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POLISHED FLINT 'SCRAPERS' FROM NIDA NEOLITHIC SETTLEMENT – WERE THEY TOOLS? CLUES FROM EXPERIMENTAL STUDIES AND A USE-WEAR ANALYSIS

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The Nida site is an extensively investigated Neolithic settlement with extraordinary rich, Rzucewo culture material (3200–2400 cal BC). A special type of flint tool with polished edges is well known there and is characteristic to exclusively the Rzucewo culture. It has been called a polished 'scraper' by previous researchers with a strong affiliation for utilitarian functions. However, no arguments for their use as a hide or other scraper have yet been presented. The goal of this paper is to present the results of the first attempt to understand the function of these polished 'scrapers' through the combination of a use-wear analysis and an experimental study. Although the interpretation of the initial results was greatly hindered by post-depositional alterations during aeolian processes, the present authors assert that these polished 'scrapers' were probably not used for household activities in the traditional sense. This is supported by their low effectiveness in such activities, which was observed through the use of experimental tools and the results of a use-wear analysis of the experimental and prehistoric implements.

Keywords: Rzucewo culture, polished flint 'scrapers', function, use-wear, experiments.

Nidos neolito gyvenvietė yra plačiai tyrinėta, priskiriama Pamarių (Rzucewo) archeologinei kultūrai (3200–2400 cal BC). Čia žinomas vienas ypatingas titnago dirbinių tipas. Tai – dirbiniai gludintais ašmenimis, būdingi tik Pamarių kultūrai ir ankstesnių tyrinėtojų vadinti gremžtukais, taip pabrėžiant jų numanomą utilitarinę funkciją. Deja, iki šiol nepateikiama jokių įrodymų, kad jie buvo naudoti kailiams ar kitoms medžiagoms gremžti. Šio straipsnio tikslas yra supažindinti su rezultatais pirmojo bandymo suprasti minėtų dirbinių funkciją analizuojant darbo žymių mikroskopinius pėdsakus ir eksperimentų būdu. Nors rezultatų interpretaciją labai apsunkino postdepozitinis pustomo smėlio poveikis, autorių manymu, gludinti titnaginiai „gremžtukai" tikriausiai nebuvo naudojami tradiciniuose namų ūkio darbuose. Tai liudija ir žemas efektyvumas bandant jų replikas įvairiose veiklose, ir darbo žymių ant priešistorinių dirbinių bei jų replikų mikroskopinė analizė.

Reikšminiai žodžiai: *Pamarių (Rzucewo) kultūra, gludinti titnaginiai „gremžtukai", funkcija, darbo žymės, eksperimentai.*

INTRODUCTION TO THE NIDA SITE

Nida is situated on the Curonian spit, a narrow strip of land that consists of plains and dunes and lies between the Baltic Sea and the Curonian Lagoon (Fig. 1). The spit or a chain of islands rose from the water only 6000 years ago, during the Littorina Sea regression. Its landscape has been subsequently remodelled many times by aeolian processes (Piličiauskas *et al.* 2015). The Curonian Lagoon, the largest lagoon in Europe (1584 km^2), is a mainly freshwater basin fed by Lithuania's largest river, the Nemunas.

Fig. 1. Situation of Neolithic Nida site. *Drawing by G. Piličiauskas.*

Nida stands among the best known Lithuanian archaeological sites because of its long research history as well as the huge quantity of elaborate, impressive pottery mainly decorated with cord compositions. This type of pottery is usually called 'corded ware', although Nida's has many specific traits. These and other unique cultural elements have enabled archaeologists to distinguish a separate Rzucewo culture (alternate names: Pamariai, Bay Coast, and Haffküstenkultur) in the Southeastern Baltic (Żurek 1953; Killian 1955; Rimantienė 1989).

The Nida site has been known and extensively investigated since 1832. However, the largest quantity of archaeological material was collected during 1974–1978 when Rimutė Rimantienė conducted a large-scale excavation (4640 m^2) there (Rimantienė 1989). The very rich cultural layer could not be excavated completely at many locations because it dropped below the groundwater level[1]. 322 postholes and 88 fireplaces were documented during the excavation, although the size and construction of the ancient buildings remained unclear owing to the superimposition of structures of different ages over a very long settlement history. More than 100 000 potsherds were collected during the 5-year excavation, almost all of which belong to the Rzucewo Culture, only 60 being ascribed to the preceding sub-Neolithic porous ware. Very few amber ornaments have been found, probably because of their poor preservation in aeolian sand (Rimantienė 1989).

The excavation of the Nida site resumed in 2011–2013 with the investigation of 80 m^2. Ground penetrating radar was used to locate Rimantienė's trenches and to reconstruct the ancient aeolian landscape. Several stratified profiles were precisely documented using 3D mapping (Fig. 2). The 24 radiocarbon dates obtained from different materials greatly contributed to the understanding of the site's chronology. The sub-Neolithic porous pottery was dated to 3500–3300/3200 cal BC, the Neolithic Rzucewo to 3300/3200–2500/2400 cal BC (Piličiauskas, Heron 2015; Piličiauskas 2016).

The Nida population lived on the shore of the Curonian lagoon, the W bank of which was one km to the W of the modern coastline. The village would have suffered from aeolian activities from time to time as is seen from the numerous palaeosoils and cultural horizons buried by sand (Fig. 2; Piličiauskas,

[1] This stratigraphy was recorded during the recent excavation (see Fig. 2).

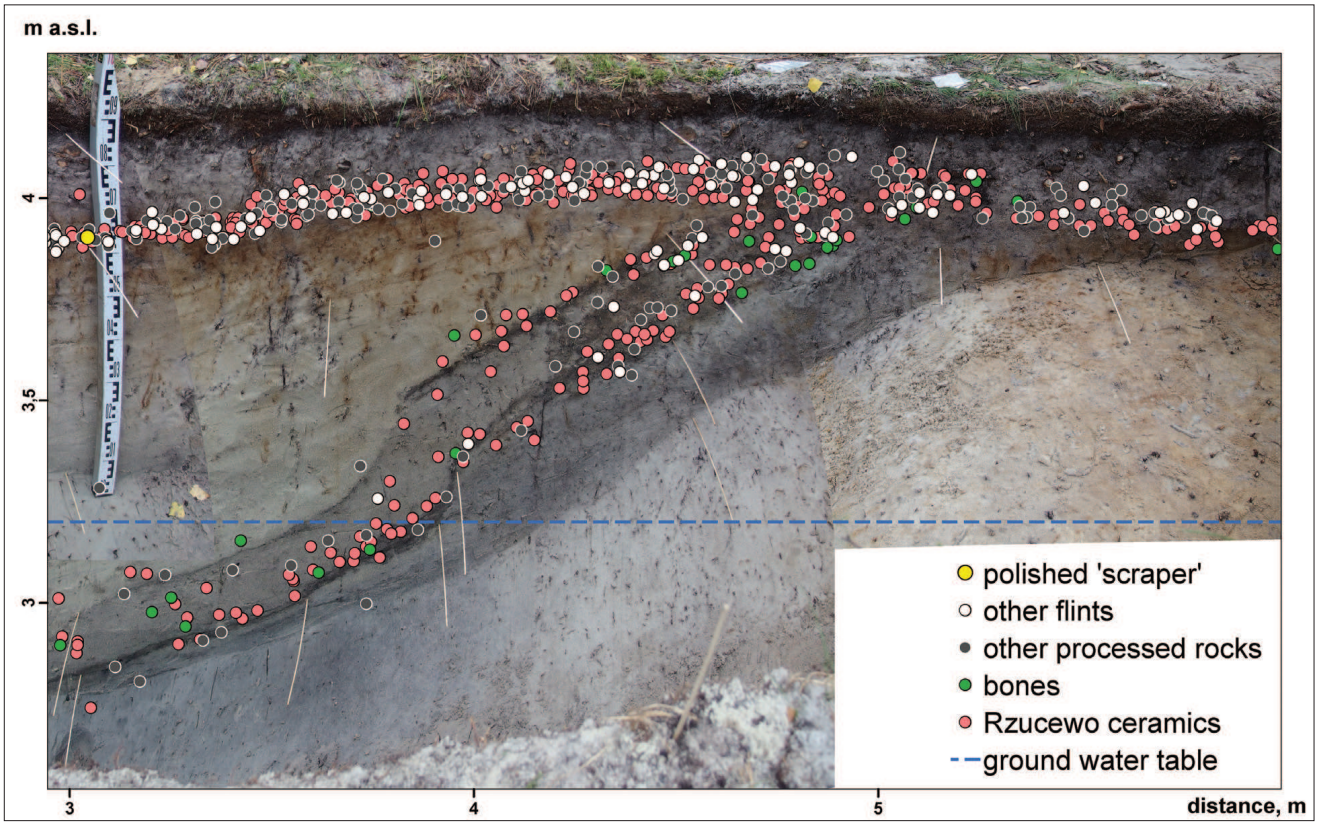

Fig. 2. A sample of the aeolian stratigraphy at the Nida site. A georeferenced composite photograph with the artefact distribution projected from the 1 m wide trench excavated by G. Piličiauskas in 2013. Palaeosoil remains (dark humus-rich sand) are visible in the lower horizon while the artefacts in the upper horizon have been weathered considerably owing to aeolian processes. Both cultural horizons were AMS dated to 2600–2400 cal BC (after Piličiauskas, Heron 2015).

Heron 2015, Fig. 8). The stable isotope and biomolecular analyses of the organic residues on the vessels attest to a strong aquatic component, especially freshwater, in the diet of Nida's prehistoric population. Domestic animals would have been kept and diary products have been documented in at least one Neolithic beaker (Heron *et al.* 2015). Seal, dog, beaver, red deer, elk, fox, horse, boar/pig, aurochs/cattle, sheep/goat, bird, bream, and pike bones have been recorded. The zooarchaeological material attests to the use of a wide range of food resources although no quantitative data are available (Hollack 1985; Rimantienė 1989; Piličiauskas, Heron, 2015; Piličiauskas 2016). It is likely that a mixed economy was practiced there (Piličiauskas 2016). It is crucial to know the ancient economy when trying to identify household activities or the function of artefacts by any means.

POLISHED FLINT 'SCRAPERS'. AN OVERVIEW OF THE PROBLEM

Siliceous and other rock types would have been collected as beach pebbles and used for various household tasks at the Nida site. The local flint nodules were of poor quality and small. The bipolar-on-anvil technique was consequently the main knapping method used there. Some morphological types of retouched artefacts made on flakes, bladelets, and scaled pieces are known, e.g. perforators, scrapers and knives, although many other unretouched flints were also definitely in use.

The most striking and unique type among Nida site's flint tools is a 'scraper' with a polished edge. The term 'scraper' is used here as a purely typological category because no attempt had been made to

infer the function of these tools microscopically prior to this study. A total of 25 polished 'scrapers' have been found in Nida (Rimantienė 1989). They were made from flakes or scaled pieces, often with the cortex preserved. Some of them could be classified as 'end-scrapers', some as 'side-scrapers', and some as rounded. This means that the position of the polished working edge is of minor importance or the tools were used in several ways. Polished 'scrapers' are very common at the Rzucewo site, where about 120 have been found (Żurek 1953). More than 30 polished 'scrapers' are known from Niedźwiedziówka, a few from each Rewa (Januszek 2010), Suchacz (Ehrlich 1934), and Pribrezhnoye (Зальцман 2010). Several artefacts of this type have also been found at Funnel Beaker culture (Łupawa group) sites in Eastern Pomerania (Domańska 1983; 1987). They are, however, very few in number and might be admixtures or traded items from the Rzucewo culture. No polished flint 'scrapers' were mentioned in the latest paper on the flint industry of the Łupawa group (Domańska 2015).

