar stone. Direct percussion comparable with scraping, cutting, whittling etc. was much quicker, but any wrong blow could result in breakage of a preform. In our experiments sometimes I hit one end of a preform with a hammerstone, but it was broken in the middle or at the other end. It is not surprising that preforms broken during treatment by direct percussion make series among waste products in find levels of Mesolithic sites of the studied area (Zhilin, 1998b). These experiments made possible to understand technology of the manufacture of Mesolithic projectile heads.

A number of controlled experiments were carried out to replicate use-wear traces on bone projectile heads and to understand their formation. Some of them which produced most similar traces could be briefly described here, though their detailed description with high quality photos and microphotos are far beyond limits of this article. In 2013 a special target was built of bricks of peat cut from modern surface of a peat bog near the bog shore in the shape and size of a semi-adult wild boar. It contained besides peat various roots, sand, some small atones etc., and was covered with a fresh skin of a wild boar. Projectiles with conical tips similar to tips of described spearheads were launched from a distance of 30 steps (about 25 meters), and pierced through boar skin and through peat inside it, coming from the other side of the target. After several hits bone points were studied with a help of a stereomicroscope. Use-wear traces included smashing, chipping, and rounding of the tip of the point, initial bright polishing and linear traces of two types. Narrow short shallow striations running from the tip along the tool axis or at acute angle to it (first type) were accompanied by scarce wider short grooves running from the tip in the same direction (second type). More experiments should be carried out, including ones with real beasts, but it is possible to notice that these traces correspond with ones observed on studied Mesolithic spear heads. Data from experiments aimed at production and use of various bone and antler spearheads in Late Palaeolithic and Mesolithic of Northern and Western Europe (David, 1999; Pétillon and Langlaix 2011; Pétillon *et al.,* 2011) were also helpful for our study.

TECHNOLOGY OF THE MANUFACTURE OF MASSIVE SPEAR HEADS

Traces of various operations preceding the final treatment and overlapping each other were discovered at several places in many of the artifacts. Such ‘technological stratigraphy’ accompanied by the presence of blanks, preforms, reshaped tools and refuse in the find material made it possible to establish the sequence of operations

(chaîne opératoire) and to reconstruct different stages of production of massive thrusting spear heads with a sufficient degree of certainty. First, elk long bones were soaked in water for softening, as indicated by a cache of three long bones of an elk buried in a pit, encountered in the lowest layer of the Ivanovskoye 7 site (find level IV). It had been dug below the ancient water level, and the bones placed there were resting in sand and water. One of the bones featured shallow longitudinal straight lines along both sides, made with a sharp burin in places where grooves would later be made (Zhilin *et al.*, 2002).

When the bones had softened, shallow transverse grooves running across the perimeter of the bone were made near one or both of the epiphyses, which were broken off along this groove. Such a groove was usually made with the help of a chisel or an adze with an unpolished cutting edge, which left characteristic pit-like traces on the bone surface. Such adze still in its original position in an elk antler sleeve was found at Stanovoye 4 (layer III, trench 3) (Zhilin, 2006a, 2007a, 2009). A series of 13 removed epiphyses with similar traces and breakage scars was found at Ivanovskoye 7 (find level IV). In some cases the long bones were cut into halves with preserved epiphyses, as indicated by such halves from bottom find levels of Ivanovskoye 7 and Sakhtysh 14. The next step was to split the bone into halves. Two longitudinal grooves were cut at opposite sides of a bone to a depth of 2/3 to 5/6 of the thickness of a wall of the bone. Long parallel traces left by a burin can be seen along the sides of the groove. Such traces are usually visible on lateral sides of the finished spear heads (fig. 3: 1-2), indicating the use of this technology of blank production. Fragments of broken flint blades served as burins, with a very sharp working edge for cutting slots that feature a V-shaped cross-section. Trapezoid-like cross-section of grooves on some broken blanks indicates that the cutting edge of the burin was formed by a very narrow burin scar. With the help of a wedge a long bone was split into two halves.

Then, the halves were turned into preforms. Epiphysis on one end where the point should be was totally removed, while on the butt end where bevel should be it was flattened with the help of a stone adze or chisel (fig. 2; 3; 11; 13). E. David described experiments where epiphyses of long bones were shaped with a flint flake which served as a chisel (David, 1999). Scars at butt ends of our spearheads suggest using similar tools for this operation. It is worth noting that facets from flattening of epiphyses remove traces of grooving, indicating that epiphyses were shaped after initial bone was split into halves. There is almost no evidence about the initial treatment of the point, because its traces were later totally removed by secondary treatment, but one unfinished massive spearhead from the bottom find layer of Ivanovskoye 7 (fig. 2: 3) suggests that it was most probably done by direct percussion with a hammerstone. Such technology is well known in the Mesolithic of Western Russia (Zhilin, 1998b, 2001, 2015) and other territories. The secondary treatment of a preform began with sharpening the point of what would eventually become a spearhead with longitudinal whittling or rarely scraping. Normally massive spear heads show both the long linear traces left by a burin on their sides, which are preserved on the surface of the grooves, as well as the long flat longitudinal

Fig. 3.—Stanovoye 4, find level III, trench 2: 1, a massive spear head; 2, traces of grooving; 3, traces of whittling removing traces of grooving; 4, traces of whittling.

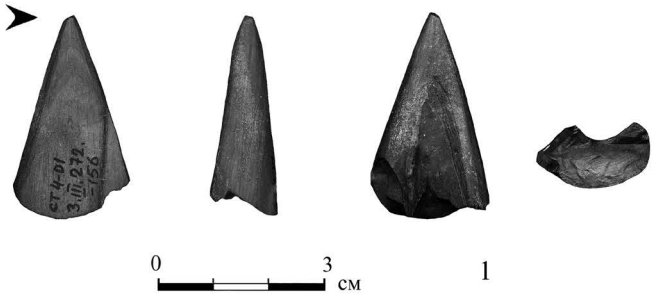
facets with typical longitudinal linear traces left by a whittling knife. Whittling traces remove traces of grooving indicating the operation sequence (fig. 3: 3). Some massive spear heads show traces of grinding with a fine abrasive slab above whittling traces, and some display traces of bright polishing with a hide or plant material. Under magnification of 20x or higher very fine striations following the direction of the polish are observed inside the polished area. Such polish covers not only convex or plain areas of the tool surface, but also concave areas of the inner part of the bone. This indicates the use of some soft abrasive instrument similar to modern glass-paper used in woodworking. Probably, the inner surface of a fresh hide was intentionally covered with very fine sand or silt powder. After drying these mineral particles were firmly attached to the hide and Mesolithic "glass-paper" was ready for work. At the same time tiny mineral particles are usually present in the air and can stick to the fresh hide without any human effort. This also gives an effect of a very fine "glass-paper" and leaves described traces on the surface of polished bone tools. It is worth noting that the bevels of the spear heads were not polished.

