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Technology of the processing of bone and antler at Ivanovskoje 7 Mesolithic site, Central Russia

SUMMARY - TECHNOLOGY OF THE PROCESSING OF BONE AND ANTLER AT IVANOVSKOJE 7 MESOLITHIC SITE, CENTRAL RUSSIA - Ivanovskoje 7 is a multilayer peat bog site in Central Russia. About 500 square meters were excavated during 1974 to 1997. Three Mesolithic and two Neolithic cultural layers had been recovered, separated by sterile streaks, ^{14}C dated confirmed by pollen analysis indications. The Mesolithic layers yielded abundant faunal remains and lithic assemblages together with bone and antler artefacts. The latter included various projectile points, spear-heads and daggers, fishing hooks, knives, piercers, scrapers and planes, as well as axes, adzes and gouges, pendants and figurines. Given to this overwhelming bone and antler production this article is devoted to the technology of bone-working during the Mesolithic inhabitation of Ivanovskoje 7. The good preservation state of both stone and bone assemblages allowed the technological and use-wear analyses, applied by means of stereo and metallographic microscopes, making it possible the reconstruction of the technological sequence for bone tools different productions. A set of stone tools used for bone working was singled out in each cultural layer. This set included scrapers, burins, whittling knives, saws, chopping tools and abrasive slabs. A very interesting plane fixed on a shaft was found in the upper Mesolithic layer. Use-wear traces observed on these tools are described and illustrated in the article. The technology applied to manufacture these artefacts demonstrates high achievements in bone-working in order to obtain blanks to be finally modified into tools and decoration objects. Such well developed set of stone tools for bone and antler processing made it possible the manufacture of the very fine and skilled bone and antler industry at this site.

Keywords: peat bog site, Central Russia, Mesolithic, bone industry, lithic tools, technological analysis, use-wear analysis.

INTRODUCTION

Extensive field surveys and excavations of last decades in Central Russia brought to light about 300 Mesolithic sites, more than 70 of which were excavated. Several archaeological cultures were singled out (Koltsov and Zhilin 1999; Zhilin 2006). Almost all these sites are situated on mineral soils where organic materials are not preserved, stratification is often not reliable, ^{14}C and pollen data are scarce or absent. Field surveys and excavations, carried out by M.G. Zhilin in 1988-2000 revealed about 60 wetland sites with good preservation of organic remains, reliable stratification and perfect opportunities for the application of scientific methods. Twelve of them were excavated, bringing very good sequence of cultural layers from the very beginning till the very end of the Mesolithic (Zhilin 2007).

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Almost all of these sites are situated at large peat bogs, occupying glacial depressions. Layers of clay and *gyttja* under peat deposits indicate the presence of large lakes and lake systems during the Stone Age. These lakes were connected by small rivers with the main rivers of Central Russia - Volga and its right tributary - Oka (fig. 1). Climatic changes during early Holocene caused lake transgressions and regressions, resulting in shoreline displacement. Sites, inhabited during regressions were later submerged, and their cultural layers were sealed by *gyttja* and peat, making superb conditions for preservation of bone, antler, wood, bark, seeds, plant fibres, resin, glue, coprolites, insects and other organic remains. Later, when water level dropped, some of them were occupied again, and afterwards again submerged. This process led to formation of sites with several Mesolithic cultural layers, divided by sterile streaks, or easily separated from each other. The present article deals with one of the most impressive sites - Ivanovskoje 7.

THE MESOLITHIC SITE

The Ivanovskoje peat bog is situated about 150 km to the north-east of Moscow, in the middle flow of river Nerl, which ran through a large lake during the Stone Age, connecting it with the Klyazma River, the left tributary of the Oka. Ten sites were discovered there. Ivanovskoje 7 is the most interesting. 106 square meters were excavated there by D.A. Krainov in 1974-1975, and 332 square meters by M.G. Zhilin in 1992-1997. The site has 3 Mesolithic and 2 Neolithic cultural layers. Mesolithic settlements occupied low promontory during lake regressions, which was submerged during transgressions.

The lower, early Mesolithic (IV) layer is dated by ^{14}C to 9650±110 BP (GIN-9520) and 9640±60 BP (GIN-9516). It is dated by pollen to the first half of Preboreal period, before its optimum. During middle Preboreal transgression the site was submerged. About 300 bone and antler artefacts were found. Among arrowheads long needle-shaped are the most recurrent (fig. 2.2), some with a slot for insets (fig. 2.4); one with a relief belt near the tang is treated in a turning lathe[1] manner near the belt and in the middle of the stem (fig. 2.3). A preform of a long neddle-shaped arrowhead was found (fig. 2.1). Other types include long with regular biconical ornamented head (fig. 2.5); narrow tanged slotted with microblades preserved in slots at both sides, fixed by a sort of glue (fig. 2.12); asymmetric one-winged with a slot for insets opposing the wing (fig. 2.14), and a small barbed one for shooting pike (fig. 2.13). Unilateral barbed points with sparse or dense teeth and massive harpoons (fig. 2.6,15), massive lance heads (fig. 2.16), fragments of slotted spearhead, intact and slotted daggers (fig. 2.17) were found together with intact fishing hooks (fig. 2.8-10) and a short double pointed rod[2] (fig. 2.11), which served as a hook for catching big pike and pike-perch. Of special interest is a spear-heads, made of obliquely cut tubular bone of reindeer, richly ornamented with geometric designs over the whole surface (fig. 2.7). Other tools include hollow endscrapers; planes made from tubular elk bones (fig. 3.13); wide elk scapula knives and fish scaling knives made of splitted ribs; awls (fig. 3.9); needles (fig. 3.10) and a needle case (fig. 3.11); beaver mandible tools; antler axes (fig. 3.15), adzes (fig. 3.16,17), chisels and gouges (fig. 3.12); perforated antler sleeves for mounting axe and adze blades (fig. 3.18); punches and pressure flakers (fig. 3.14); animal teeth pendants (fig. 3.1-7) and a flat bone pendant with incisions (fig. 3.8).

The next occupation, which left the middle Mesolithic (III) cultural layer, 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). About 8500 BP this settlement was submerged again. Bone artefacts include arrowheads - needle-shaped, with biconical head (fig. 5.1-3), narrow flat (fig. 5.4) and long with a barb near the point (fig. 5.5); a short unilateral flat finely barbed point (fig. 5.6) and fragments of two other points - with sparse and dense teeth (fig. 5.7); fragments of daggers, one with a slot for insets; two waste pieces from fishing hook

[1] The bone arrowhead was rotating while the burin was slowly moving along it like in modern lathe.

[2] It is a tool with a bipoint.

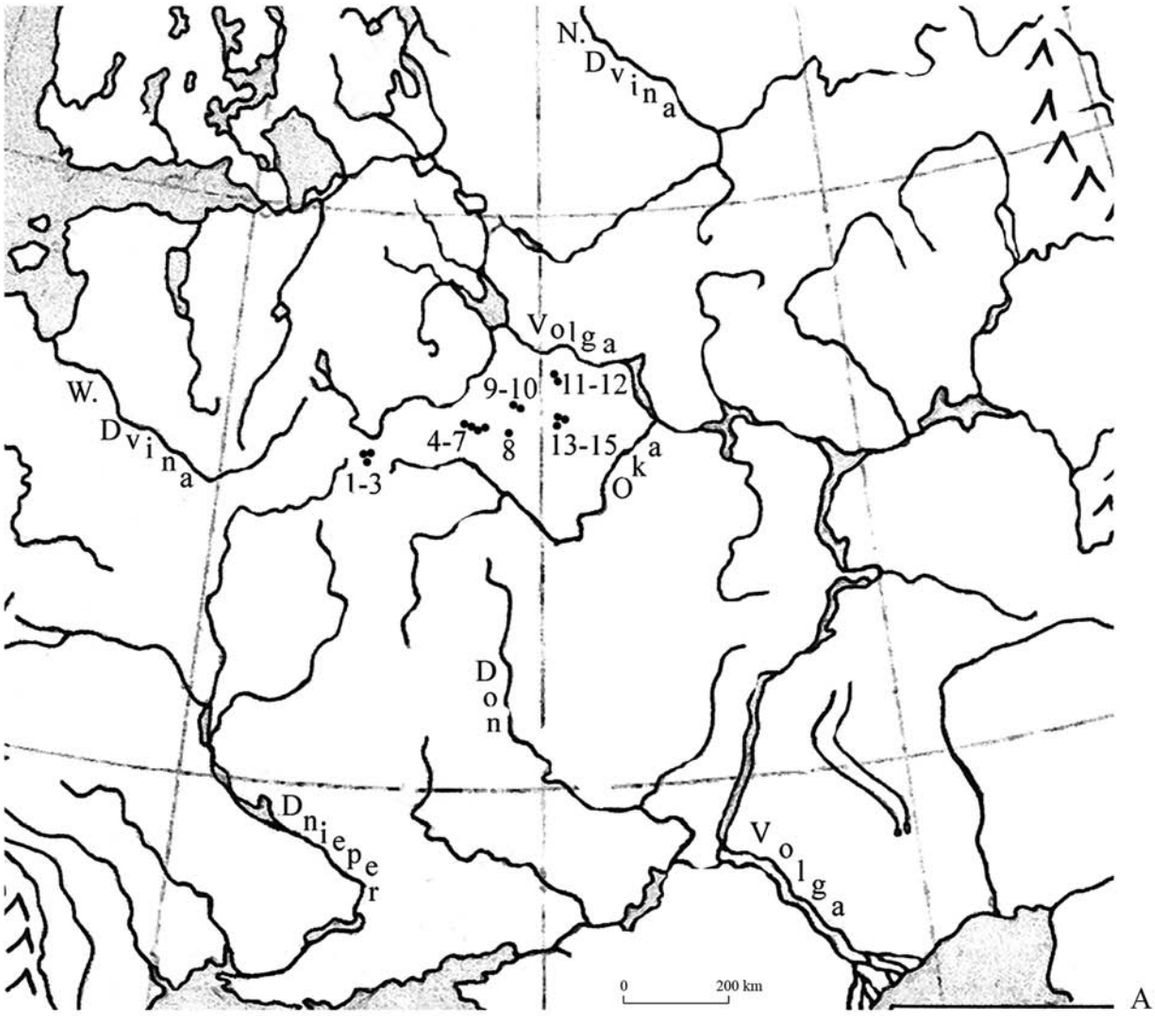

Fig. 1 - A) Mesolithic wetland sites: 1-3. Ozerki 5,16,17; 4-7. Nushpoli 11, Okajomovo 4, 5, 18a; 8. Chernetskoje 8; 9, 10. Ivanovskoje 3, 7; 11, 12. Stanovoje 1, 4; 13-15. Sahtysh 2a, 9, 14. B) Excavation of the site Ivanovskoje 7.