In summarising the distribution, this artefact type is specific to the Neolithic Rzucewo culture and was not produced or used elsewhere. Polished 'scrapers' were definitely in use during 2600–2400 cal BC as proven by two artefacts found in stratified and well-dated cultural horizons at Nida in 2013 (Fig. 2). Their use during the earliest phase of the Rzucewo culture at Nida has not been proven as the 1974–1978 artefacts lack well-dated contexts. In 2012, a few segments of the site with the oldest Rzucewo pottery types were investigated, but the excavation revealed no polished 'scrapers'. However, only a small area was excavated and a wider excavation might change the situation.

The most intriguing question is the function of the polished 'scrapers'. Did they perhaps have a very specific function and was their function perhaps related to the specific nature of the coastal economy? Jan Żurek (1953) once expressed an idea that polished scrapers could have been used to process seal skins. However, no use-wear, ethnographic, or other arguments have so far been presented for this or any other interpretation.

In order to find answers or to narrow the range of possible functional interpretations, a special use-wear/experimental study was conducted, its results being presented here. The subject of the analysis was 10 artefacts with polished edges from the Nida site. The conducted microscopic tests aimed to identify possible wear damage on the surface of the artefacts, to determine the purpose of the polished edges, and, finally, to allow for an interpretation of probable functions of these products. Most of them had experienced severe post-depositional damage and some of the observed micro-traces have no close analogies in the other published prehistoric flint collections. For that reason, all of the suggestions made here must be considered preliminary and should be verified during future use-wear analyses, experimental studies, and discussions. Considering the uniqueness of the analysed collection, the atypical characteristics of the observed wear traces (?), and the interpretation problems that arose owing to various reasons, it was decided to include in the article a full multi-aspect photographic documentation of the recorded damage. The documentation will allow readers to analyse the surface of the artefacts in detail and to verify the observations in a relatively objective way and will provide grounds for a possible discussion. In order to allow better visualization of the analysed artefacts and to show the related interpretational problems, the paper also includes photomicrographs of some of the discovered (more typical) post-depositional damage and the natural surfaces of the artefacts.

USE-WEAR ANALYSIS. METHODOLOGY AND EQUIPMENT

The initial part of the use-wear analysis was conducted with the use of a *Nikon SMZ-2T* microscopic-computer kit with 12.6x maximum magnification (a real magnitude of 120x) and computer digitisation and processing of the optical images. During the further analysis of the polished surfaces, a *Zeiss-Axiotech*

microscopic-computer kit was used with maximum magnification of 50x (a real magnitude of 500x). The photomicrographs listed as Figs. 5; 6; 8:2, 4, 6; 9:3–8; 10:1, 2, 5, 6; 11:2, 4; 12:3, 6, 7; 13:2, 3, 7, 8; 14:1 were also made with this equipment. The rest of the photomicrographs were made with a *Carl Zeiss™ SteREO Discovery V8* microscope (with a maximum magnification of 80x) with a Canon A620 camera attached. Prior to the analysis, the material was cleaned with a detergent diluted in water and pure C_2H_5OH.

The applied terminology was based on the concept system created by: the Ho Ho Committee (1979, pp.133–135), Patric Clemente Vaughan (1985, Glossary, pp.10–13), Annelou van Gijn (1989, pp.16–20), Helle Juel Jensen (1994, pp.20–27), Galina Fiodorowna Korobkowa (1999, pp.17–21), and Grzegorz Osipowicz (2010, pp.24–35). The terminology proposed by those authors was adjusted according to the study's needs and requirements.

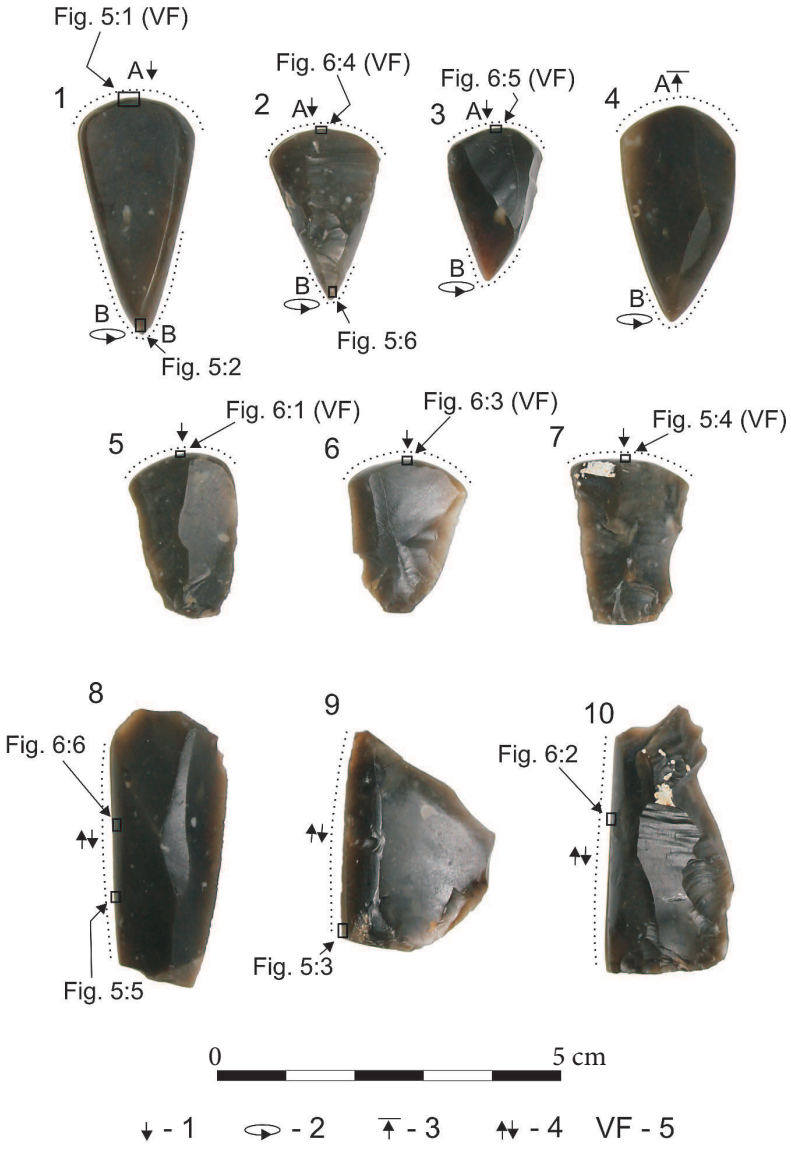

Fig. 3. Replicas of the Nida artefacts used in the experimental program. The working edges used, the type of performed action, and the locations of the photomicrographs are marked: 1 – scraping, 2 – drilling, 3 – splitting, 4 – sawing, 5 – photographs of the tool's ventral side. *Photo by G. Osipowicz.*

EXPERIMENTAL PROGRAM

The morphological specificity and uniqueness of the polished products from the Nida site required planning and the implementation of a special experimental program, the results of which served as one of the bases for interpreting the functions of the prehistoric items. One of the main research objectives was to determine the possible labour intensity of the preparation process of the discussed type of implements, as well as their effectiveness in processing of the different kinds of raw materials available in the prehistoric era. Nevertheless, the most important of the posed problems was observing if and how the processing of specific raw materials affects the formation of wear traces on the polished working edges. How do such surfaces change and is the damage that occurs on them through their use different from the damage typical of non-polished tools? And, lastly, is it even possible to determine the original function of such implements from prehistoric sites?

For the purpose of the work planned under the experimental program, ten 'scrapers' with polished working edges were manufactured as replicas of the Nida artefacts (Fig. 3). All ten were made of Baltic

Fig. 4. Examples of the experimental tasks performed during the project: 1 – hide scraping, 2 – hide cutting, 3 – wood sawing, 4 – wood drilling, 5 – antler scraping, 6 – antler sawing, 7 – amber drilling, 8 – scraping the calcium cortex on a piece of flint. *Photo by J. Kuriga.*

erratic flint and the polished surfaces were initially retouched. These items were used in 14 activities (Fig. 4). The conducted experimental program was based on the assumption of the necessity for testing the largest possible number of raw materials that could have been processed in the Nida site, including most of the basic raw materials of the prehistoric economy. To that end, the following types of raw materials were subjected to processing: hide, wood, antler, amber, and earthenware. Likewise, the set of performed activities consisted of basic operations that could have been executed with the use of the tools being analysed, i.e., scraping, sawing/cutting, and drilling/piercing. The detailed characteristics of the performed experimental tasks are presented in Table 1.

Table 1. Catalogue of experimental tools used for the analyses

No.	Activity	Conditions of the experiment / photomicrography	Work time (minutes)	Tool / working edge	Wear traces
1	Hide scraping	Boar hide, dry and hard, no haft during the work, Fig. 4:1	60	Fig. 3:1, edge A	Fig. 5:1 – polish on the working edge
2	Hide piercing	Boar hide, dry and hard, no haft during the work	60	Fig. 3:1, edge B	Fig. 5:2 – polish on ridges
3	Hide cutting	Boar hide, dry and hard, tool with wooden haft, Fig. 4:2	90	Fig. 3:9	Fig. 5:3 – polish on the working edge, visible polishing residue
4	Wood scraping	Lime tree and pine wood, dry, no haft during the work	55	Fig. 3:7	Fig. 5:4 – polish on the working edge
5	Wood sawing	Lime tree and pine wood, dry, no haft during the work, Fig. 4:3	60	Fig. 3:8	Fig. 5:5 – polish on the working edge
6	Wood drilling	Pine wood, dry, tool with stick haft, rotated between the palms, Fig. 4:4	35	Fig. 3:2, edge B	Fig. 5:6 – polish on ridges
7	Antler scraping	Deer antler, unsoftened or poorly softened by boiling in water, no haft during the work, Fig. 4:5	90	Fig. 3:5	Fig. 6:1 – polish on the working edge
8	Antler sawing	Deer antler, unsoftened or poorly softened by boiling in water, no haft during the work, Fig. 4:6	90	Fig. 3:10	Fig. 6:2 – polish on the working edge, visible polishing residue
9	Antler drilling	Deer antler, unsoftened, no haft during the work	60	Fig. 3:3, edge B	–
10	Amber scraping	No haft during the work	60	Fig. 3:6	Fig. 6:3 – polish on the working edge
11	Amber drilling	no haft during the work, Fig. 4:7	60	Fig. 3:4, edge B	–
12	Scraping of calcium cortex on flint	Baltic erratic flint, no haft during the work, Fig. 4:8	45	Fig. 3:2, edge A	Fig. 6:4 – polish on the working edge
13	Ceramic scraping	Ceramic with plant addition, fired in a hearth, no haft during the work	30	Fig. 3:3, edge A	Fig. 6:5 – polish on the working edge
14	Amber splitting	Hafted tool	15	Fig. 3:4, edge A	Fig. 15:3, 4 – roughening on the working edge

RESULTS OF THE EXPERIMENTAL STUDY

The conducted experimental tests, owing mainly to the limited number of executed experiments, certainly cannot serve as a foundation for drawing far-reaching and firm conclusions regarding the area of application of the polished artefacts from the Nida site. Nevertheless, it is hoped that the observations made here will constitute a considerable contribution to the discussion that can be conducted after the completion of a larger number of experiments and use-wear analyses or, for example, the securing of new relevant archaeological sources. For the moment, the suggestions presented ought to be regarded as the researchers' subjective assessments, which may be verified in the near future.