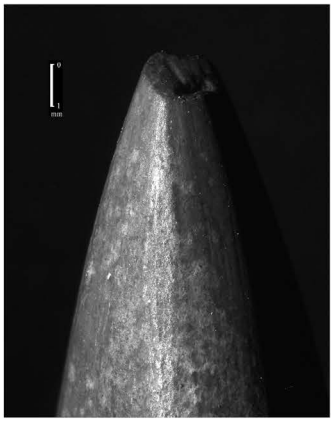
The following operation sequence (chaîne opératoire) in the manufacture of massive bone spear heads in the Mesolithic of Central Russia was established: softening a long elk bone by soaking (probably in water mixed with ash) → obtaining a blank by cutting grooves along opposite sides and splitting bone along these grooves → removing and leveling epiphyses → shaping the preform by percussion, coarse scraping or whittling → fine longitudinal whittling or scraping of the point → fine abrasive grinding → bright smooth polishing. This operation sequence was not always carried out in full, as a number of studied artifacts had been used but did not feature grinding and/or polishing. On the other hand sometimes epiphyses were removed before cutting grooves.

One technological detail of shaping the very tip of described spearheads is of special interest. The tip of several points was intentionally obliquely truncated with a fine abrasive slab at an angle of about 45°-60° to the tool axis (fig. 2: 7-8; 4; 12; 14). As a result an oval-shaped oblique flat surface about 1-2 × 0,5-1 mm emerged. Use-wear traces indicate that artifacts shaped in this manner were used as spearheads before as well as after such treatment. Most probably this specific detail is a result of reshaping of the tip of a spearhead which was smashed when hit some hard material. This is confirmed by traces of such breakage not totally removed on the tip of one spearhead (fig. 4). This was the simplest and quickest way to repair the point of a spearhead and to prevent it from further breakage. Such treatment is observed on several massive spearheads from bottom find levels of Ozerki 17, Ivanovskoye 7, find levels III and IV of Stanovoye 4 in the Volga-Oka interfluve, and also from Veretye 1 in the Russian North (Oshibkina, 1989), and Shigir peat bog in the Trans-Urals (Savchenko *et al.*, 2015).

USE-WEAR TRACES ON BONE MASSIVE SPEAR HEADS

Massive bone spear heads from Mesolithic sites of Central Russia, including fragments with a preserved point, displayed more or less pronounced signs of use-





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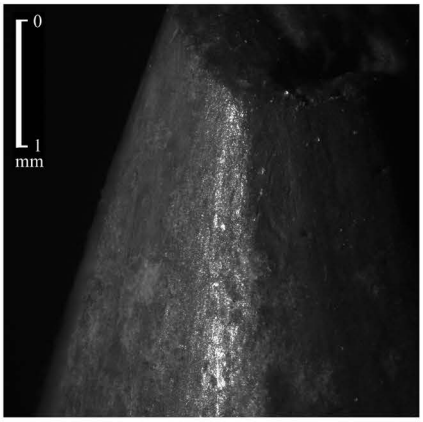

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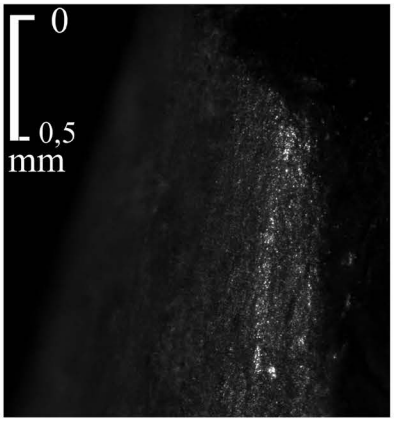

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Fig. 4.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 2-5, traces of reshaping of the point and use-wear.

wear under the microscope. In the majority of the artifacts this included rounding, smashing or chipping of the tip; sometimes small or larger flat or semi-flat facets, running from the tip along one or two (and sometimes several) sides of the point; 'hide' polishing, beginning from the tip and gradually disappearing; fine striations and coarse grooves, running from the tip along the axis of the arrowhead and/or at an acute angle to it. Similar traces were also observed on the points of bone arrowheads from these sites and on points of our experimental arrowheads (Zhilin, 2015). Usually use-wear is not well pronounced on massive spear heads (figs. 4-6), indicating a rather short period of use, but some of them display very good use-wear patterns which deserve a separate description.

Well preserved intact massive spearhead comes from find level III of trench 2 at Stanovoye 4 (fig. 3; 7). Its point was very carefully sharpened by longitudinal whittling and after it carefully polished. The tip of the point is strongly smoothed and rounded, bright polish is observed at the point but gradually becomes more dull. Inside this polished area two types of linear traces are observed: fine short narrow sharp scratches and rather coarse grooves with uneven surface (fig. 7: 2-5). It is worth noting that the starting point of such grooves facing the tip of the point is deeper and larger than its rear end facing the butt end of the spearhead, which gives it the comet-like appearance (fig. 7: 4-5). Such grooves are similar to traces on digging sticks used for digging sandy soils or soft boggy soils with admixture of sand. When combined on one pointed tool they indicate piercing some soft medium dirty material (hunted mammals) and also thrusting into the ground.

Three fragments of points and a fragment of a middle part of a massive spear head come from the same trench. All of them display typical breakage scars which originate on one face of a spearhead and obliquely terminate at the other face, indicating strong force transversally applied to the tool. Scars at the fragment of a medium part are running towards each other, one in the direction of the point, and the other – in the direction of the butt end. This also indicates transversal breakage of this massive spearhead made from a thick elk long bone under a very strong impact. Described breakage patterns are typical for these massive thrusting spear heads and sometimes they are also met at projectile heads.