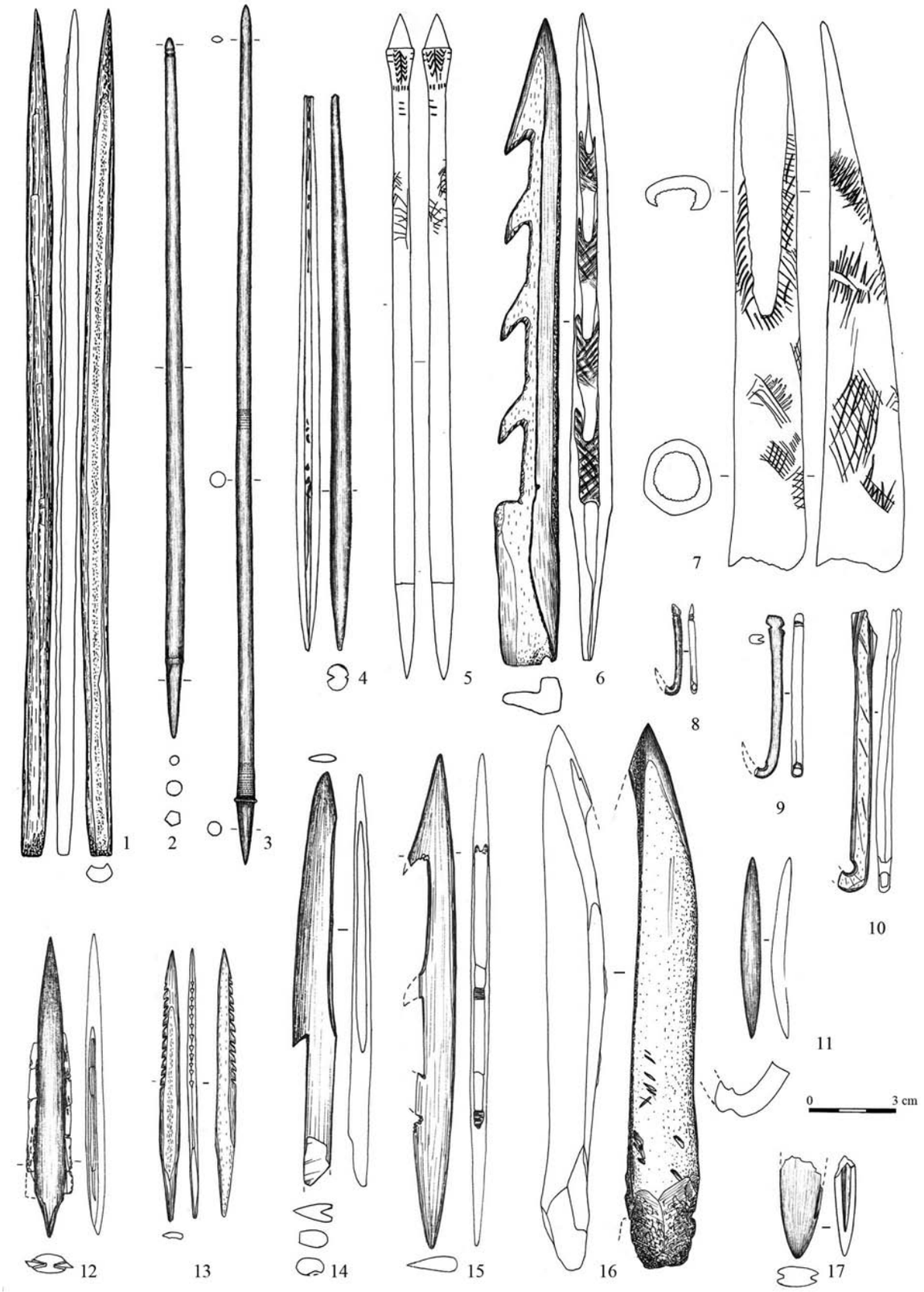

Fig. 2 - Ivanovskoje 7, lower Mesolithic layer (IV), bone and antler artefacts: 1. half-finished arrowhead; 2-5, 12-14. arrowheads; 6, 15. harpoon heads; 7, 16. spearheads; 8-11. fishing hooks; 17. point of a slotted dagger.

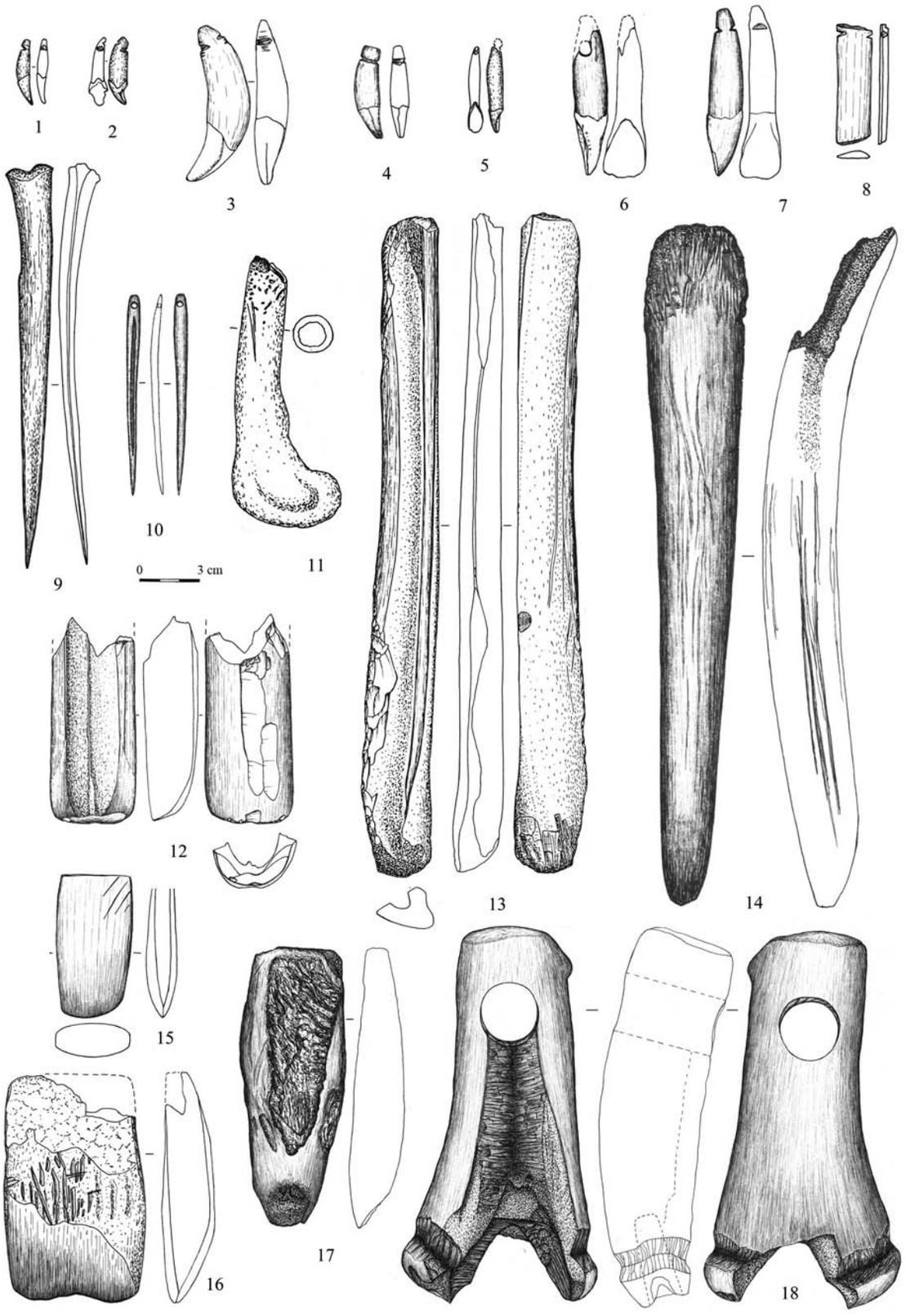

Fig. 3 - Ivanovskoje 7, lower Mesolithic layer (IV), bone and antler artefacts: 1-8. pendants; 9. awl; 10. needle; 11. needle case; 12. fragment of a gouge; 13. plane; 14. pressure-flaker; 15. axe blade; 16, 17. adze blades; 18. sleeve for hafting adze blades.