The first issue that the conducted experiments were intended to help resolve is the problem of the time necessary for making the items of the discussed type, namely, the number of man-hours required for polishing their edges. In the course of the work conducted in this area, two kinds of fine-crystalline sandstone were used as sanding plates: ferruginous quartz sandstone, so-called Jotnian sandstone, and

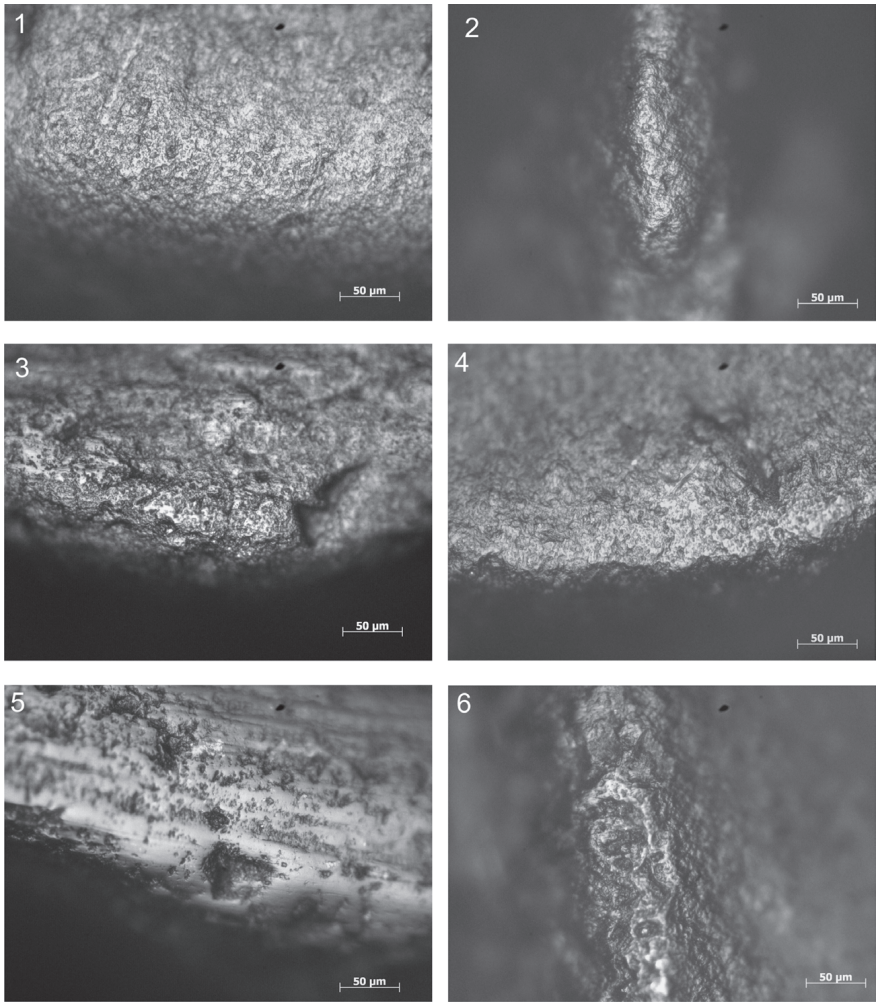

Fig. 5. Examples of the wear traces that formed on the experimental tools: 1 – hide scraping, 2 – hide piercing, 3 – hide cutting, 4 – wood scraping, 5 – wood sawing, 6 – wood drilling. All photomicrographs – x250, ob. 20. *Photo by G. Osipowicz.*

the white-yellow quartzite sandstone with an even finer grain (which is still used to make grindstones). Both of the raw materials take the form of erratics in the European lowlands. As a result of the conducted experimental task, it was found that polishing the edges of a flake to a level comparable to that of the Nida 'scrapers' is neither difficult nor time-consuming. In every case, the process was completed within several minutes to a maximum of 40 for a roughly 2–3 cm long edge. The time required obviously depended on several factors, including mainly the type of sandstone used, the precision of the retouch, the shape of the working edge, the size (handiness) of the piece, etc. However, it certainly cannot be stated that products of this sort were particularly difficult to produce; hence, they were not a commodity that was hard to come by (at least not for that specific reason) nor were they particularly valuable for prospective users.

Another problem posed by the conducted experiment was the effectiveness of the polished working edges compared to those of natural and retouched blades used for processing the basic types of raw materials available in the prehistoric era. In this case, a collection of over 400 experimental flint tools located at the Institute of Archaeology at Nicolaus Copernicus University in Toruń, Poland (hereinafter referred to as the IA NCU) was used as comparative material. The conducted experimental tasks proved that the polished blades should be considered particularly ineffective, at least in respect to the performed types of activities. In principle, all the raw materials employed in the program were difficult to process and the tools soon grew dull, at times becoming completely unsuitable for the activities after only a few minutes. It can then be assumed, with a reasonable degree of probability, that they could not have been a substitute for the 'regular' flint tools, especially in everyday household activities. However, taking into account their conspicuous appearance, the possibility cannot be definitely ruled out that the applied importance of items of this type goes beyond the typical utilitarian sphere and that they were used for activities morphologically similar to everyday activities, yet of a different nature, e.g., therapeutic or ceremonial.

The last and, at the same time, the most important issue, to the solving of which the conducted ex-

perimental program was expected to contribute, was an analysis of the effect of the processing of various kinds of raw materials on the formation of micro-traces on the polished working edges and, therefore, the possibility of interpreting the functions of the polished flake tools basing on the investigation of the readable use-wear damage present on these tools. As can be seen in the included photomicrographs (Fig. 5, 6), all of the performed activities led to the formation of working edge wear traces with characteristics close to those typical of the wear traces recorded on the classic flint tools used for similar purposes. In every case, these traces have obliterated/covered the remaining traces of the polishing, which do not preclude proper functional interpretation. In this regard, it ought to be concluded that it is highly possible to accurately determine the purpose of well-preserved artefacts of the discussed kind if the activities for which they were used are known and the properly documented in terms of use-wear and that this determination should not cause any problems other than those encountered during standard tool tests.

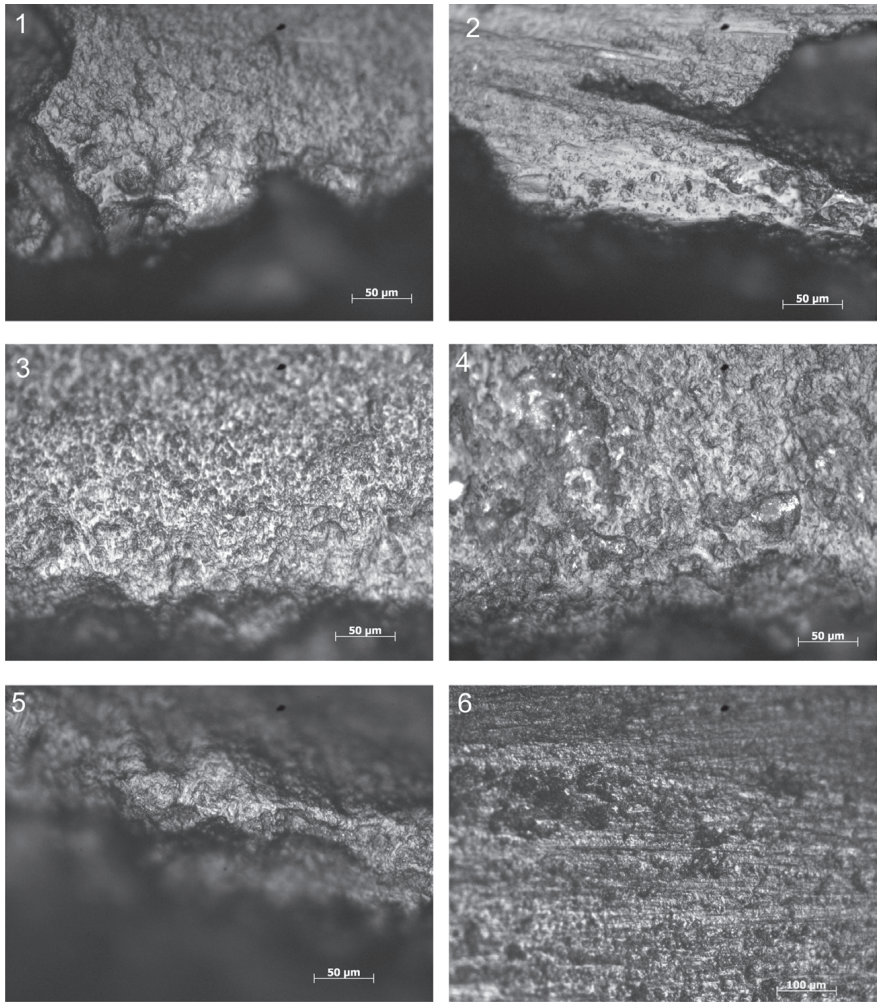

Fig. 6. Examples of the wear traces that formed on the experimental tools: 1 – antler scraping, 2 – antler sawing, 3 – amber scraping, 4 – scraping the calcium cortex on a piece of flint, 5 – earthenware scraping, 6 – an unused edge, grinding. Photomicrographs 1–5 – x250, ob. 20; 6 – x125, ob. 10. *Photo by G. Osipowicz.*

RESULTS OF THE USE-WEAR ANALYSIS OF THE NIDA ARTEFACTS

Ten scrapers from the storage facilities of National Museum of Lithuania were subjected to use-wear analysis. Due to the uniqueness of the analysed collection and the differences observed between individual specimens, all of them will be discussed individually.

1. Inv. no. EM 2243:478 (Fig. 7:1) – The artefact's entire surface has been dulled as a result of post-depositional processes, perhaps aeolian activity, i.e. sand abrasion (Fig. 8:1 x12, objective[2] 10). The ridges and both lateral edges are intensely rounded (Fig. 8:2, 4 x125, ob. 10). Only at one location on the primary polished surface is some linearity visible, the result of oblique polishing (Fig. 8:3 x32, ob. 10); elsewhere, particularly in the central part of

[2] The abbreviation *ob.* is used later in the article.

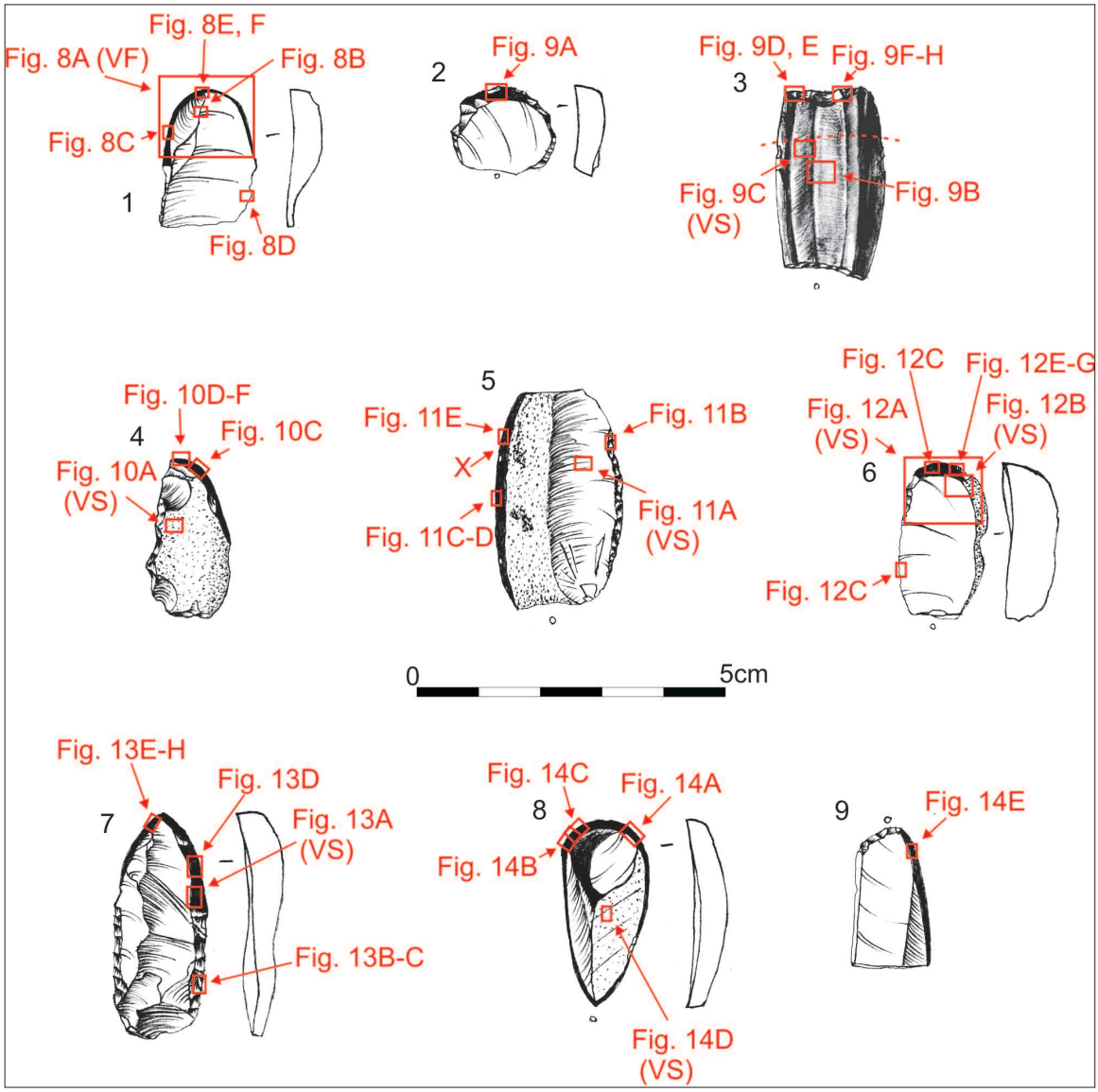

Fig. 7. The polished Nida artefacts subjected to analysis. The locations of the photomicrographs are marked. *Drawing by G. Piličiauskas, G. Osipowicz.*