Well developed use-wear traces were observed on some fragments of massive bone spearheads from the find level III in the trench 3 at Stanovoye 4. The tip of one of them displays micro chipping, rounding, and smoothing of the tip, pronounced bright polishing with multiple fine and coarse striations running from the tip parallel to the tool axis and at acute angles to it sometimes crossing each other and edges of chipping facets (fig. 8). The tip of the other became flat with rounded edges (fig. 9). Polishing is well pronounced, and various multiple striations and grooves run at various angles from the tip, mainly sub-parallel to the tool axis and at acute angles to it. Besides use-wear traces, post-depositional deformations are also clearly observed on the surface of this artifact. The tip of the third one became concave with rounded edges resembling to some extent an old volcanic crater (fig. 10). Traces of sharpening the point by longitudinal scraping and smoothing the surface by grinding with fine abrasive slab are clearly seen (fig. 10: 2, 4). Bright polishing

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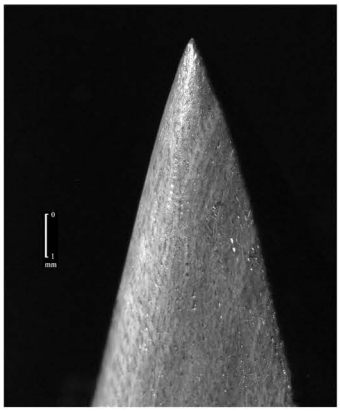

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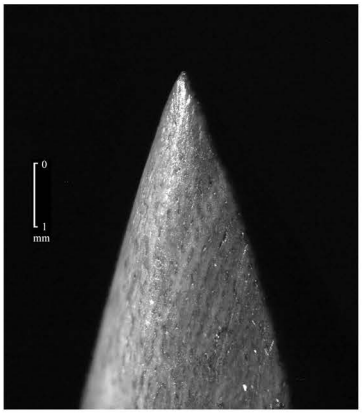

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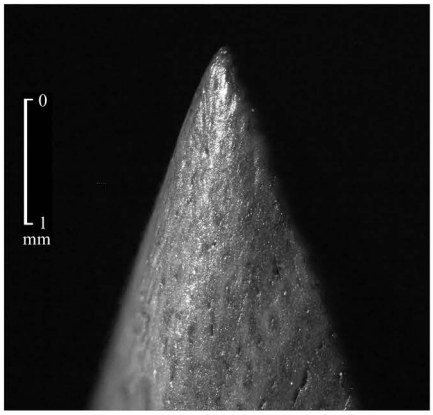

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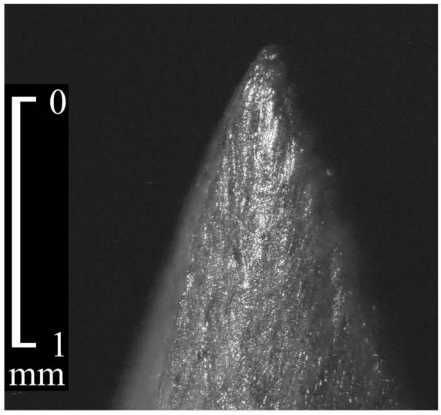

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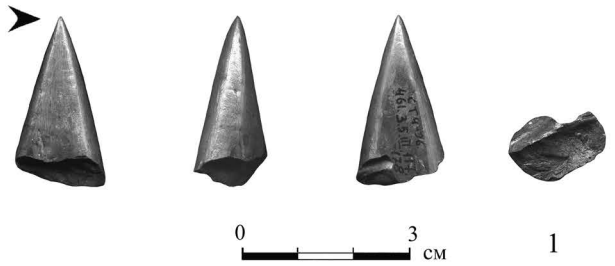
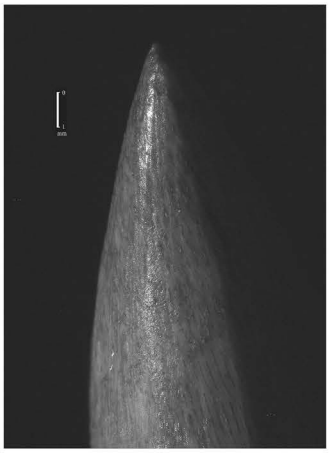
Fig. 5.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 2-5, use-wear traces.





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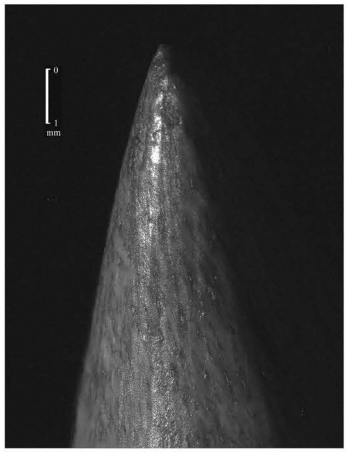

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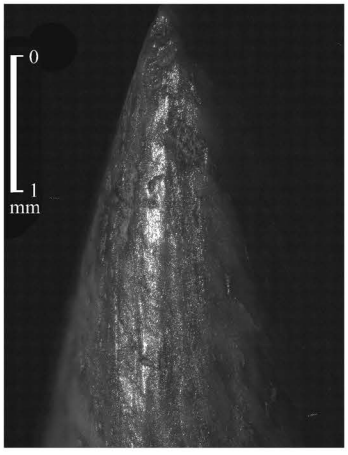

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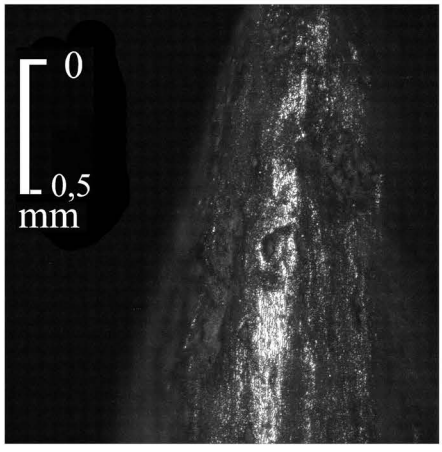

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Fig. 6.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 2-5, use-wear traces.