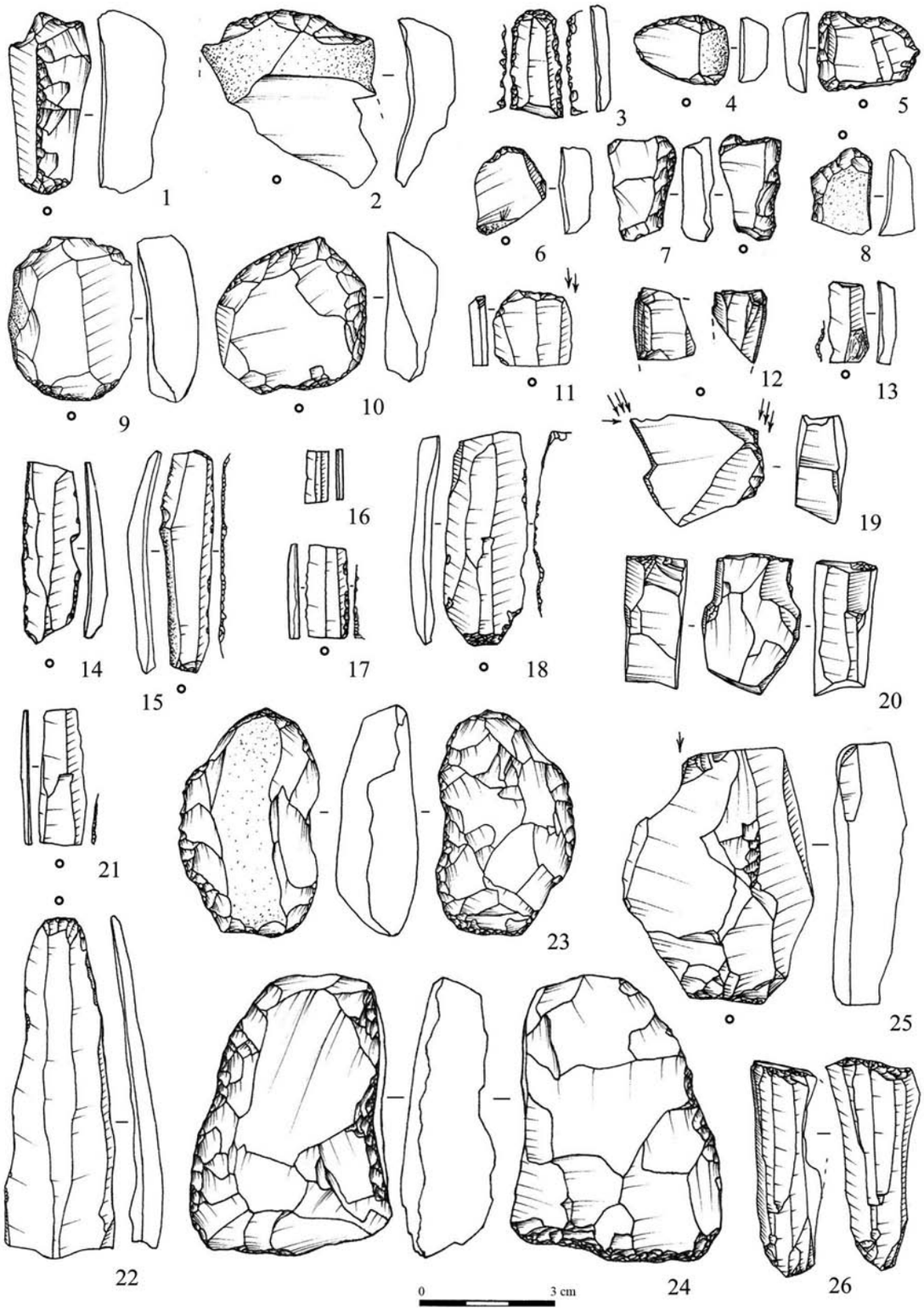

Fig. 4 - Ivanovskoje 7, lower Mesolithic layer (IV), lithic artefacts: 1-10. scrapers; 11, 19, 25. burins; 12, 20, 26. cores; 13-15, 17-18, 21. retouched blades; 16. microblade; 22. blade; 23, 24. core adzes.

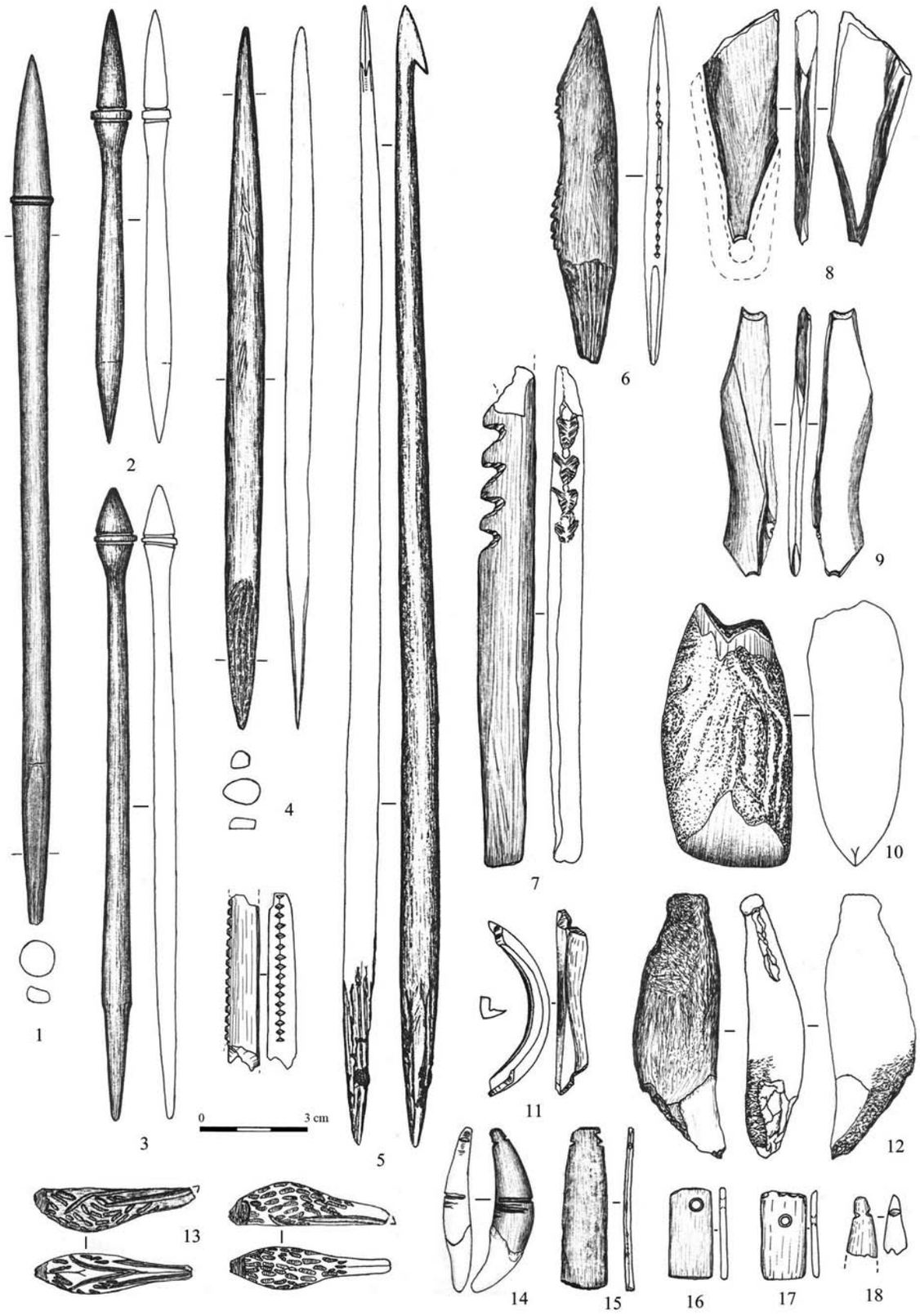

Fig. 5 - Ivanovskoje 7, middle Mesolithic layer (III), bone and antler artefacts: 1-5. arrowheads; 6-7. barbed points (javelin or leister heads); 8, 9. waste from fishing hooks; 10. antler axe; 11. plane made from beaver incisor; 12. bear tusk pressure flaker; 13. figurine of a merganser; 14-18. pendants.

production (fig. 5.8,9); a wide elk scapula knife; a fragment of a hide polisher; awls; beaver mandible tools and a plane, made of beaver upper incisor (fig. 5.11); an antler axe blade (fig. 5.10); a fragment of an "ice-pick"; a pressure flaker made of bear fang (fig. 5.12) and a wedge.

Ornaments are represented by elk incisor (fig. 5.18) and wolf fang (fig. 5.14) pendants, a flat bone pendant with incisions (fig. 5.15), and several flat rectangular perforated pendants made of split ribs (fig. 5.16,17). Of special interest is a small bone figurine, representing a merganser head (as defined by A. A. Karhu) with a long beak in a very realistic manner (fig. 5.13).

The terminal Mesolithic settlement (layer 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 to 7530±150 BP (GIN-9361 I), 7520±60 BP (GIN-9361 II), 7490±120 BP (LE-1260), 7375±170 BP (LE-1261), 7320±190 BP (GIN-9369 I). Bone and antler artefacts include arrowheads: short and long needle-shaped (fig. 7.1,2), one with a short slot, filled with glue with imprint of a microblade (fig. 7.3); long with a leaf-shaped blade with a barb at one side and a slot with glue on the other (fig. 7.4); symmetrical two-winged with a hollow for a flint point at the end (fig. 7.5) and two massive blunt for fur hunting (fig. 7.6). Several unilateral points with sparse barbs (fig. 7.7); massive "lance head" (fig. 7.8); fragments of flat narrow slotted daggers and a dagger with oblique blade; intact fishing hooks with slender or thick stem (fig. 7.9-12) were also met in this layer. Other tools include narrow knives made of split ribs and various knives of bone splinters (fig. 7.17); rib planes; awls (fig. 7.16,19); beaver mandible tools; "ice-picks"; a chisel; antler adzes (fig. 7.20) and fragments of axes; wedges; fragments of a punch and a pressure flaker; an antler spoon (fig. 7.18); pendants made of elk sublingual bone (fig. 7.14) and beaver and elk incisors (fig. 7.13,15).

Of special interest is a sculpture of a fantastic creature (fig. 8). The head is made of elk skull bone, while the body and a tail from antler, growing from the skull. The face with large protruding eyes and firmly shut jaws combines signs of various animals, but none in particular. Elongated body, seeming too small for such head, gradually changes into flat fork-like tail. An oval hole is carefully cut in the central part of the figurine for hafting it to a handle. Use-wear analysis revealed no traces of use. Most probably it served as a top of some ceremonial staff, known from petroglifs and ethnographic records (Zhilin 2010).