the surface, traces of this type are not visible. In the photomicrograph, the flint's slightly obliterated and rounded micro-relief can be seen instead of a slightly rough and cratered surface (Fig. 8:5 x50, ob. 10; 8:6 x250, ob. 20). This can be found on the entire area of the polished surface.

2. Inv. no. EM 2243:213 (without soaking) – The artefact's entire surface has been greatly damaged as a result of post-depositional processes (damage similar to that observed on specimen no. 1). The ridges and lateral edges are intensely rounded, without possible use-wear traces.

3. Inv. no. EM 2243:1290 (Fig. 7:2) – The artefact is in relatively good condition, with moderate post-depositional damage present on the surface. On the scraper's primary end, traces of polishing are visible (Fig. 9:1 x65, ob. 5). The surface of the specimen bears no other type of traces.

4. Inv. no. EM 2243:1571 (Fig. 7:3) – The artefact is in relatively good condition, with moderate

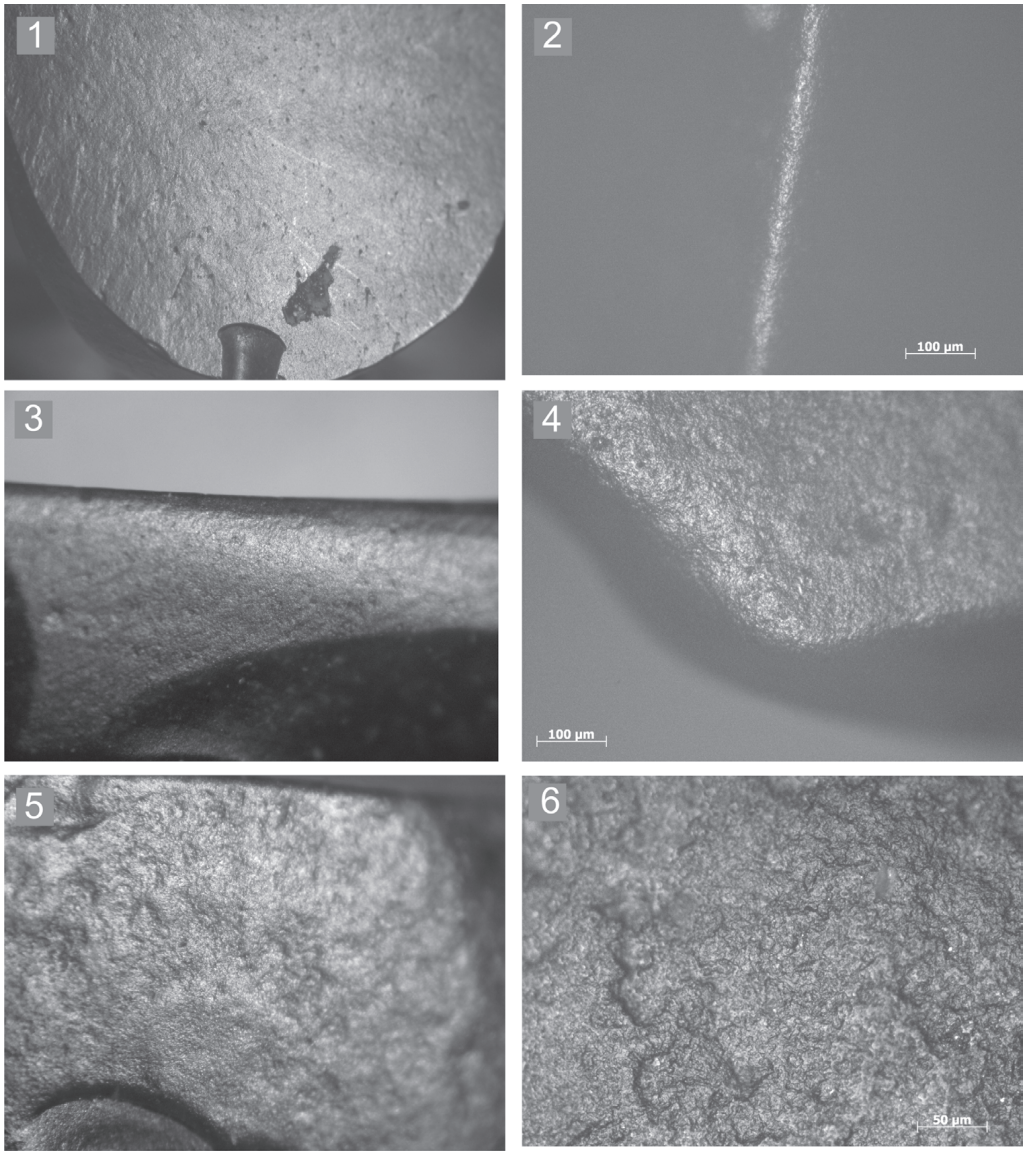

Fig. 8. Nida, artefact EM 2243:478. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x12, ob. 10; 2 – x125, ob. 10; 3 – x32, ob. 10; 4 – x125, ob. 10; 5 – x50, ob. 10; 6 – x250, ob. 20. *Photo by G. Osipowicz.*

post-depositional damage present on the surface. Its dorsal surface is covered with multifaceted polishing perpendicular or oblique to its axis (Fig. 9:2 x65, ob. 5). On the ventral surface, at 2/3 of its length to the dotted line, one can observe glossy polishing with fluted topography and a smooth texture, which disappears gradually towards the truncation and includes possible use-wear traces (Fig. 9:3 x125, ob. 10). This polishing is also visible on the analogous area on the polished dorsal surface. Very bright (glossy) and linear (oriented perpendicularly) polishing with flat topography, a rough texture, and an invasive degree of intrusion was also discovered on the surface of the scars on one of the truncations (which, unfortunately, had been destroyed) (Fig. 9:4 x125, ob. 10; 9:5–8 x250, ob. 20). It mostly covers the upper parts of the ridges, but is also visible in the deeper parts of the scars. The destruction of a large part of the truncation (including the probable working edge) makes the determination of its

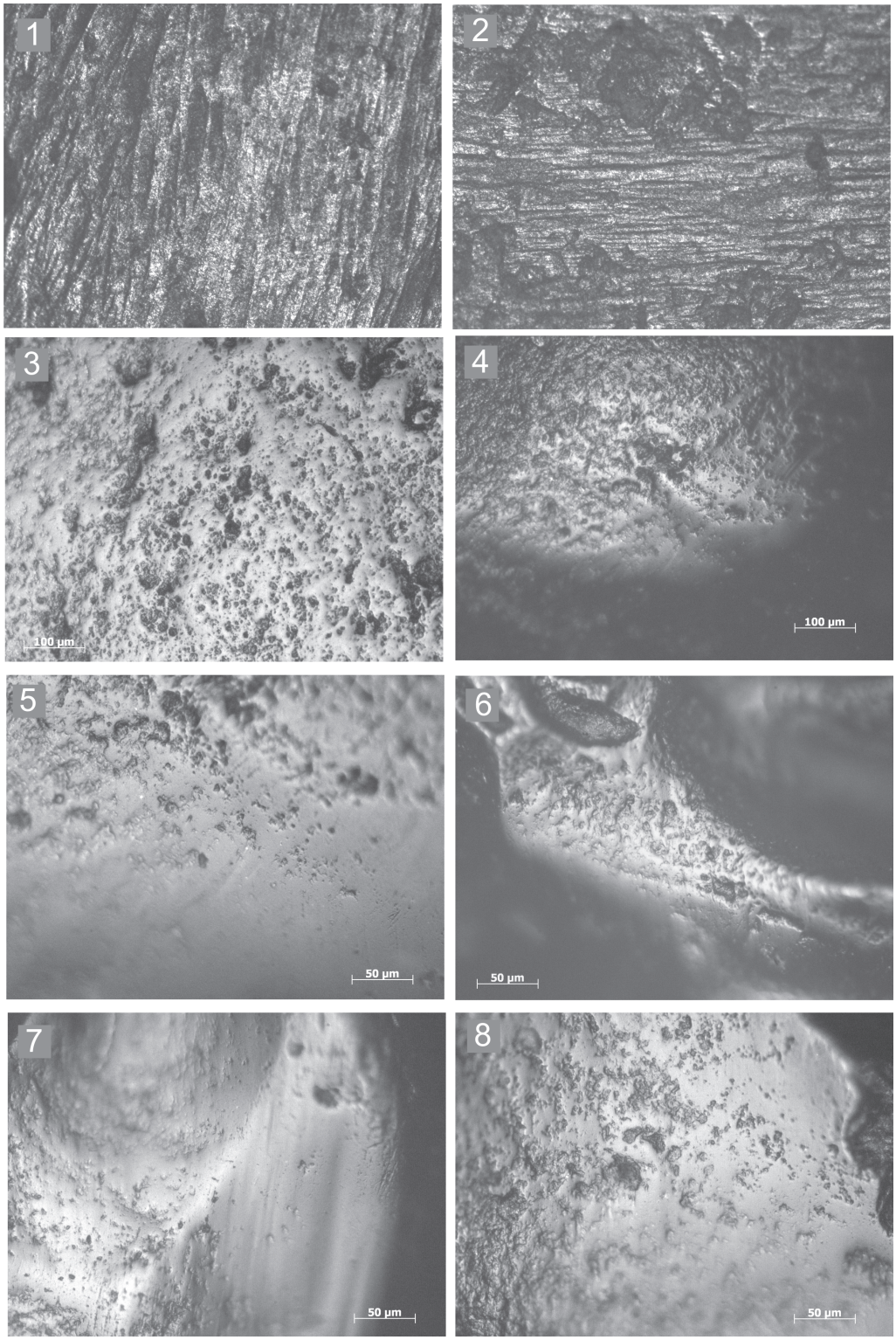

Fig. 9. Nida, artefacts EM 2243:1290 and EM 2143:1571. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x65, ob. 5; 2 – x65, ob. 5; 3 – x125, ob. 10; 4 – x125, ob. 10; 5 – x250, ob. 20; 6 – x250, ob. 20; 7 – x250, ob. 20; 8 – x250, ob. 20. *Photo by G. Osipowicz.*