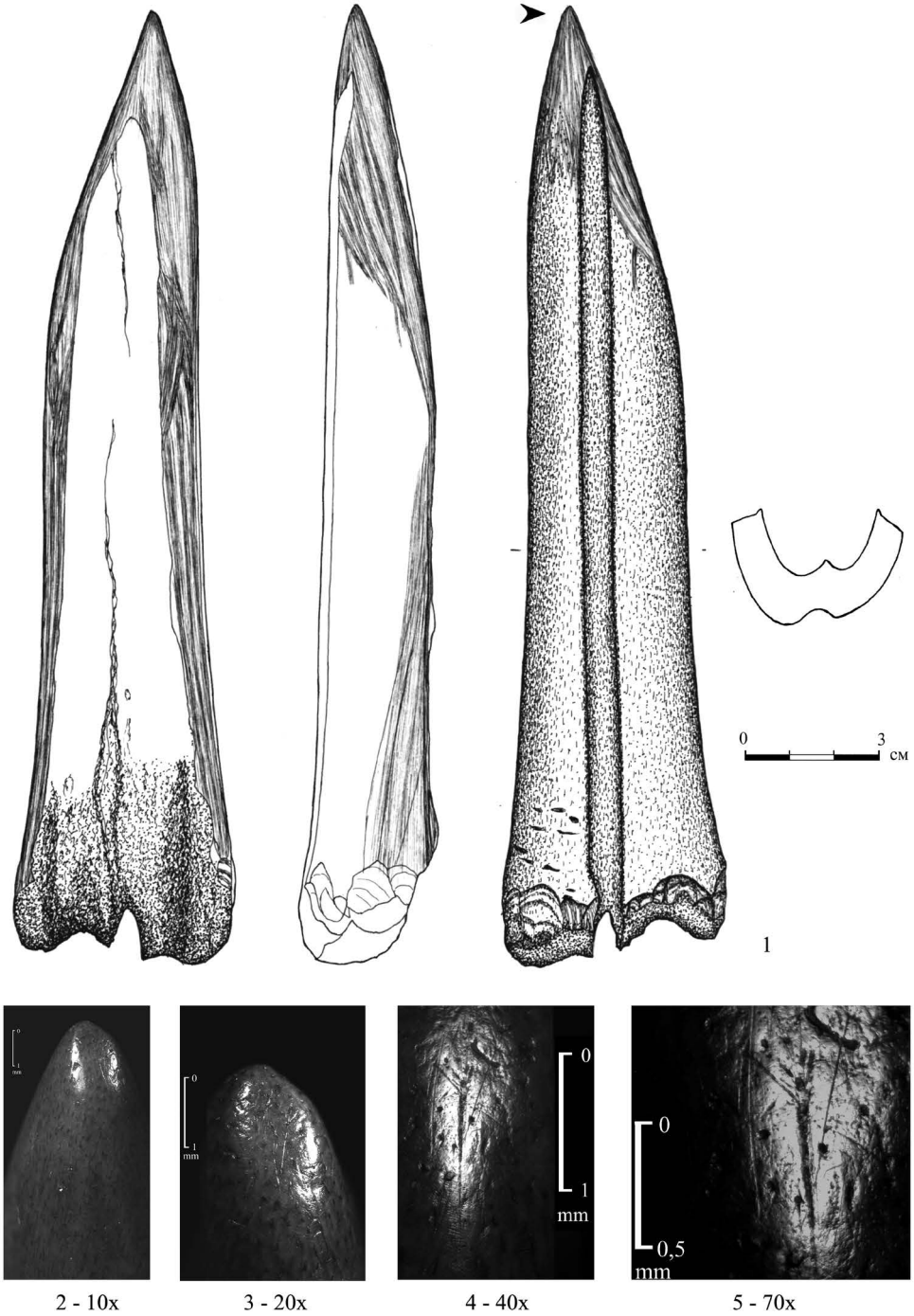


Fig. 7.—Stanovoye 4, find level III, trench 3: 1, a massive spear head; 2-5, use-wear traces.

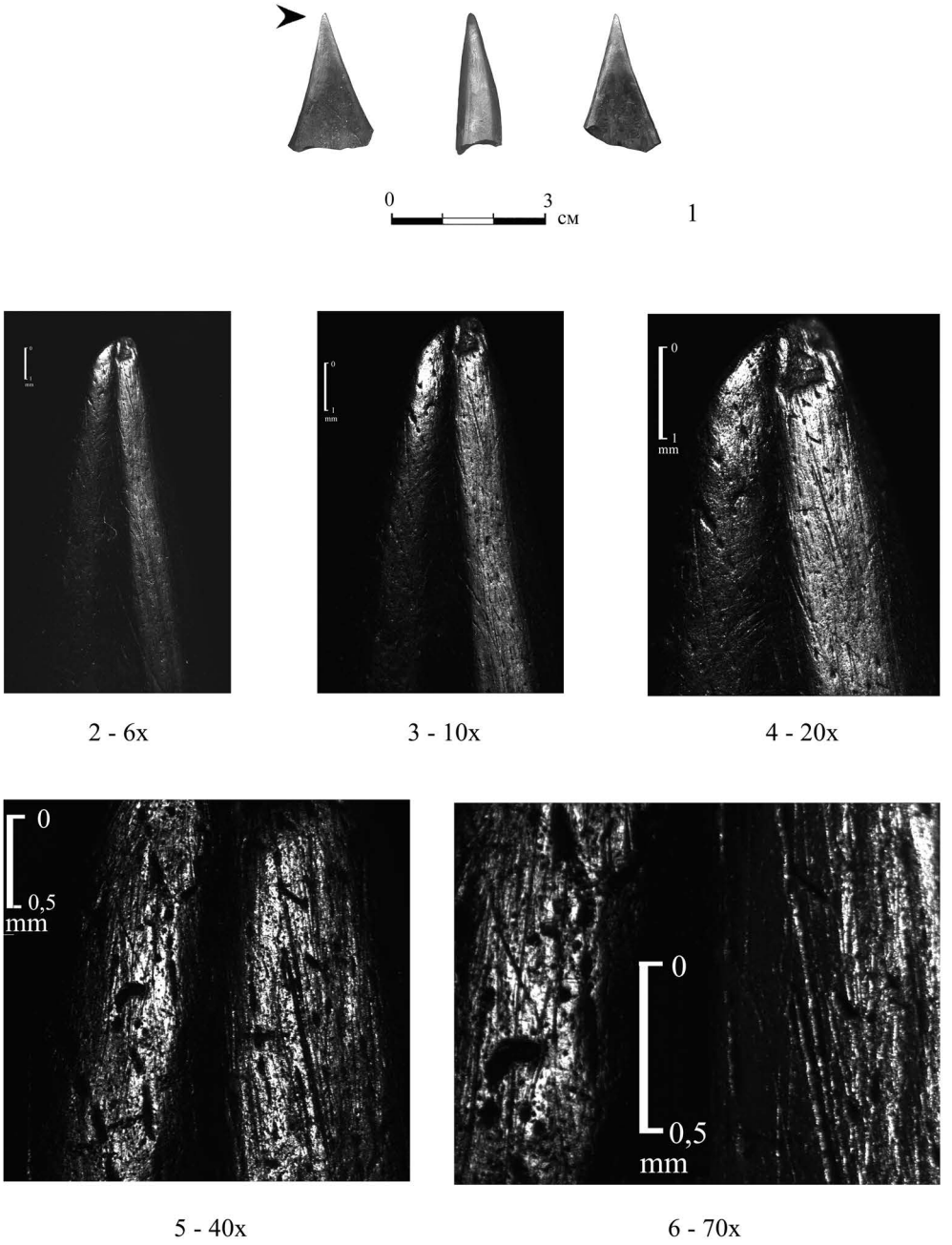


Fig. 8.—Stanovoye 4, find level III, trench 2: 1, a point of a massive spear head; 2-6, use-wear traces.