TRACEOLOGY

Traceological analyses of bone and antler artefacts with the help of a stereomicroscope MBS-10 made possible the reconstruction of the technology of the manufacture of the studied objects (Zhilin *et alii* 2002). Traceological MBS-10 analysis of lithic tools and waste was carried out with the help of a Low Power stereomicroscope and a High Power metallographic microscope (Olympus). All lithic artefacts from three cultural layers of Ivanovskoje 7 belong to the same Butovo Mesolithic culture. In the bottom (IV) layer (fig. 4) 220 of them were found; 129 come from the middle (III) layer (fig. 6) and 322 - from the upper Mesolithic layer (fig. 9). Among 671 various artefacts, including finished artefacts with secondary treatment, blanks, preforms and waste, by means of traceological analysis 378 used tools have been selected (see the diagram in fig. 17). 77 of them were used for processing bone and antler. They include tools devoted to various operations: chopping tools, whittling knives, scrapers, saws, burins, abrasive tools. Experimental data and traces, left on surfaces of bone artefacts were used to verify the functional attribution of lithic tools. The most complete spectrum of technological operations was reconstructed for bone arrowheads, because they are represented in the collection by artefacts, left at different stages of manufacture. This makes possible to trace the chain of operations from blank production to the final treatment of the artefact.

Among tools for bone-working a fragment of an axe with a convex working edge, made from some siliceous rock, trimmed by flat percussion, deserves special attention (fig. 10.A). As a result of use its edge is smashed. Spots of polishing with linear traces in the form of parallel grooves, running from the working edge, perpendicularly or at some angle to it, are

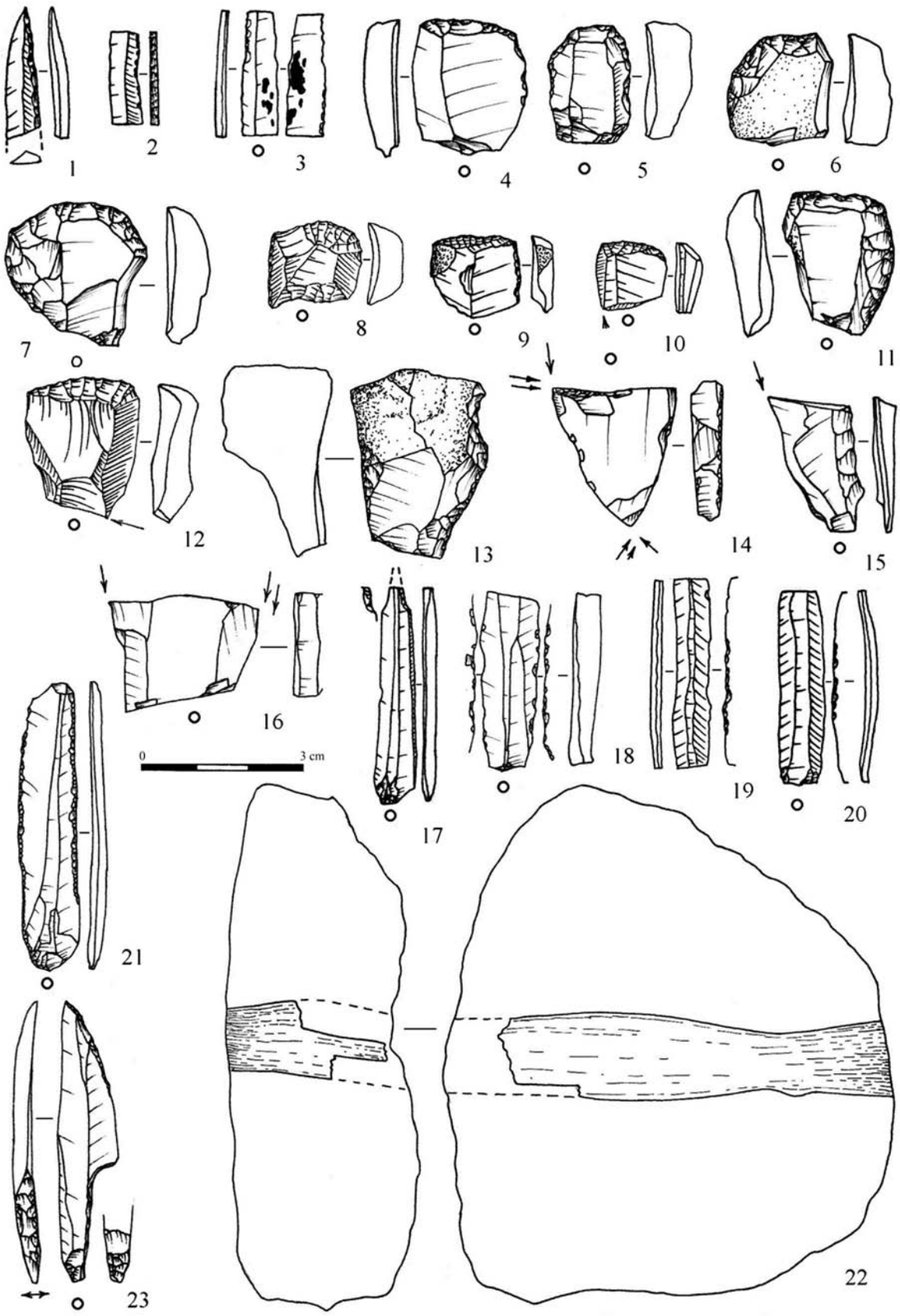

Fig. 6 - Ivanovskoje 7, middle Mesolithic layer (III), lithic artefacts: 1. backed point; 2, 3. inserts; 4-13. scrapers; 14-16. burins; 17. perforator; 18-21. retouched blades; 22. net sinker with binding; 23. arrowhead.

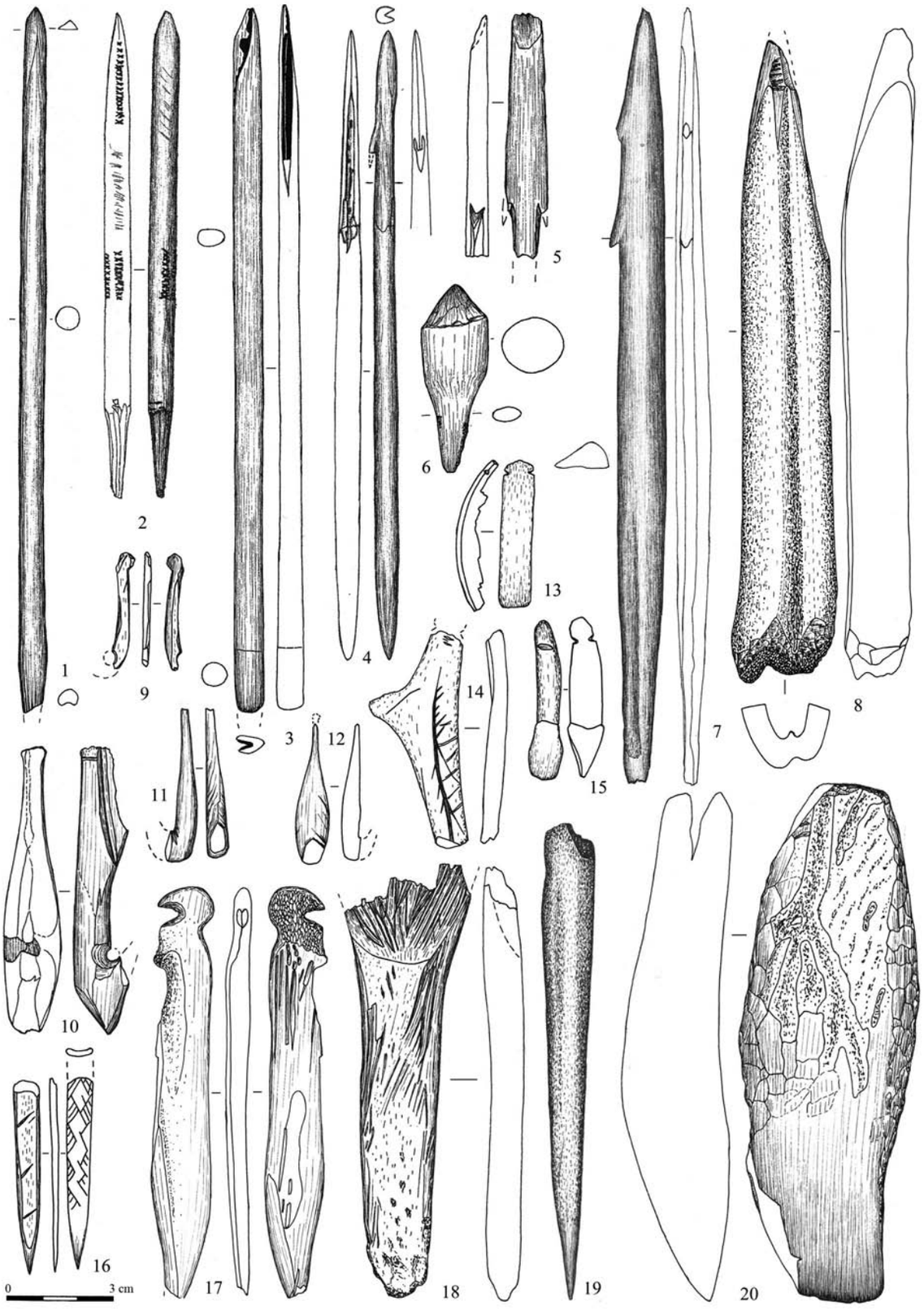

Fig. 7 - Ivanovskoje 7, upper Mesolithic layer (II a), bone and antler artefacts: 1-6. arrowheads; 7. barbed point (javelin or leister head); 8. lance head; 9-12. fishing hooks; 13-15. pendants; 16, 19. awls; 18. antler spoon; 20. antler adze blade.