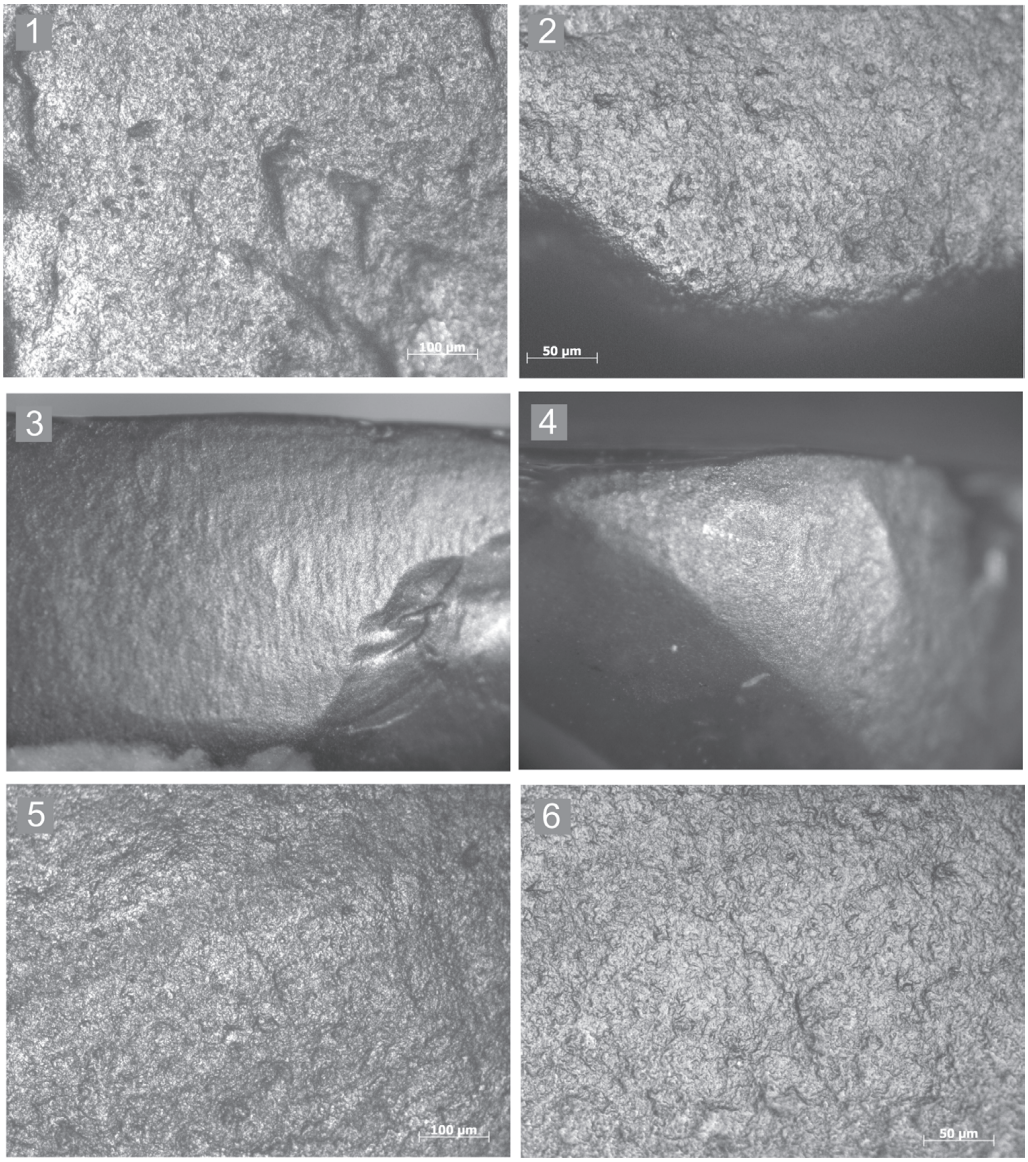

Fig. 10. Nida, artefact EM 2243:688. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x125, ob. 10; 2 – x250, ob. 20; 3 – x20, ob. 10; 4 – x40, ob. 10; 5 – x125, ob. 10; 6 – x250, ob. 20. *Photo by G. Osipowicz.*

origin very difficult. It is, however, almost the same with the polishing observed on the item's 'flat' surfaces.

5. Inv. no. EM 2243:688 (Fig. 7:4) – The artefact's entire surface has been dulled as a result of post-depositional processes (cf. item no. 1) (Fig. 10:1 x125, ob. 10). The ridges and lateral edges are rounded (Fig. 10:2 x250, ob. 20). The micro-traces visible at certain places on this item are very similar (especially at high magnification) to those typical of hide processing (Fig. 10:2). The obliterated traces of polishing can be seen on only one of the edges (Fig. 10:3 x20, ob. 10), which disappears towards the distal end. In this area, one can see delicate polishing covering the higher parts of the flint micro-relief and a roughening of the surface (Fig. 10:4 x40, ob. 10; 10:5 x125, ob. 10; 10:6 x250, ob. 20).

6. Inv. no. EM 2243:1559 (Fig. 7:5) – The artefact's surface has been dulled as a result of post-depositional processes (Fig. 11:1 x40, ob. 10 – the arte-

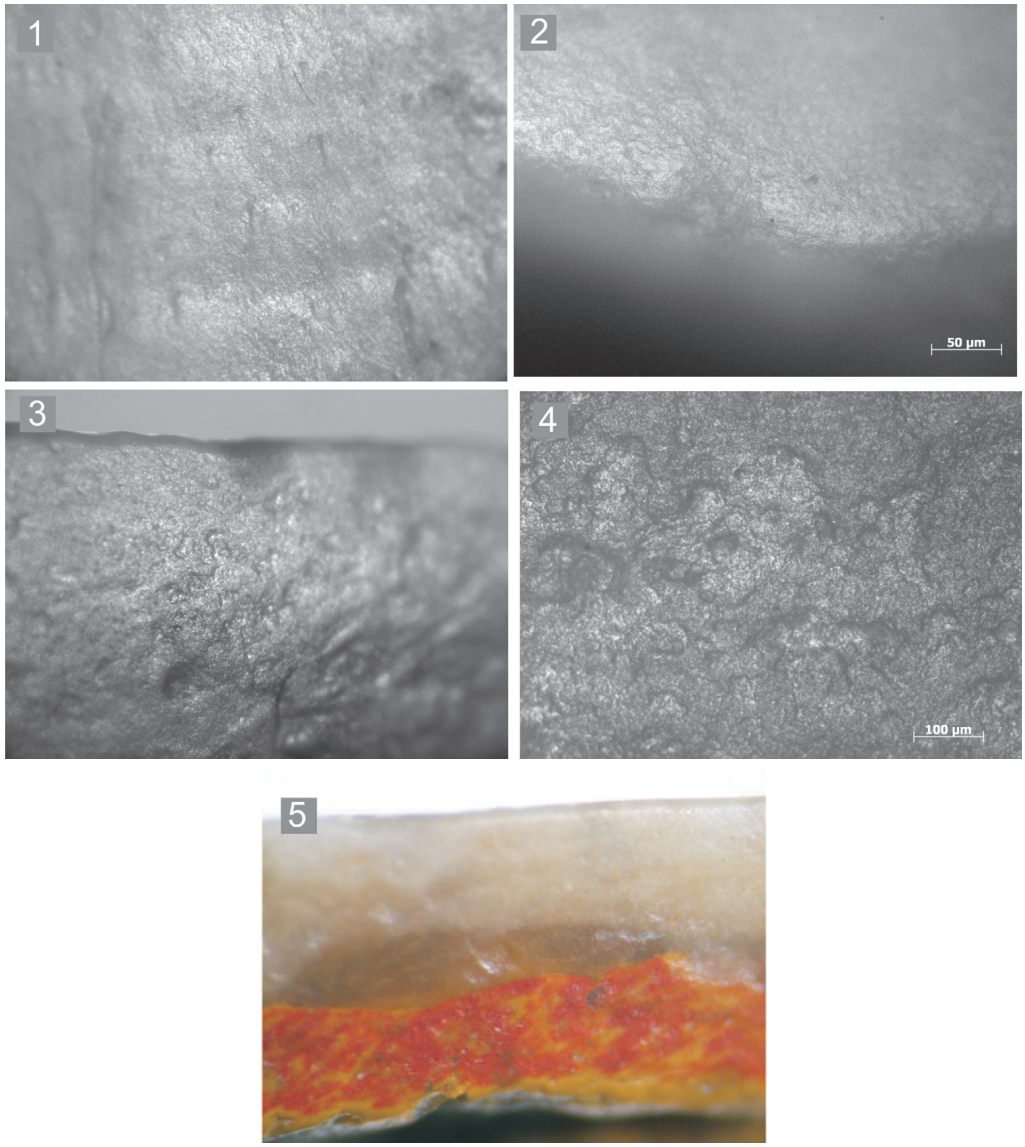

Fig. 11. Nida, artefact EM 2243:1559. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x40, ob. 10; 2 – x250, ob. 20; 3 – x40, ob. 10; 4 – x125, ob. 10; 5 – x40, ob. 10. *Photo by G. Osipowicz.*

fact's surface). The ridges and lateral edges are very rounded. The micro-traces visible on certain parts are very similar (especially in high magnifications) to those typical for hide processing (Fig. 11:2 x250, ob. 20). Obliterated traces of polishing (the places with smooth, oblique, and wavy linearity being marked with an 'X', Fig. 7:5) can be seen in only one location on the formerly polished surface. In other areas, the polishing has been eroded by roughening with the same characteristics as those described in respect to artefact no. 1 (Fig. 11:3 x40, ob. 10; 11:4 x125, ob. 10). Interestingly, the flint cortex has a red tint only in the area with probable use-wear traces (Fig. 11:5 x40, ob. 10). Consideration should perhaps be made as to whether these are residues, bound in the silica, of the substance processed with this tool.

7. Inv. no. EM 2243:498 (Fig. 7:6) – The artefact's entire surface has been dulled as a result of post-depositional processes (Fig. 12:1 x12, ob. 10;