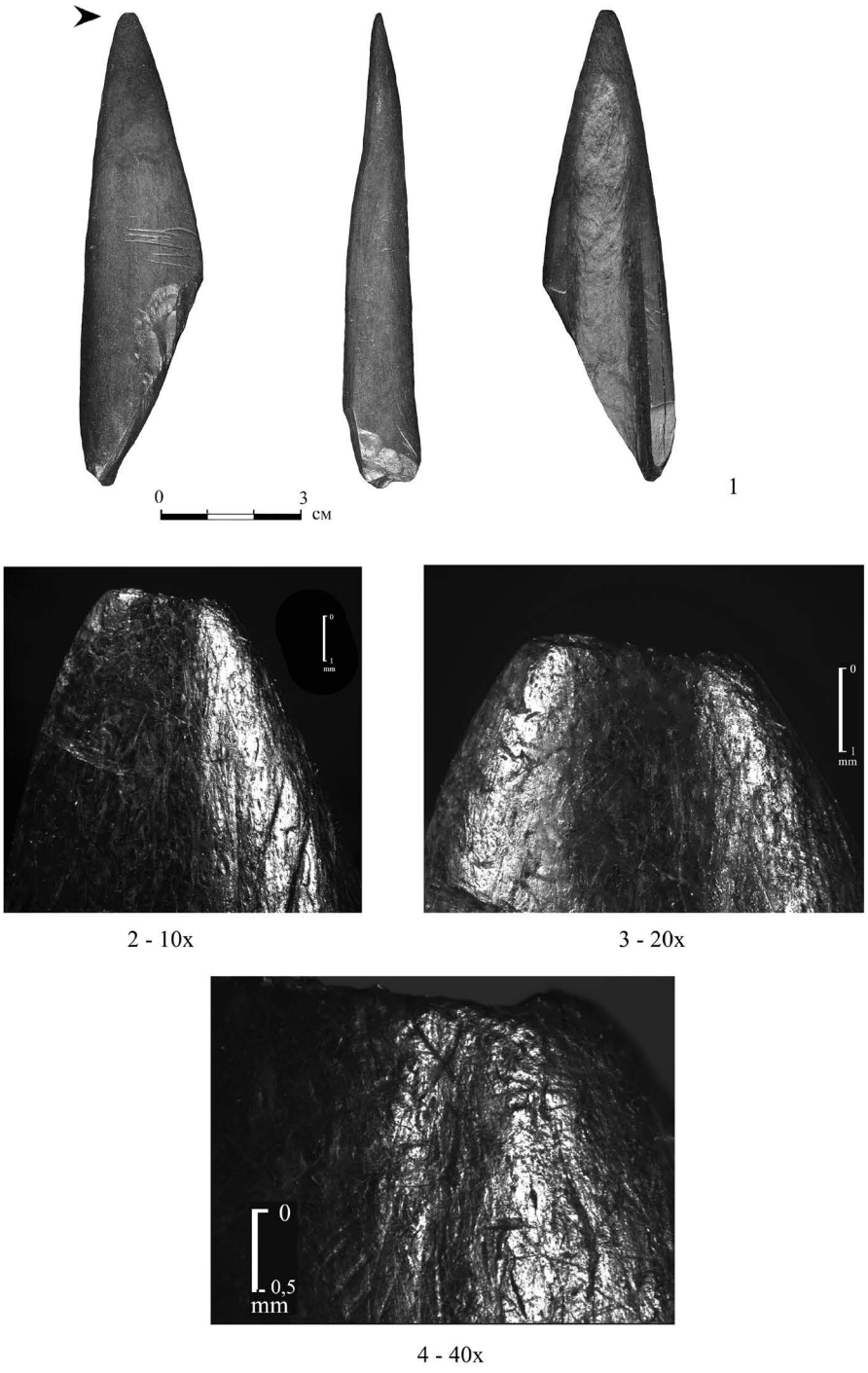


Fig. 9.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 2-4, use-wear traces.