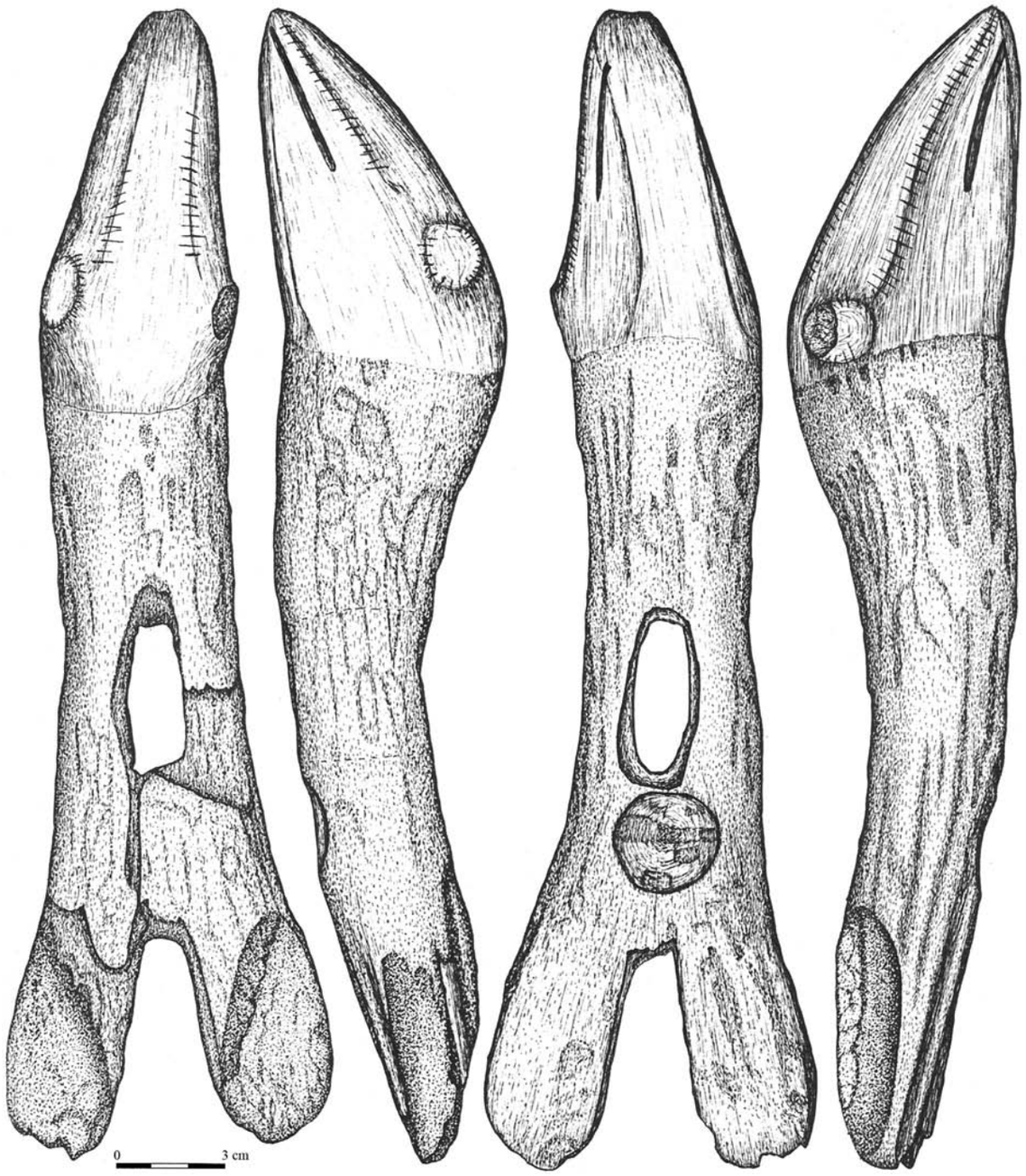

Fig. 8 - Ivanovskoje 7, upper Mesolithic layer (II a), antler staff head in the shape of a fantastic creature.

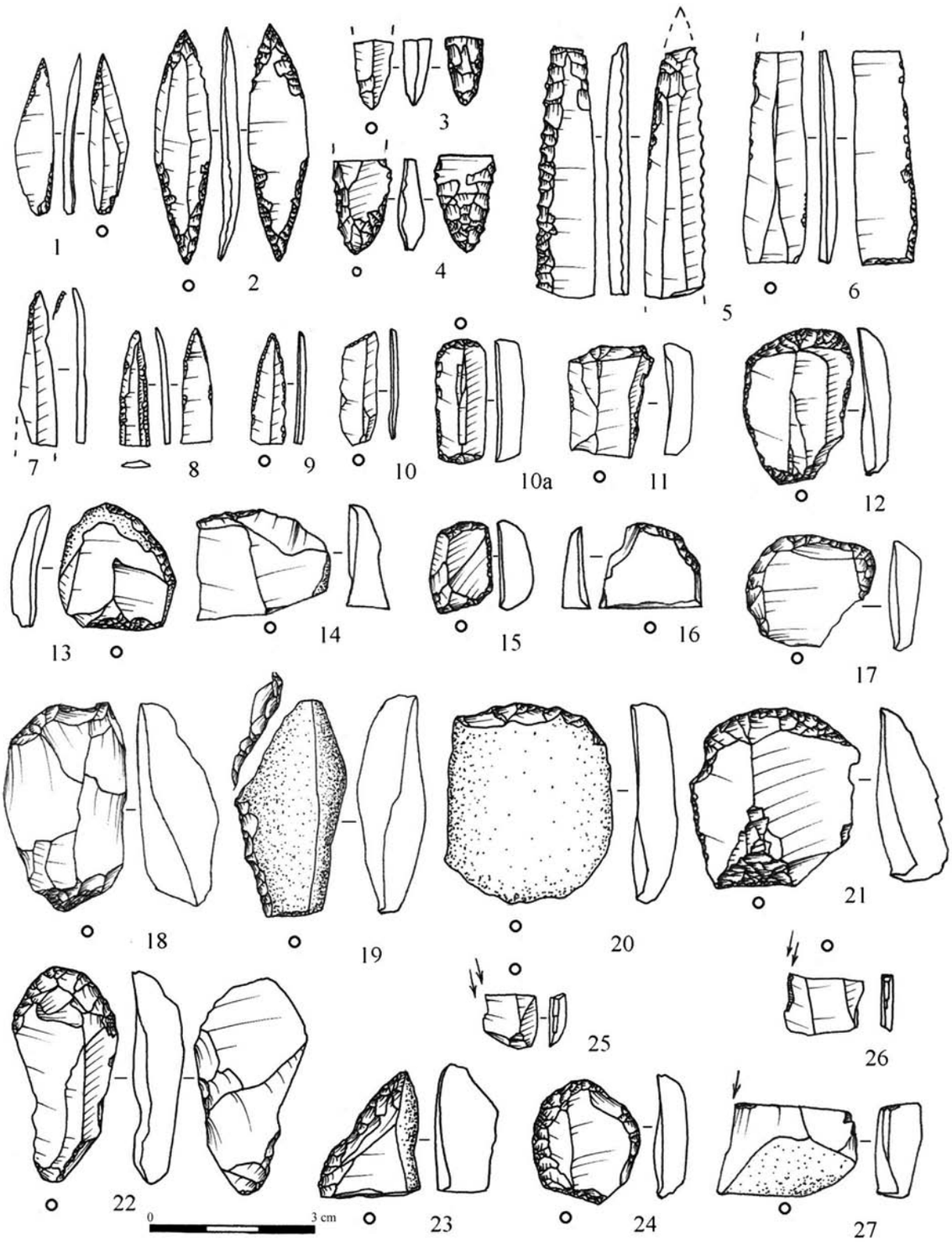

Fig. 9 - Ivanovskoje 7, upper Mesolithic layer (II a), lithic artefacts: 1, 7-10. points; 2-4. arrowheads; 5, 6. retouched blades; 10a-24. scrapers; 25-27. burins.

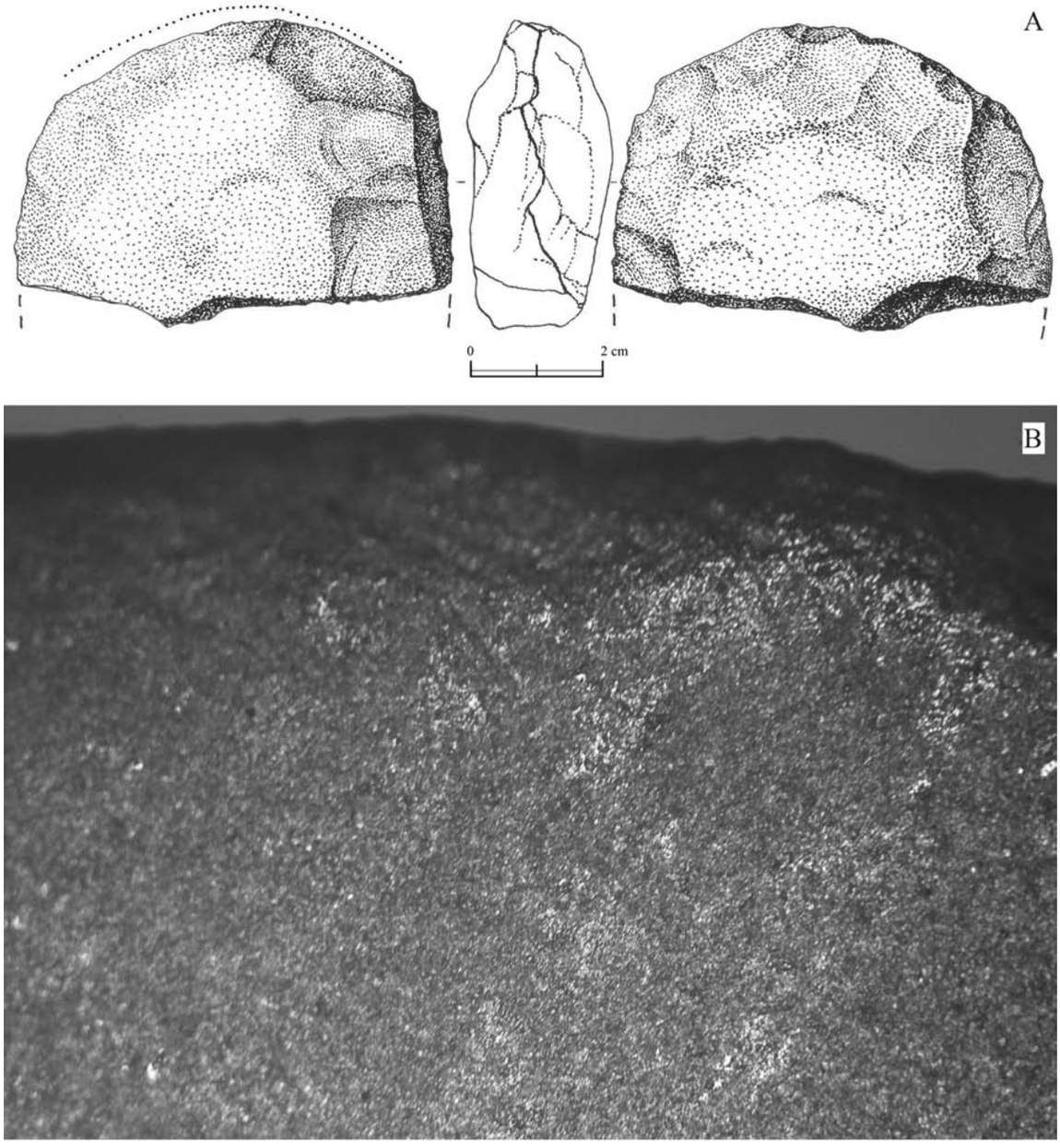

Fig. 10 - Ivanovskoje 7, upper Mesolithic layer (II a) stone axe for chopping bone: A. working edge; B. use-wear traces (30 X).