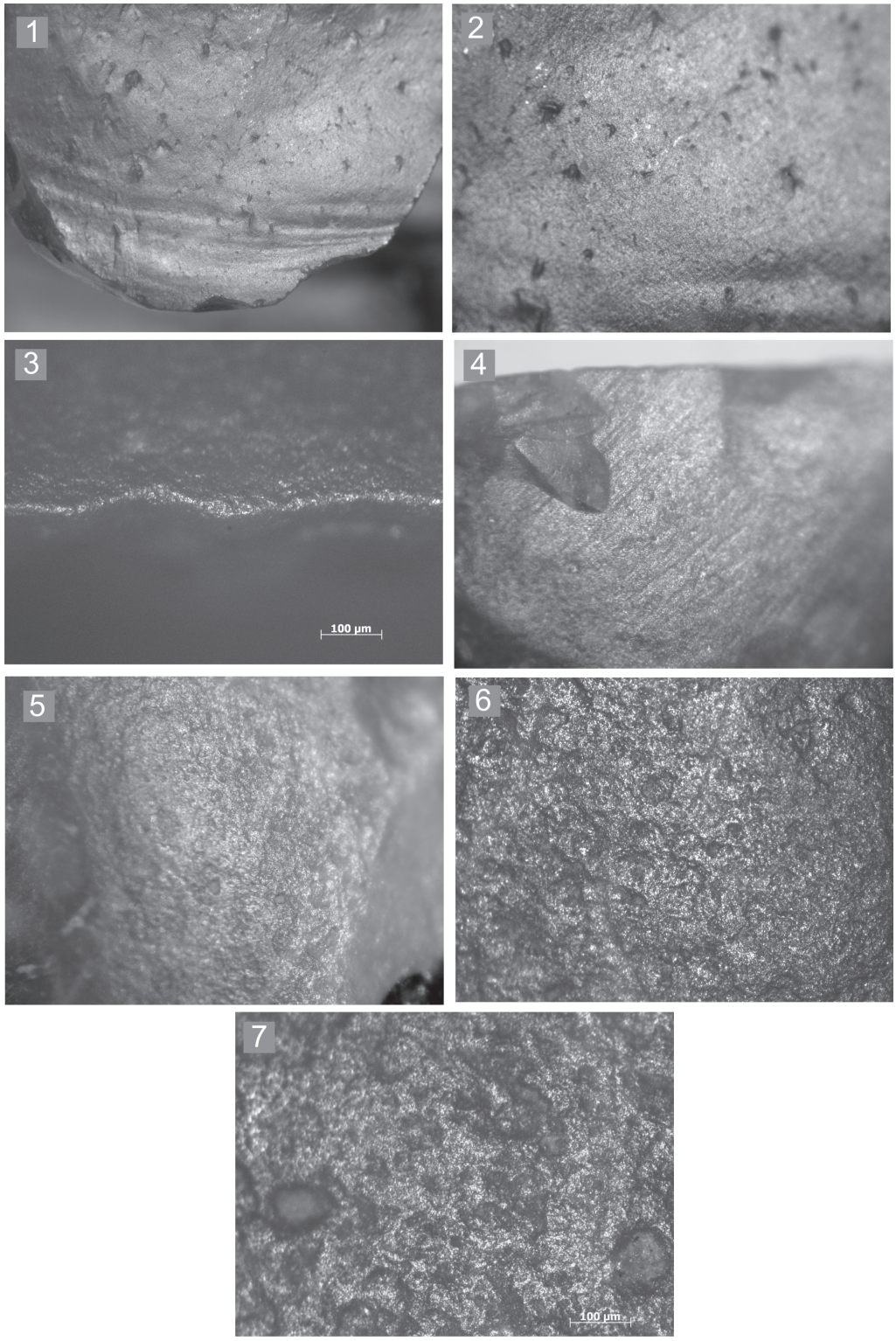

Fig. 12. Nida, artefact EM 2243:498. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x12, ob. 10; 2 – x32, ob. 10; 3 – x125, ob. 10; 4 – x50, ob. 10; 5 – x40, ob. 10; 6 – x65, ob.10; 7 – x125, ob. 10. *Photo by G. Osipowicz.*

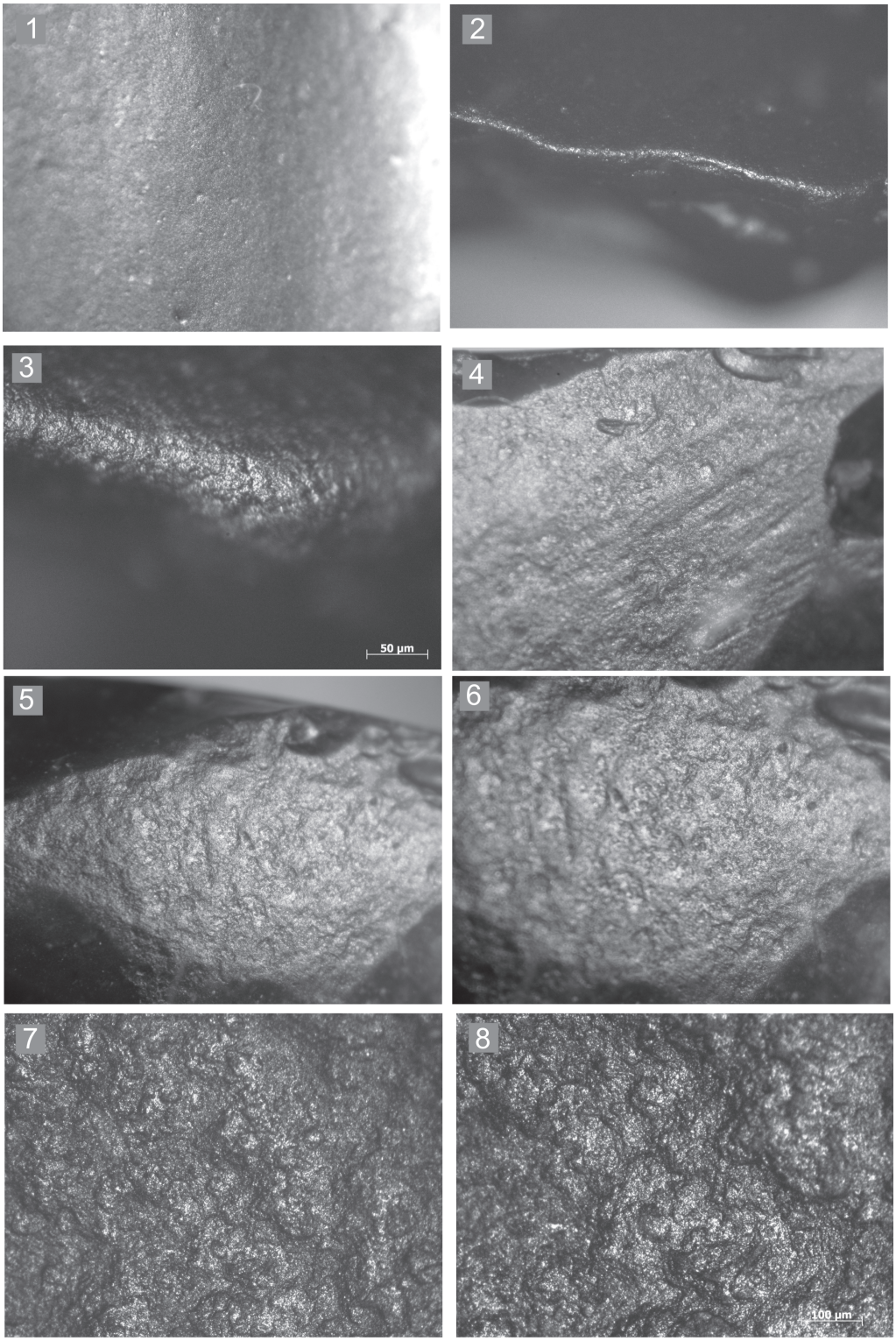

Fig. 13. Nida, artefact EM 2243:1149. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x32, ob. 10; 2 – x65, ob. 10; 3 – x250, ob. 20; 4 – x40, ob. 10; 5 – x25, ob. 10; 6 – x50, ob. 10; 7 – x65, ob. 10; 8 – x125, ob. 10. *Photo by G. Osipowicz.*

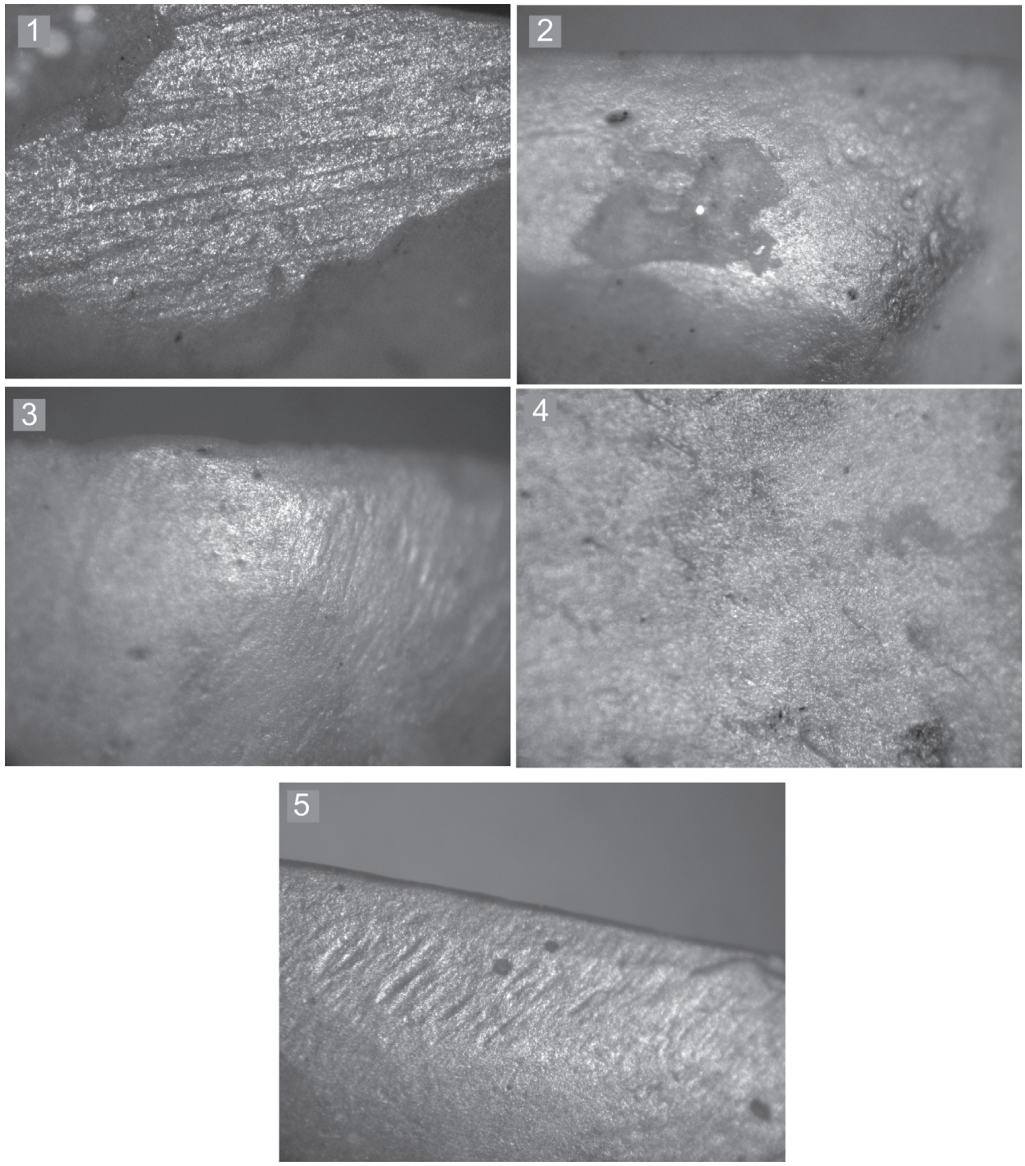

Fig. 14. Nida, artefacts EM 2243:1104 and EM 2243:1288. Photomicrographs of the surfaces, probably wear traces and post-depositional damage: 1 – x65, ob. 10; 2 – x50, ob. 10; 3 – x62, ob. 10; 4 – x40, ob. 10; 5 – x40, ob. 10. *Photo by G. Osipowicz.*

12:2 x32, ob. 10). The ridges and lateral edges are rounded (Fig. 12:3 x125, ob. 10). The obliterated traces of polishing can be seen in only one place on the formerly polished surface (Fig. 12:4 x50, ob. 10); in the other areas, roughening with the same characteristics as those described for artefact no. 1 can be observed (Fig. 12:5 x40, ob. 10; 12:6 x65, ob. 10; 12:7 x125, ob. 10).

8. Inv. no. EM 2243:1149 (Fig. 7:7) – The artefact's entire surface has been dulled as a result of post-depositional processes (Fig. 13:1 x32, ob. 10). The ridges and lateral edges are very rounded (Fig. 13:2 x65, ob. 10; 13:3 x250, ob. 20). Obliterated traces of the polishing can be seen at only one place on the formerly polished surface (Fig. 13:4 x40, ob. 10); in the other areas, roughening with the same characteristics as those described on artefact no. 1 can be observed (Fig. 13:5 x25, ob. 10; 13:6 x50, ob. 10; 13:7 x65, ob. 10; 13:8 x125, ob. 10).