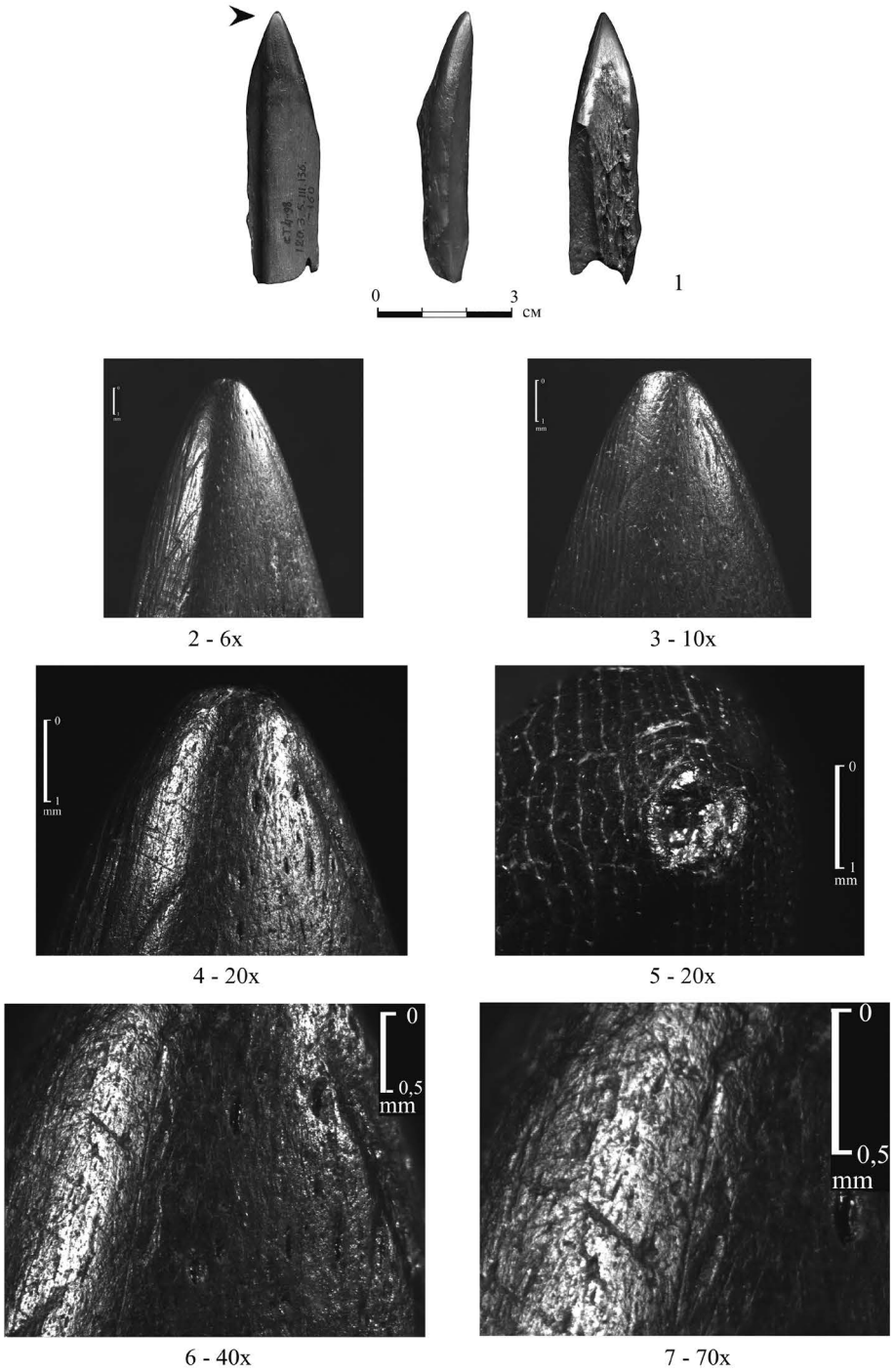


Fig. 10.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 2-7, use-wear traces.

and various striations and grooves are very similar to traces observed at the intact massive spearhead from the trench 2 of Stanovoye 4, described above. Such traces indicate long use of these spearheads and multiple hitting of hunted prey with accidental hitting the ground.

An intact massive spearhead was found in the find level III of trench 3 at Stanovoye 4 (fig. 11). The point was carefully treated by fine longitudinal whittling and grinding on fine abrasive slab, and after it polished with hide or similar soft material from the point to the middle of its length. Traces of this intentional polishing in the shape of dense very fine long striations roughly parallel to each other are clearly seen on a smooth surface of the spearhead (fig. 11: 2-4). A flat facet with a feather termination runs from the point along the dorsal surface of the artifact, and a semi-steep facet with a step termination runs along its ventral surface, indicating hitting some hard material (fig. 11: 1). Edges of these facets are rounded and smoothed, some polishing is observed on ridges and inside these facets. Linear traces in the shape of short shallow scratches and grooves running over facet edges at an acute angle to the tool axis (fig. 11: 2-5) indicate the use of this spearhead for thrusting some soft medium dirty material, most likely hunted mammals after the breakage of the point.

A fragment of a point of another massive spearhead (fig. 12) displayed traces which illustrate the history of its long use. Originally it was polished, but than the point was broken and reshaped by longitudinal whittling. After it the tip was smashed from hitting some hard material and was obliquely truncated with a fine grained abrasive slab at an angle about 60° to the tool axis (fig. 12: 2-3). As a result of its further use a flat facet about 1 mm long running from the tip emerged at its right lateral side. Edges of the truncated area as well as edges of the described facet became rounded and smoothed. Bright polishing accompanied by multiple linear traces in the shape of various scratches and grooves running from the tip at acute angles to the tool axis sometimes crossing each other are clearly observed (fig. 12: 5). Finally the point of this massive spearhead broke off as a result of a strong impact applied in the transverse direction.

The left side of one massive spearhead from the lower Mesolithic layer of Ivanovskoye 7 was broken off (fig. 13: 1-2), the point was also broken off, but later was carefully reshaped by longitudinal whittling and partly ground with a fine-grained abrasive slab. The tip of the point is rounded and smoothed, bright polishing runs from it gradually becoming dull and finally disappearing. Inside the polished area short grooves and various scratches some of which are more than 1 mm long running from the tip along the tool axis and at acute angles to it are observed (fig. 13: 2-5). Such traces indicate multiple piercing some soft medium dirty material, most probably hunted mammals during long use of this spear head.

A fragment of a point of the other massive spear head from the same find level of Ivanovskoye 7 is carefully sharpened by longitudinal whittling, the tip is obliquely truncated at an angle about 60° to the tool axis with the help of a fine abrasive slab (fig. 14). The point is broken off as a result of a strong side pressure, the breakage crack starts at a distance of 1 cm from the point. Micro chipping running from the

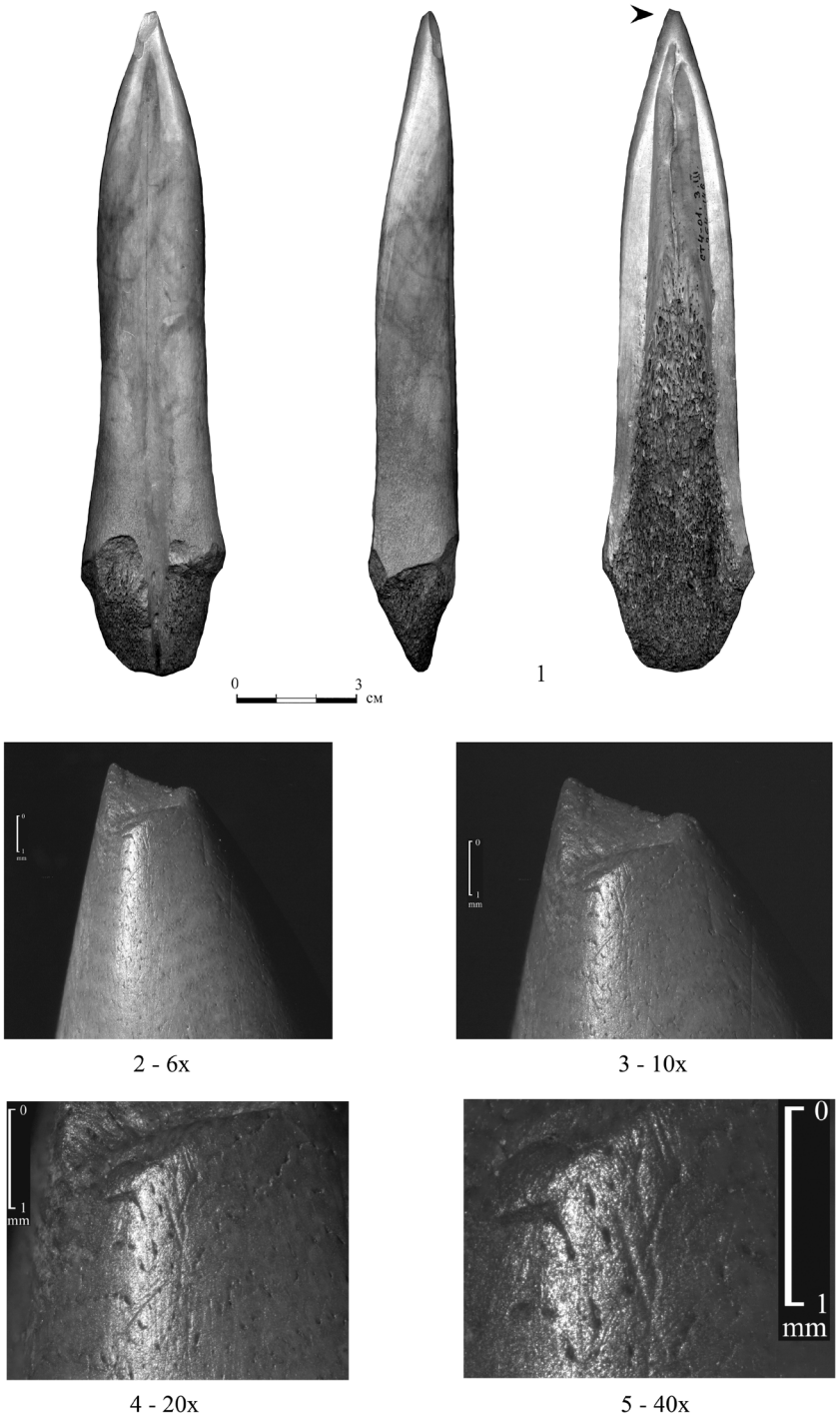
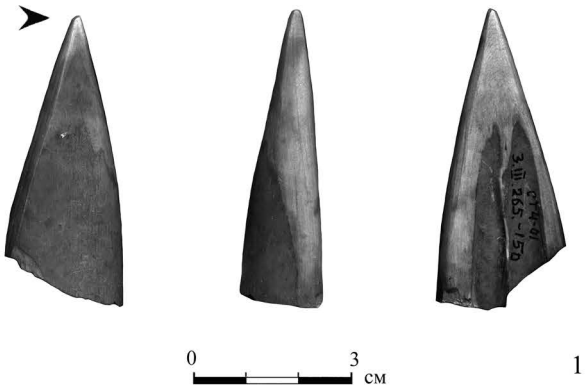
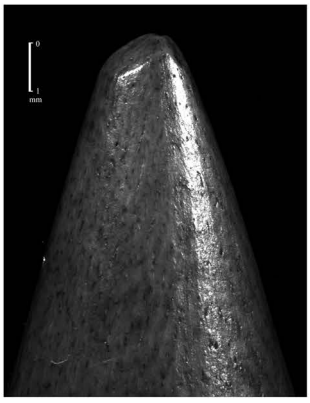