clearly observed at the remaining areas of the tool blade (fig. 10.B). This tool was used for the primary bone processing: splitting, circular chopping by notches, and also removing of waste material from performs. Traces of these preparatory operations are hardly visible on finished tools because they were removed by successive treatment, but some artefacts preserve areas with traces of chopped off epiphyses. Traces of chopping were observed on the massive antler arrowhead for hunting small animal for fur[3] (fig. 7.6). The end of a tine was circularly chopped and then broken at the area, thinned by chopping. The point of the arrowhead in the shape of a low wide cone, changing into a massive head was formed at his area. Traces of flat chopping with an axe or an adze are also observed on some antler tools for treating wood (fig. 7.20).

14 whittling knives were singled out. Blade fragments and flakes of various sizes were used as blanks (fig. 11). These tools with a small angle of a working edge, which was placed at a sharp angle to the working material, were widely used for bone-working. Some of them have a retouched butt. Single flat breakage facets, produced during work and microwear in the form of polishing and linear traces, running transversally from the edge or oblique to it (fig. 11.C,D), are observed on their working edges. Whittling was used for planning of the blank surfaces, removing of waste material and treatment of details (fig. 11.B). A unique stone tool, made from a narrow thin rectangular blade (8,1×3,5×1 cm) (fig. 12) was also used for this. Marking, made before sawing of stone, is clearly seen at its sides (fig. 12.A,B). The working area is straight; it displays clearly observed use-wear traces - long parallel strips and spots of abrasion (fig. 12.A,B). Degree of use-wear and the position of use-wear traces indicate long use of this tool, which served for making flat surfaces on tightly fixed artefacts. Regularity and clear direction of linear traces drive to a conclusion that this tool was hafted in a special handle and used as a metal insert of a modern plane.

Traces of whittling knives are clearly seen on surfaces of various arrowheads, made from long narrow splinters, cut from tubular bones of ungulates, mainly elk. As a pre-form from the bottom layer of Ivanovskoje 7 shows, at first the general shape and the point of the arrowhead were formed, and than the base (fig. 2.1). Barbs of one-winged arrowheads and some barbed point and harpoons were also made by whittling (fig. 2.14; 5.6; 7.5, 7).

Scrapers are tools made from flint blades, flakes and splinters with massive working edge often with step like facets of steep utilization retouch (18 tools) (fig. 6.14; 9.18; 13.1). Two endscrapers made from flakes were used for this purpose. The working edge of scrapers was placed vertically to the surface of the worked material. They display, besides utilization retouch, linear traces, running perpendicularly to the working edge and the polish area at some parts of the blade, not broken off during work (fig. 13.A,C). These tools were used for removing extra material from bone artefacts, smoothing them before final polishing, and also for making hollows (fig. 13.B). One scraper was made from a cortex flake trimmed by careless percussion. The working edge is situated in two notches, which were formed during work. Surfaces of some arrowheads show traces of scraping, which smoothed the ribs from the previous treatment by whittling.

Saws in the studied collection were made from regular blades of medium size, and also from flakes (fig. 9.5; 14.1). The working edge is severely deformed, and even consists of denticulations and notches at intensively used tools (13 artefacts). Spots of bright polish and linear traces, running parallel or at acute angles to the working edge are observed at some areas of saws (fig. 14. B,C). Judging by the use-wear these tools penetrated into the worked material at the depth of 3-5 mm. It was considered that sawing was a scarcely used operation in the Mesolithic, saws from the studied collection display clear use-wear. Traces of sawing are preserved on many bone artefacts (fig. 14.A), among them arrowheads with biconical heads, where the contact of two cones is indicated by circular grooves, made by sawing (fig. 5.2,3). Barbs at sides of some flat barbed points and harpoons were shaped by transversal sawing (fig. 2.15). Change of the angle of the flint saw during work made possible removing of waste bone and shape barbs at some barbed points and harpoon heads. Traces of sawing, crossing each other are clearly seen between the barbs (fig. 2.6; 5.7).

[3] Hunting small fur mammals like marten, squirrel, etc.

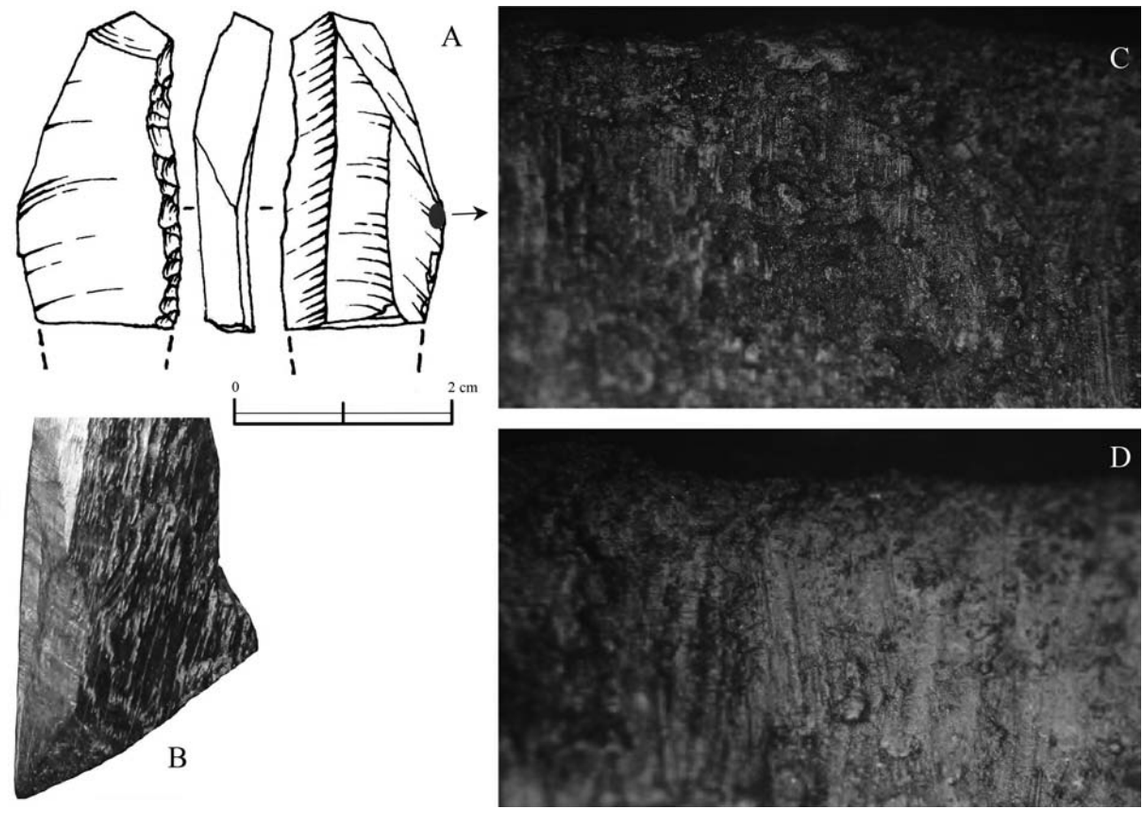

Fig. 11 - Ivanovskoje 7, upper Mesolithic layer (II a) whittling knife for bone: A. working edge; B. traces of whittling on bone (10 X); C. use-wear traces on the Mesolithic whittling knife for bone (200 X); D. use-wear traces on the experimental whittling knife for bone (200 X).

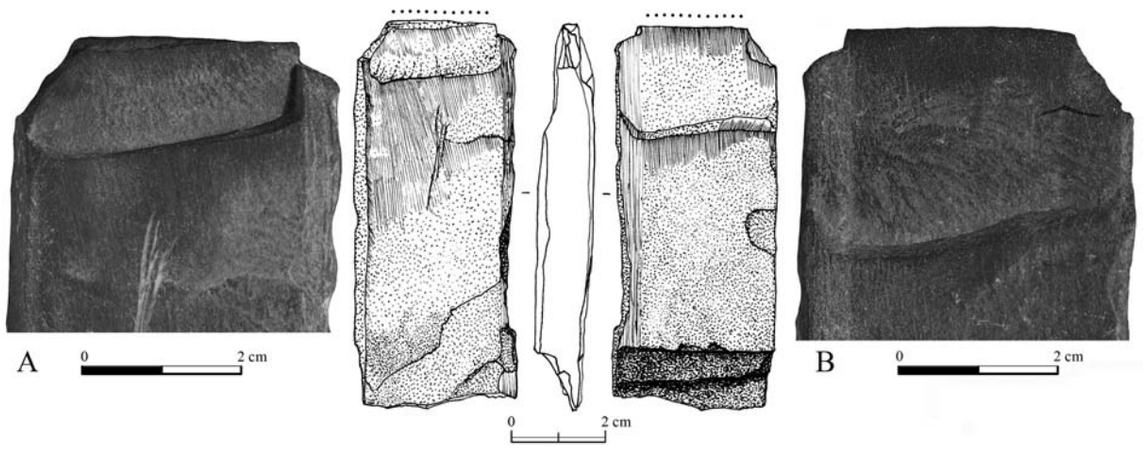

Fig. 12 - Ivanovskoje 7, upper Mesolithic layer (II a) stone plane blade for planning bone: working edge; A, B. use-wear traces (10 X).