9. Inv. no. EM 2243:1104 (Fig. 7:8) – The artefact

is in relatively good condition. It is polished around the perimeter. The traces of polishing (oblique) are relatively well preserved: Fig. 14:1 x65, ob. 10. On one of the lateral edges, they have been destroyed by a delicate roughening of the surface (Fig. 14:2 x50, ob. 10). Both types of traces (polishing, roughening) are documented in Fig. 14:3 (x62, ob. 10). Fig. 14:4 (x40, ob. 10) shows the implement's natural surface.

10. Inv. no. EM 2243:1288 (Fig. 7:9) – The artefact is in relatively good condition. One of the lateral edges has been polished (Fig. 14:5 x40, ob. 10). No other type of use-wear traces is visible on the artefact.

DISCUSSION

On most of the aforementioned artefacts, the use-wear analyses failed to reveal wear traces that could be interpreted as signs of the typical household activities covered by the conducted experimental program (or documented by means of former experiments carried out at IA NCU). Among the numerous types of damage observed on the surfaces of the artefacts, special attention should be given to a specific roughness visible on the polished surfaces of some of the artefacts. The interpretation of these micro-traces is extremely difficult because of the massive post-depositional damage of the analysed artefacts and its unique character. An initial assumption, i.e., that it could have been the result of use, can be made. This hypothesis is supported by the repeatability of the discovered traces (both in terms of characteristics and localization) and the fact that it covers only certain fragments of the polished surfaces. If it had been of post-depositional origin, the roughness would have very likely been visible on all of the surfaces.

The attempt to interpret the observed traces posed numerous problems. However, the processed material appears to have been quite soft (no major damage or retouches are present on the artefacts), although still hard enough to obliterate the evidence of polishing and to roughen the flint surface. The absence of linear traces and the linearity of the roughing suggest that the activity in question was not that of cutting, whittling, or scraping. The location and characteristics of the traces instead indicate hitting or perhaps (which is far less possible) rubbing. During the archaeological experiments carried out at IA NCU, similar traces were created only on the microlithic axes used for amber knapping (Fig. 15:1, x40, ob. 10). Hence[3], it was decided to conduct an additional experiment, in which one of the experimental items (Fig. 3:4) was used in this kind of activity[4] (Fig. 15:2). The tool proved relatively effective considering that the person who conducted the experiment was not experienced in performing operations of this sort. Unfortunately, owing to limited access to large quantities of the raw material, this experiment was restricted to only 15 minutes (during which five amber nuggets roughly 4.0 by 3.0 cm in size were split). As a result of the conducted tasks, a roughness with characteristics analogous to that visible on the implements from the Nida site formed on the tool's working surface (Fig. 15:3 x60; 15:4 x80). Naturally, owing to the experiment briefness, the range and intensity of these traces were definitely smaller than those on the analysed artefacts. Nevertheless, based on the obtained results, it is possible to hypothesize that at least some of the analysed prehistoric artefacts could have been used in a similar manner. Obviously, this does not mean that they were used specifically for splitting amber. For the moment at least, there are no data that could support this suggestion in a rational and responsible way. Various raw materials with a hardness similar to that of amber could have been subjected to processing and the very nature of the performed activity could have been similar to splitting. However,

[3] As recommended by Amber Jeweller Eryk Popkiewicz, M.A., a prehistoric technology expert, who stated that implements of this type might have been used for such activities.

[4] Such an activity could have been performed, e.g., during the preliminary assessment of the raw material's quality.

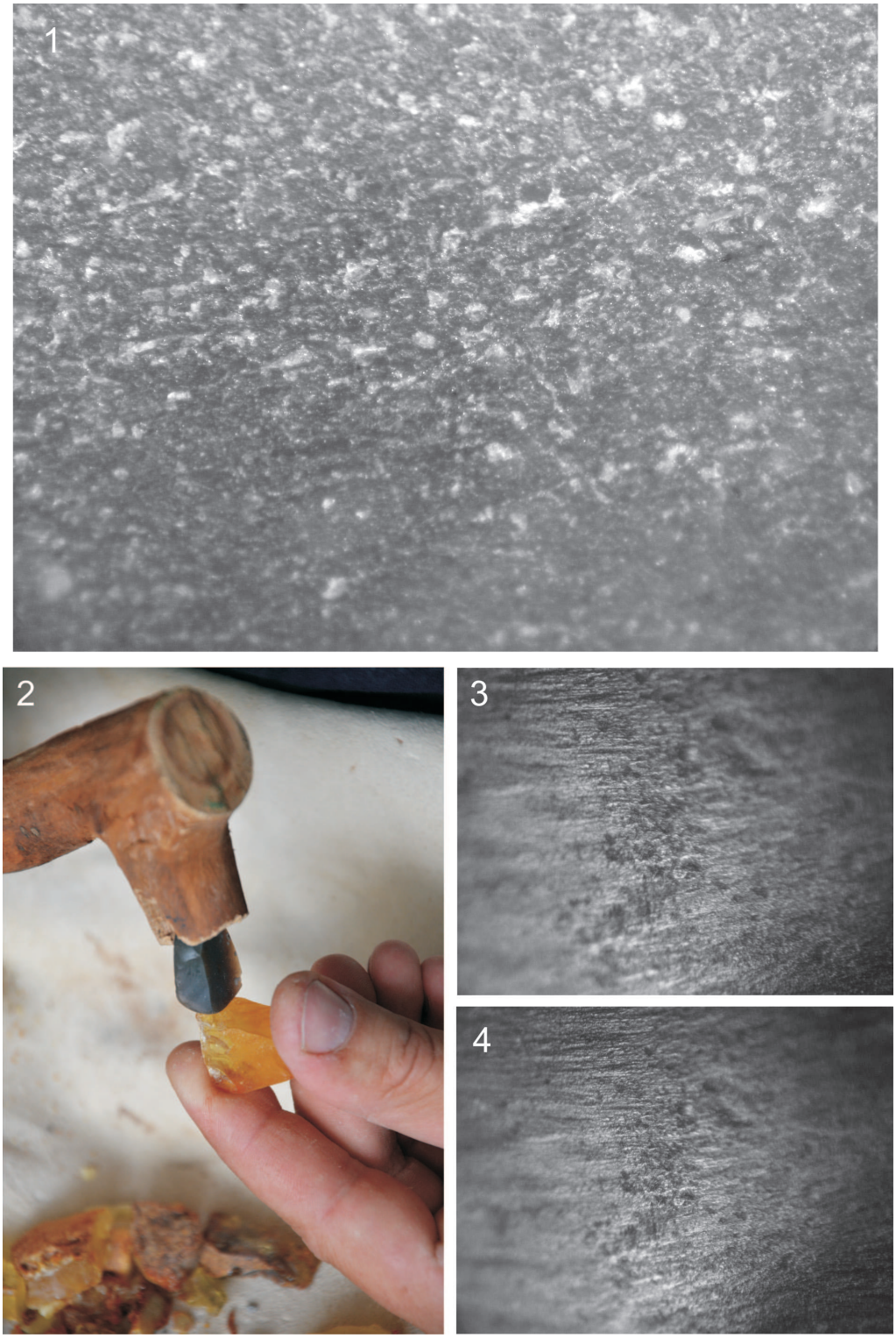

Fig. 15. Experimental amber processing: 1 – traces noticed on an axe used for splitting raw amber (x65), 2 – experimental amber splitting using a Nida tool replica, 3, 4 – roughening noticed on the Nida tool replica used for amber splitting (3 – x65, 4 – x80, both ob. 10). *Photo by G. Osipowicz (1, 3, 4) and J. Kuriga (2).*

it should be noted that damage, which to a certain extent calls into question the proposed hypothesis, was also observed on the employed experimental tool. As a result of the performed work, an intense lithic reduction occurred on the hafted sharp part of the tool, something not recorded on any of the artefacts. The reduction's formation could probably have been avoided by using a piece of hide as an isolating layer, something commonly used in such situations to protect the tool from direct contact with the haft.

Finally, use-wear traces with characteristics different from those observed on some of the Nida 'scrapers' should also be discussed. On the surface of artefact EM 2143:1571, the discovery of polishing with some attributes (e.g., brightness) led to its connection with the processing of silica plants. However, its topography (the flint's very flat, completely destroyed micro-relief) and texture (slightly rough) suggest that this polishing was probably created through the processing of hard materials by additionally using natural acids. Such use-wear traces might be created, for instance, during the processing of bone softened using acids obtained from sorrel or sour milk (Osipowicz 2007, Table 5b). The distribution of the observed polishing suggests that it has a complex origin. The polishing discovered on the 'flat' surfaces (ventral and dorsal faces) probably came from a handle made from silica plants or (more likely) from hard materials. The tool's inner surface was somehow 'etched' by substances that got there in the course of the performed work. The use-wear traces visible on the damaged (possibly during a repair attempt) truncation are probably the result of use.

On certain parts of the tools from Nida there are also traces with characteristics similar to those typical for hide processing. Due to the large post-depositional destruction of the artefacts, the origin of the traces is unclear, yet we should not rule out that in some cases, at least to some extent, they are use related. Even more likely, these traces could have resulted from the long-term storage of the tools in a leather bag.

CONCLUDING REMARKS

In summarising the performed analysis, it should be noted that in light of the findings obtained during the research, the polished flint products found at the Nida site were probably not used for household activities in the traditional sense. This is supported by their low effectiveness in such activities as observed through the use of experimental tools and the results of a use-wear analysis of the experimental items and prehistoric artefacts. The meaning of the polished implements from Nida might go beyond the purely utilitarian sphere. Moreover, they might be related to numerous specialist activities, the course of which it is currently impossible to reconstruct. Unfortunately, the problem of determining the function of the discussed artefacts has not been definitively solved here. Nevertheless, owing to the performed analyses, some relatively significant observations have been made, which can constitute the first important step towards understanding the purpose of these very interesting and unique prehistoric artefacts. To bring this about, however, it is vital to conduct further studies that include not only microscopic and experimental analyses, but also multi-aspect studies of the environmental and archaeological context in which these implements were deposited.

Acknowledgements

We would like to thank the National Museum of Lithuania for the opportunity to study the flint collection from the Nida site.

REFERENCES

Domańska, L., 1983. Wybrane zagadnienia krzemieniarstwa strefy nadmorskiej w epoce kamienia. *In:* Malinowski, T., red. *Problemy epoki kamienia na Pomorzu*. Wyższa Szkoła Pedagogiczna w Słupsku, 217–228.

Domańska, L., 1987. Wytwórczość krzemieniar-

ska grupy łupawskiej kultury pucharów lejkowatych. *Acta Universitatis Lodziensis. Folia Archaeologica*, 8, 17–60.

Domańska, L., 2015. Przyczynek do badań nad krzemieniarstwem grupy łupawskiej KPL. *Folia Praehistorica Posnaniensia*, 20, 111–126

Ehrlich, B., 1934. Ein jungsteinzeitliches Dorf der Schnurkeramiker in Succase, Kr. Elbing. *Altschlesien*, 5, 60–64.

van Gijn, A.L., 1989. The wear and tear of flint principles of functional analysis applied to Dutch Neolithic assemblages (=*Acta Praehistorica Leidensia*, 22).

Heron, C., Steele, V.J., Gledhill, A., Craig, O.E., Luquin, A., Thompson, A., Piličiauskas G., 2015. Cooking fish and drinking milk? Patterns in pottery use in the southeastern Baltic, 3300–2400 cal BC. *Journal of Archaeological Science*, 63, 33–43.

Ho Ho Committee, 1979. The Ho Ho classification and nomenclature Committee Report. *In:* Hayden, B., ed. *Lithic use-wear analysis*. New York: Academic Press, 133–135.

Hollack, E., 1895. Bericht des Herrn Lehrer Hollack über seine. Untersuchungen und Ausgrabungen auf der Kurischen Nehrung im Juli 1891. *Sitzungsberichte der Altertumsgesellschaft Prussia*, 19, 146–161.

Januszek, K., 2010. Small polished flint tools in Rzucewo culture in Poland. *Archaeologia Baltica*, 13, 69–79.