Fig. 11.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 2-5, use-wear traces.





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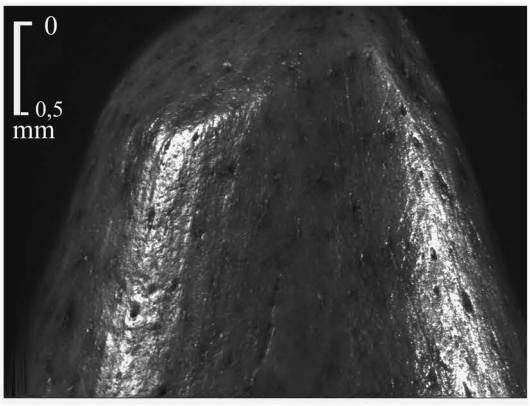

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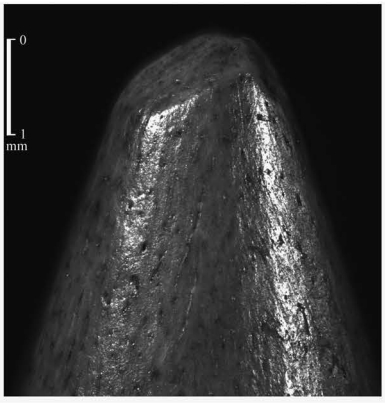
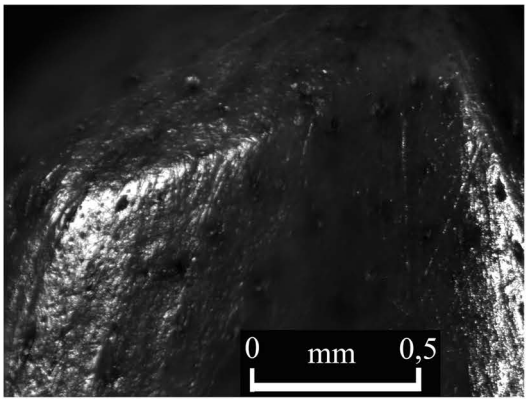


3 - 20x



5 - 70x

Fig. 12.—Stanovoye 4, find level III, trench 3: 1, a point of a massive spear head; 3-5, use-wear traces.

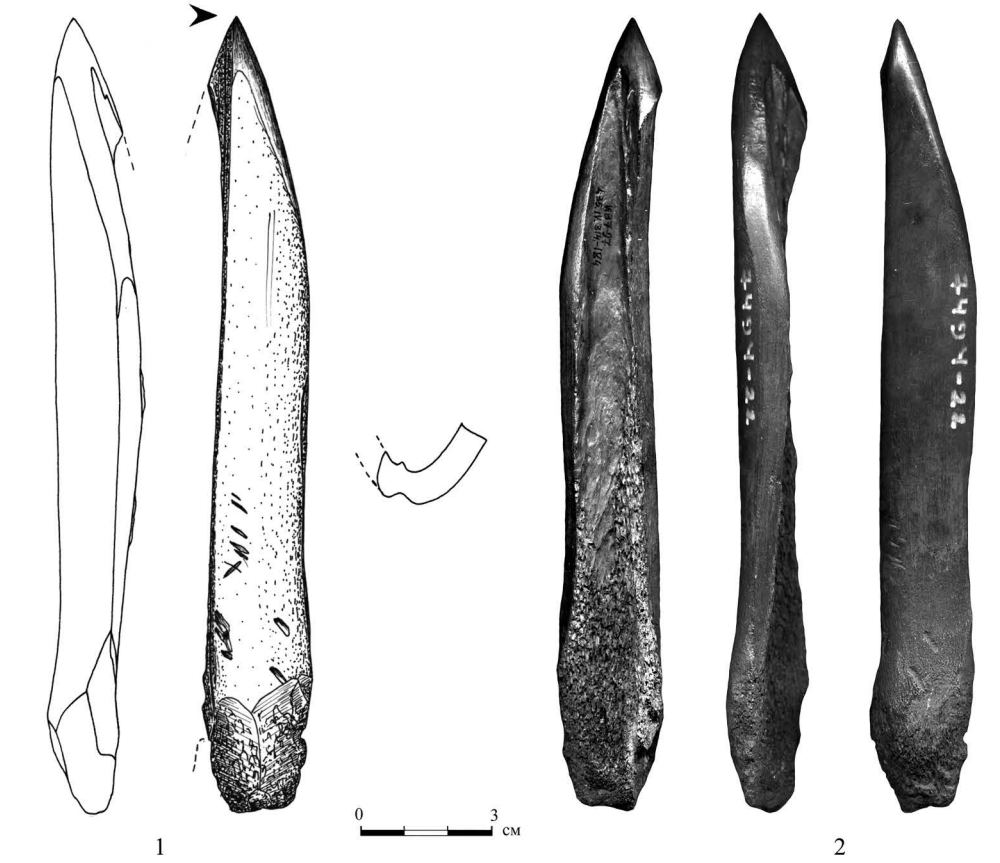
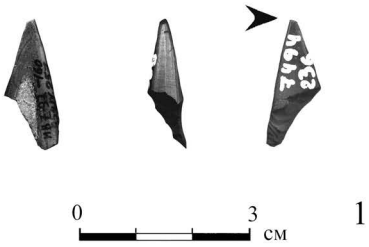
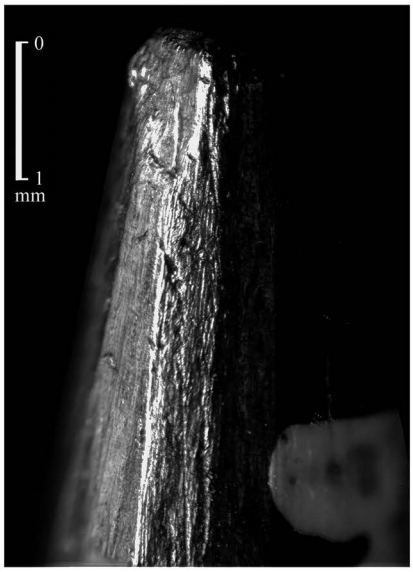