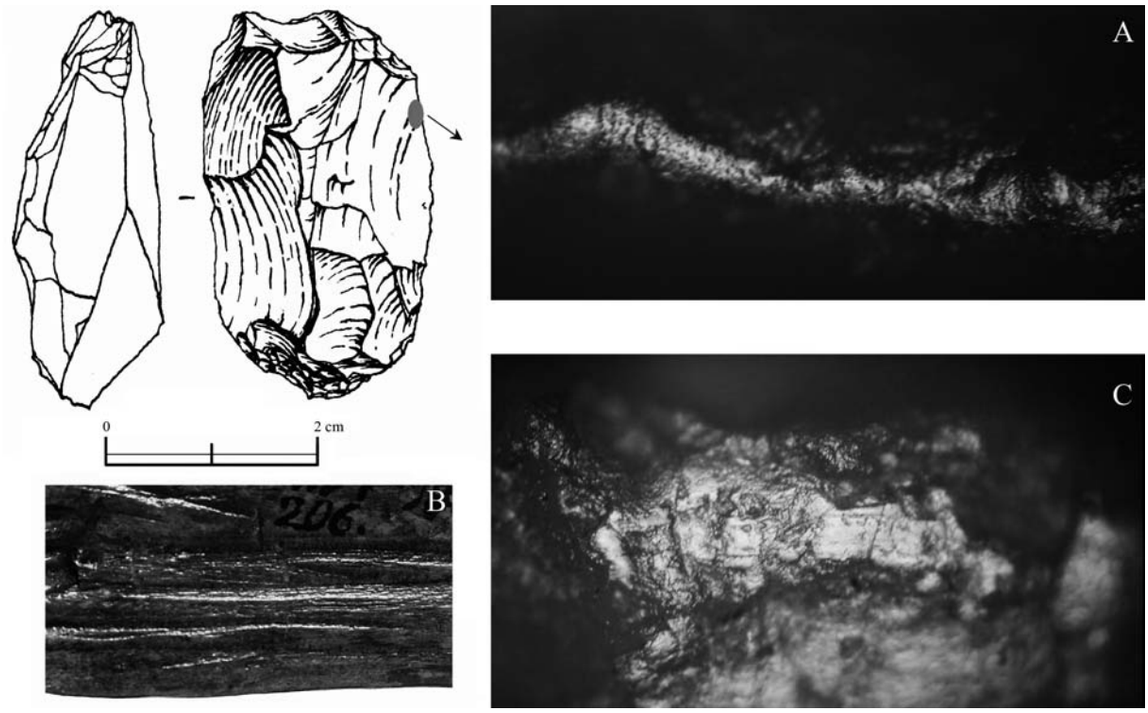

Fig. 13 - Ivanovskoje 7, upper Mesolithic layer (II a) scraper for bone-working: use-wear on working edge; A. use-wear traces on the Mesolithic scraper for bone-working (200 X); B. scraping traces for bone-working (10 X); C. use-wear traces on the experimental for scraping bone (200 X).

Burins make the next group of 23 artefacts. Significance of these tools was especially marked by S.A. Semenov, who considered that this late Paleolithic invention led to much better treatment of bone and antler and compared their role with the role of metallic burins in modern industry (Semenov 1957: 188). Traces of use in this function were identified on typologically determined burins and also on fragments of blades and flakes with miniature burin facet or a sharp edge, suitable for work (fig. 6.14; 9.26,27; 15.1). The edge between the transversal facet (platform) of the burin scar was often used and judging by use-wear traces - spots of polish near the working edge and linear traces, running transversally and obliquely to the working edge - the tool was placed at an acute angle to the working surface like a whittling knife (fig. 15.B,C). Traces left after treatment with burins are observed on many artefacts from the studied collection. Experiments indicate that burins can be used for a wide spectrum of operations. It includes cutting of splinters from bone and antler, smoothing surfaces, three dimensional shaping of artefacts, careful treatment of details, marking and engraving (fig. 15. *A1-A4*). Burins with narrow working edge were used for making slots for inserts in composite tools. Slots at such tools have trapezoidal or V-shaped cross section with the maximum depth in the middle part about 3 mm, ends of slots are slanting, sometimes step-like (fig. 15.B,C). Experiments show, that slots with trapezoidal cross section emerge when the burin moves forward, removing shaving with an edge of a transversal facet (platform), gradually going deeper. The bottom of the slot is sometimes uneven. When the angular cutting edge is used, the cross section of the slot is V-shaped. Slots for inserts on arrowheads were cut with a narrow edged tool before final whittling, because traces of the latter remove scratches produced with a burin near the beginning and the end of the slot. After the arrowhead was ready, the slot was filled with glue, and the artefact was heated over small fire or burning charcoal. When the glue melted, microblades were inserted into the slot. Usually they were arranged in such man-

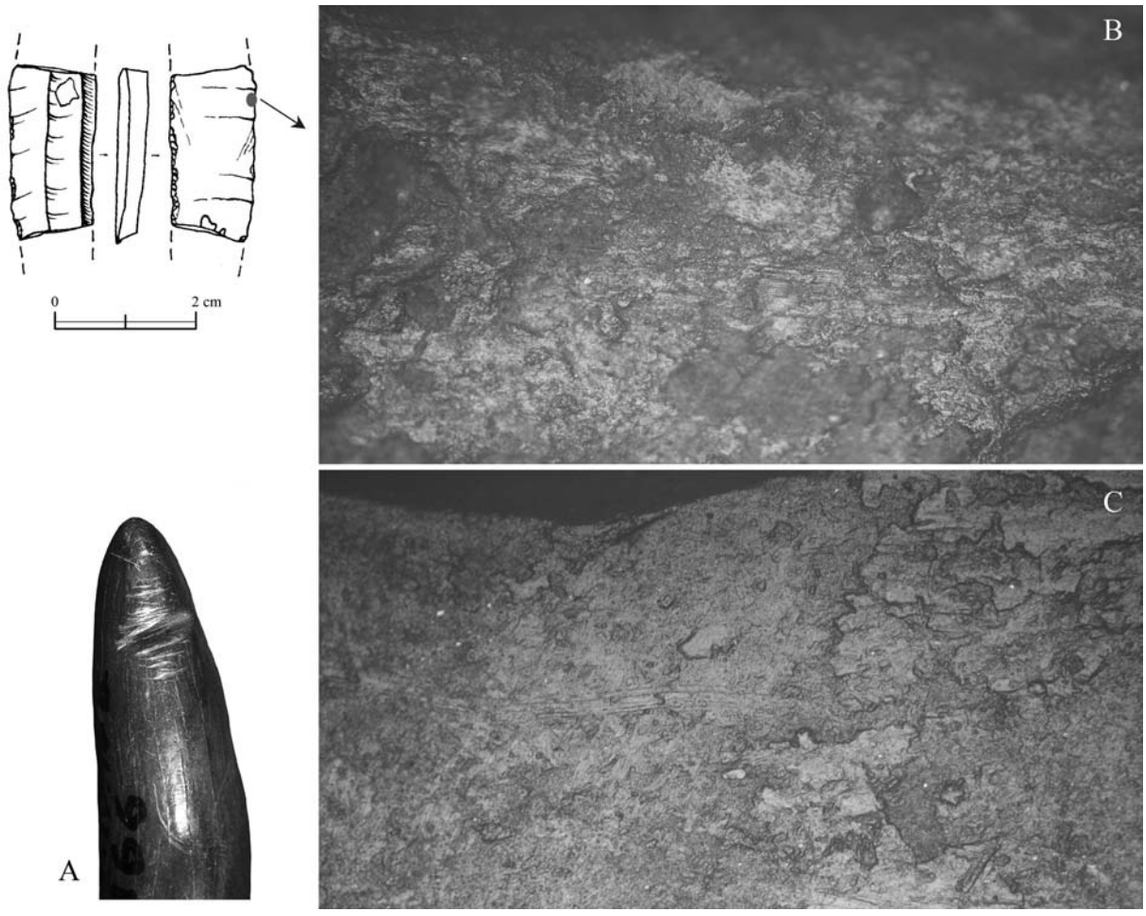

Fig. 14 - Ivanovskoje 7, upper Mesolithic layer (II a) saw for bone-working: flint blade used for sawing bone; A. traces of sawing on the root of a tooth (10 X); B. use-wear traces on the Mesolithic saw for bone (200 X); C. use-wear traces on the experimental saw for bone (200 X).

ner, that dorsal sides of microblades were up along the whole length of the slot. Arrowheads of various types with slots at both sides show that along one side all microblades are usually mounted with dorsal faces up, and at the other side with dorsal faces down (fig. 2.12). This gave more symmetry to the arrowhead, though had no practical significance. Edges of some inserts, protruding too much from the slot were levelled with the finest retouch.

Cutting of curved barbs was more complicated. It was done with narrow edged burins in the technique of gradual removing of bone (fig. 7.4). Tools with traces of wear on angles of sides of working edge could have been successfully used for various grooving, engraving etc. Small tools were used in handles as indicated by specific traces on their butts and more pronounced wear on their working edges. Engraved ornamentation, made with a very sharp pointed tool is met on some artefacts (fig. 2.5,7; 7.2,14,16). Experiments showed that it can be easily done with an angle of a broken blade.