Jensen, H.J., 1994. *Flint tools and plant working, hidden traces of stone age technology. A use wear study of some Danish Mesolithic and TRB implements*. Aarhus University Press.

Kilian, L., 1955. *Haffküstenkultur und Ursprung der Balten*. Bonn: Habelt.

Korobkowa, G. F., 1999. *Narzędzia w pradziejach. Podstawy badania funkcji metodą traseologiczną*. Toruń: Wydawnictwo Uniwersytetu Mikołaja Kopernika.

Osipowicz, G., 2007. Bone and Antler, Softening techniques in prehistory of the North Eastern part of Polish Lowlands in the light of experimental archaeology and micro trace analysis. *EuroREA, Journal of (Re) construction and Experiment in Archaeology*, 4, 11–21.

Osipowicz, G., 2010. *Narzędzia krzemienne w epoce kamienia na ziemi chełmińskiej. Studium traseologiczne*. Toruń: Wydawnictwo naukowe Uniwersytetu Mikołaja Kopernika.

Piličiauskas, G., 2016. Lietuvos pajūrio subneolitas ir neolitas. Žemės ūkio pradžia. *Lietuvos archeologija*, 42, 25–103.

Piličiauskas, G., Heron, C., 2015. Aquatic radiocarbon reservoir offsets in Lithuania. *Radiocarbon*, 57 (4), 539–556.

Piličiauskas, G., Luik, H., Piličiauskienė, G., 2015. Reconsidering Late Mesolithic and Early Neolithic of the Lithuanian coast: the Smeltė and Palanga sites. *Estonian Journal of Archaeology*, 19 (1), 3–28.

Rimantienė, R., 1989. *Nida. Senųjų baltų gyvenvietė*. Vilnius: Mokslas.

Vaughan, P.C., 1985. *Use-wear analysis of flaked stone tools*. Tucson: University of Arizona Press.

Żurek, J., 1953. Osada z młodszej epoki kamiennej w Rzucewie, pow. Wejherowski, i kultura rzucewska. *Fontes Archaeologici Posnaniensis*, 4, 1–42.

Зальцман, Э.Б., 2010. *Поселения культуры шнуровой керамики на территории Юго-Восточной Прибалтики* (=*Материалы охранных археологических исследований*, 14). Тверская областная типография.

ABBREVIATIONS

IA NCU – Institute of Archaeology at Nicolaus Copernicus University in Toruń, Poland

GLUDINTI TITNAGINIAI „GREMŽTUKAI“ IŠ NIDOS NEOLITO GYVENVIETĖS. AR TAI BUVO ĮRANKIAI? EKSPERIMENTINIŲ TYRIMŲ IR DARBO ŽYMIŲ ANALIZĖS REZULTATAI

Grzegorz Osipowicz, Justyna Kuriga, Gytis Piličiauskas

Santrauka

Nidos neolito gyvenvietės tyrimų istorija labai ilga, o ji pati garsi nepaprastai turtinga Pamarių (Rzucewo) kultūros medžiaga, datuojama 3200–2400 cal BC. Gyvenvietės tyrimai rodo, kad Nidos žmonės gyveno ant Kuršių marių kranto, kuris tuomet buvo 1 km į V nuo dabartinio. Priešistorinis kaimas kartas nuo karto kentėjo nuo pustomo smėlio. Pagrindinis maisto šaltinis buvo lagūnos žuvys, nors jau buvo auginami naminiai gyvuliai. Prastos kokybės maži titnago žaliavos gabalai buvo renkami jūros paplūdimyje ir apdirbami dvipoline technika, daužant kietu muštuku ant kieto pagrindo. Iš titnago dirbinių išsiskiria „gremžtukai“ gludintais ašmenimis. Šie dirbiniai būdingi tik Pamarių kultūrai, randami Lenkijos pajūrio gyvenvietėse. Jie neabejotinai buvo naudoti 2600–2400 cal BC, tai rodo 2 dirbiniai, 2013 m. rasti tiksliai datuotuose kultūriniuose horizontuose (2 pav.). Kol kas neaišku, ar jie naudoti ir ankstesnėse šios kultūros fazėse. Labiausiai intriguojantis klausimas yra gludintų „gremžtukų“ funkcija. J. Żurek teigė, kad jie naudoti ruonių odoms apdirbti, bet nepateikė jokių argumentų.

Mes atlikome specialų eksperimentinį-trasologinį tyrimą. Eksperimentams buvo pagaminta 10 „gremžtukų“ replikų (3 pav.), kurios išbandytos 14-oje veiklų (4 pav.), apdirbant odą, ragą, gintarą, keramiką (1 lent.). Dviejų rūšių smulkių kristalų smiltainis naudotas eksperimentinių dirbinių ašmenims gludinti. Paaiškėjo, kad tai nėra nei ilgas, nei sunkus darbas. 2–3 cm ilgio gludintiems ašmenims parengti reikėdavo nuo kelių iki 40 minučių. Tolesni eksperimentai parodė, kad tokie dirbiniai yra ypač neefektyvūs, bent jau išbandytose veiklose.

Tyrinėta 10 dirbinių gludintais ašmenimis iš Nidos gyvenvietės (7 pav.). Darbo žymių mikroskopinės analizės metu ant daugumos tirtų archeologinių dirbinių nerasta pėdsakų, identiškų ar panašių į gautuosius eksperimento metu, taip pat į daugelio ankstesnių eksperimentų, kurių pavyzdžiai saugomi Torūnės archeologijos institute (Lenkija). Aptiktų pėdsakų interpretaciją labai apsunkino unikalus jų pobūdis ir didžiuliai postdepozitiniai pažeidimai. Nepaisant to, atrodo, kad juos sukėlė gana minkšta medžiaga (nėra darbinio retušo), tačiau pakankamai kieta, kad paveiktų gludintą paviršių, pašiaušty jį. Eksperimento metu panašiausi rezultatai gauti smulkiu kirveliu skaldant gintaro žaliavą (15:1 pav.).

Gludinti titnaginiai „gremžtukai“, rasti Nidoje, atrodo, nebuvo naudojami tradicinėse namų ūkio veiklose. Tai rodo menkas jų efektyvumas eksperimentinėse veiklose ir archeologinių dirbinių darbo žymių mikroskopiniai tyrimai. Šių dirbinių reikšmė gali būti ne utilitarinė, nors lygiai taip pat jie galėjo būti naudojami veiklose, kurių mes šiandien dar negalime atkurti, todėl svarbu tęsti šių dirbinių studijas, ne tik trasologines ir eksperimentines, bet ir aplinkos bei archeologinius tyrimus tų kontekstų, kuriuose jie buvo rasti.

Vertė G. Piličiauskas

LENTELIŲ SĄRAŠAS

1 lentelė. Tyrime naudotų eksperimentinių įrankių katalogas

ILIUSTRACIJŲ SĄRAŠAS

1 pav. Neolito Nidos gyvenvietės situacija. *G. Piličiausko brėž.*

2 pav. Eolinės stratigrafijos pavyzdys. Georeferencinė fotomozaika su iš 1 m pločio perkasos surinktų radinių projekcija, 2013 m. G. Piličiausko tyrimai. Apatiniame horizonte matomos senojo dirvožemio (humusingo smėlio) liekanos, o viršutinio horizonto radiniai stipriai paveikti pustymų. Abu kultūriniai sluoksniai datuoti AMS ^{14}C metodu 2600–2400 cal BC (pagal: Piličiauskas, Heron 2015).

3 pav. Eksperimentuose naudotos Nidos radinių replikos. Pažymėtos naudotos darbinės briaunos, atliktų veiksmų tipai ir fotomikrografijų vietos: 1 – gremžimas, 2 – gręžimas, 3 – skėlimas, 4 – pjovimas, 5 – apatinės pusės fotografija. *G. Osipowicz nuotr.*

4 pav. Atliktų eksperimentų vaizdai: 1 – odos gremžimas, 2 – odos pjovimas, 3 – medžio pjovimas, 4 – medžio gręžimas, 5 – rago gremžimas, 6 – rago pjovimas, 7 – gintaro gręžimas, 8 – kalkinės titnago žievės gremžimas. *J. Kurigos nuotr.*

5 pav. Darbo žymių ant eksperimentinių įrankių pavyzdžiai: 1 – odos gremžimas, 2 – odos dūrimas, 3 – odos pjovimas, 4 – medžio gremžimas, 5 – medžio pjovimas, 6 – medžio gręžimas. Visos fotomikrografijos – x250, ob. 20. *G. Osipowicz nuotr.*

6 pav. Darbo žymių ant eksperimentinių įrankių pavyzdžiai: 1 – rago gremžimas, 2 – rago pjovimas, 3 – gintaro gremžimas, 4 – kalkinės titnago žievės gremžimas, 5 – keramikos gremžimas, 6 – nedirbta, gludinimas. Fotomikrografijos 1–5 – x250, ob. 20; 6 – x125, ob. 10. *G. Osipowicz nuotr.*

7 pav. Tyrinėti Nidos gyvenvietės gludinti dirbiniai su pažymėtomis fotomikrografijų vietomis. *G. Piličiausko, G. Osipowicz pieš.*

8 pav. Nida, dirbinys EM 2243:478. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x12, ob. 10; 2 – x125, ob. 10; 3 – x32, ob. 10; 4 – x125, ob. 10; 5 – x50, ob. 10; 6 – x250, ob. 20. *G. Osipowicz nuotr.*

9 pav. Nida, dirbiniai EM 2243:1290 ir EM 2143:1571. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x65, ob. 5; 2 – x65, ob. 5; 3 – x125, ob. 10; 4 – x125, ob. 10; 5 – x250, ob. 20; 6 – x250, ob. 20; 7 – x250, ob. 20; 8 – x250, ob. 20. *G. Osipowicz nuotr.*

10 pav. Nida, dirbinys EM 2243:688. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x125, ob. 10; 2 – x250, ob. 20; 3 – x20, ob. 10; 4 – x40, ob. 10; 5 – x125, ob. 10; 6 – x250, ob. 20. *G. Osipowicz nuotr.*

11 pav. Nida, dirbinys EM 2243:1559. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x40, ob. 10; 2 – x250, ob. 20; 3 – x40, ob. 10; 4 – x125, ob. 10; 5 – x40, ob. 10. *G. Osipowicz nuotr.*

12 pav. Nida, dirbinys EM 2243:498. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x12, ob. 10; 2 – x32, ob. 10; 3 – x125, ob. 10; 4 – x50, ob. 10; 5 – x40, ob. 10; 6 – x65, ob.10; 7 – x125, ob. 10. *G. Osipowicz nuotr.*

13 pav. Nida, dirbinys EM 2243:1149. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x32, ob. 10; 2 – x65, ob. 10; 3 – x250, ob. 20; 4 – x40, ob. 10; 5 – x25, ob. 10; 6 – x50, ob.10; 7 – x65, ob. 10; 8 – x125, ob. 10. *G. Osipowicz nuotr.*

14 pav. Nida, dirbiniai EM 2243:1104 ir EM 2243:1288. Paviršių, galbūt darbo žymių ir postdepozitinio poveikio fotomikrografijos: 1 – x65, ob. 10; 2 – x50, ob. 10; 3 – x62, ob. 10; 4 – x40, ob. 10; 5 – x40, ob. 10. *G. Osipowicz nuotr.*

15 pav. Eksperimentinis gintaro apdirbimas: 1 – žymės ant kirvio, naudoto žaliavai skelti (x65), 2 – eksperimentinis gintaro skėlimas naudojant Nidos įrankio repliką, 3, 4 – šiurkštumas, pastebėtas Nidos įrankio replikos paviršiuje po gintaro skėlimo (3 – x65, 4 – x80, abu ob. 10). *G. Osipowicz (1, 3, 4), J. Kurigos (2) nuotr.*

Gauta 2015 10 30
Priimta 2016 04 07