Fig. 13.—Ivanovskoye 7, find level IV: 1-2, a massive spear head; 2-5, use-wear traces.





2 - 10x 3 - 20x

Fig. 14.—Ivanovskoye 7, find level IV: 1, a point of a massive spear head; 2-3, use-wear traces.

edge of oblique truncation on the tip, rounding of the edge and rather bright polishing accompanied by coarse grooves and multiple thin striations running from the tip mostly parallel to the tool axis are observed under the microscope (fig. 14: 2-3). These traces are similar to described on the previous spearhead, but the grooves are more numerous, longer and deeper, indicating multiple hitting sandy soil.

DISCUSSION AND CONCLUSIONS

These artifacts are sometimes called ice-picks (Loze, 1988) judging by their morphology and authors' ideas about tool function. But no use-wear analysis aiming to prove or neglect such supposition was ever carried out. This article is the first presentation of results of use-wear and technological analyses of more than a hundred of these artifacts carried out by the author during last twenty years.

Traceological study of massive points with conical tip made from elk long bones, typologically described as spear heads (Zhilin, 2001) from Mesolithic sites of South-Eastern Baltic, Central Russia, Russian North and Trans-Urals revealed standard use-wear traces, more or less pronounced at all intact artifacts and their fragments with preserved point. Besides micro chipping, rounding and smoothing of the tip, two types of linear traces running from the tip along the axis of the tool or at acute angles to it were observed. The first includes fine sharp scratches, usually short, and only at rare occasions longer than 1 mm. The second is composed of coarse grooves with uneven surface up to 0.1 mm wide and deep and up to 5 mm long. It is worth noting that the starting point of such grooves facing the tip of the point is deeper and larger than its rear end facing the butt end of the spearhead, which gives it the comet-like appearance. Such grooves are similar to traces on bone digging stick heads used for digging sandy soils or soft boggy soils with admixture of sand. But these traces were met only at the tip of spear heads, while on digging stick heads they are much longer, and run up to 3 cm and more from the point. The second important difference is that the number and density of coarse grooves on digging stick heads is much greater than on described massive spear heads. The character of polishing is also different – more bright and even at spear heads compared to more dull and coarse polishing on digging stick heads.

Such combination of two described types of linear traces - fine striations and coarse grooves on one pointed tool indicates piercing some soft medium dirty material (hunted mammals) and also thrusting into the ground at a very small depth. Besides these, smashing of the tip, scars and facets running from the point were also documented on some massive spear heads with described use-wear pattern. Such macro traces indicate contact with some hard material, most probably bones of large mammals. Many massive spear heads are broken as a result of a very strong impact applied obliquely or transversally to the artifact which in combination with observed traces also points at large mammals. All these data correspond well to the purpose of a massive thrusting spear used for killing large mammals. As we know from ethnographic sources (Gurina, 1956; Semenov, 1968; Anell, 1969; Dzeniskevich, 1987; Averkieva, 1991; Fainberg, 1991; Zalisnyak, 1991) hunting of such game often started with wounding it by arrows and ended with stabbing the wounded animal with a thrusting spear.

Archaeological record also gives examples of large mammals first wounded by arrows and finally killed with a spear. The best evidence is a skeleton of an aurochs from the bog Vig in Denmark. On the first occasion it was wounded by arrows but escaped, and on the second occasion it was again hit with several arrows and killed

with a spear which pierced through the shoulder blade (Nygaard, 1974; Zaliznyak, 1991). Shoulder blades of elk, red deer and roe deer with damage caused by arrows and spear heads were found at Mesolithic sites from England and Denmark to Trans-Urals (Nygaard, 1974, 1975; Zaliznyak, 1991; Nuzhnyi, 2008, Zhilin *et al.* 2014).

Hunting large mammals accompanied by fishing and fowling played the main role in the economy of Mesolithic population of Western Russia (Zhilin, 2004; 2007a, b; 2014). Judging by faunal remains from excavated sites elk was the most important mammal taken from the very beginning till the very end of the Mesolithic in this area. It supplied inhabitants of Mesolithic sites with large amount of meat, skin, antler, bones and sinew. Presence of elk skulls with stumps from shed antlers and remains of chopped off antlers indicates elk hunting all year round. A fragment of elk temporal bone, pierced with a needle-shaped bone arrowhead (Zhilin, 2004: 96) indicates the use of bow and arrows for elk hunting. Any other big mammals like brown bear, reed deer, reindeer, wild pig and roe deer played no significant role in the total volume of mammals taken. The share of their bones put together is several times less than the share of elk bones. From the very beginning of the Mesolithic dog bones are rather numerous among faunal remains. Besides other functions, the main purpose of a dog was helping in hunting large mammals.

Basing on archaeological and ethnographic data and results of the use-wear study of various weapons (Zhilin, 2001; 2014; 2015) we come to the conclusion that the Mesolithic population of Western Russia developed a variable and highly sophisticated set of weapons, suitable for taking any animal resources in their environment. Together with projectiles - bow and arrows and javelins, heavy thrusting spears with massive bone heads played an important role in hunting large mammals, first of all, elks.

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