Small slabs of fine and coarse grained rocks were used for crude and fine polishing of bone and antler artefacts from the collection (fig. 16.A). These final treatment operations usually obscure identification of the technology of the manufacture of particular artefacts. Polishing could be done with the help of fine grained slabs with soft abrasive powder, and also with the help of bark, leather or hide. Observations show that bright polishing was the final operation because traces of polishing on orna-

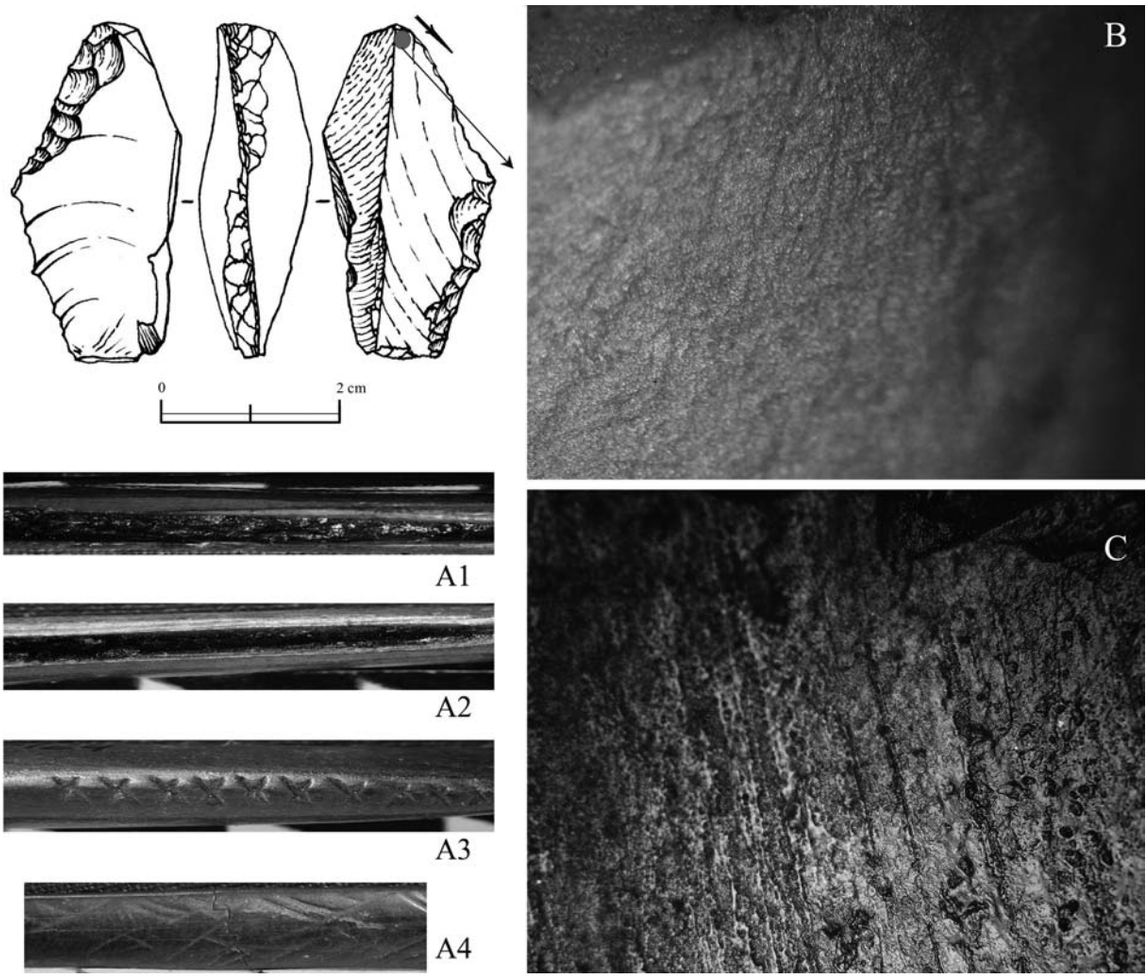

Fig. 15 - Ivanovskoje 7, upper Mesolithic layer (II a) burin for bone engraving: working edge; A. traces of cuts on bone (10 X) *(A1* - trapezoidal cross section; *A2* - V-shaped cross section; *A3* - ornament procutting; *A4* - engraving); B. use-wear traces on the Mesolithic burin for bone (200 X); C. use-wear traces on the experimental burin for bone (200 X).

mented tools overlay traces of engraving of the ornamentation.

Some abrasive slabs were used for a long time; use-wear traces are visible with a naked eye not only at flat surfaces, but also at sides (fig. 16.A).

Thus in the inventory of the Mesolithic site Ivanovskoje 7 a group of tools for processing bone was singled out. Implements for the whole technological set of operations were found, except for borers, though bone artefacts with drilled perforations are present in the collection. Blades and flakes without secondary treatment were used as blanks for most tools. Some tools combining several use-wear patterns were met: a whittling knife which working edge was later used as a scraper, and an axe that was used as a wedge after breakage.

Use-wear analyses showed that despite the seasonal character of the Mesolithic site Ivanovskoje 7 its inventory included the full set of instruments for various needs of its inhabitants. Hunting weapons, fishing and butchering tools, instruments for processing hides, plants, wood and lithic materials were distinguished. Given to the role played by bone processing (21% of used tools) the transformation of bone and antler was an intensive activity at the site. Numerous and various bone and antler artefacts, including a unique elk antler staff head (fig. 8)

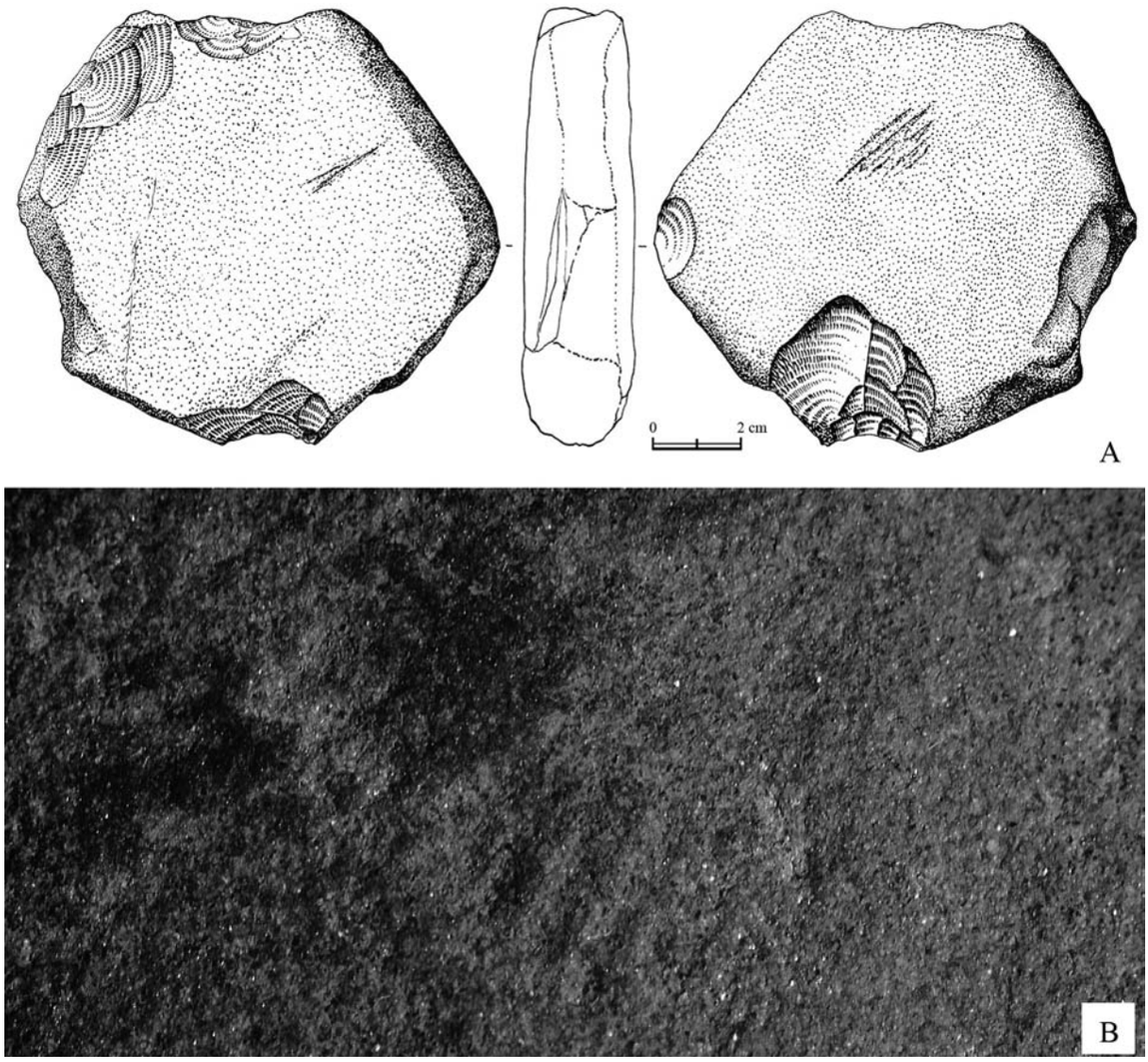

Fig. 16 - Ivanovskoje 7, upper Mesolithic layer (II a) abrasive for bone: A. working edge; B. use-wear traces on the Mesolithic abrasive for bone.

can be considered a striking evidence for the high level of its development and the relevance for social behaviours. The sophisticated technology for the manufacture of these artefacts demonstrates high achievements in bone-working all along the whole operative chain: from blanks preparation to final shaping, design, treatment, up to ornamentation purposes.

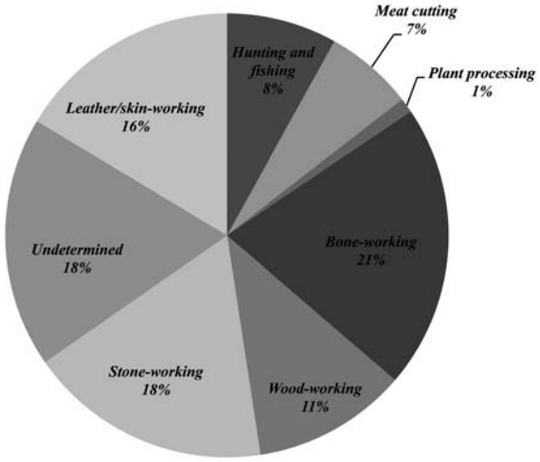

Fig. 17 - The functional classification of stone implements from Ivanovskoje 7 site.

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