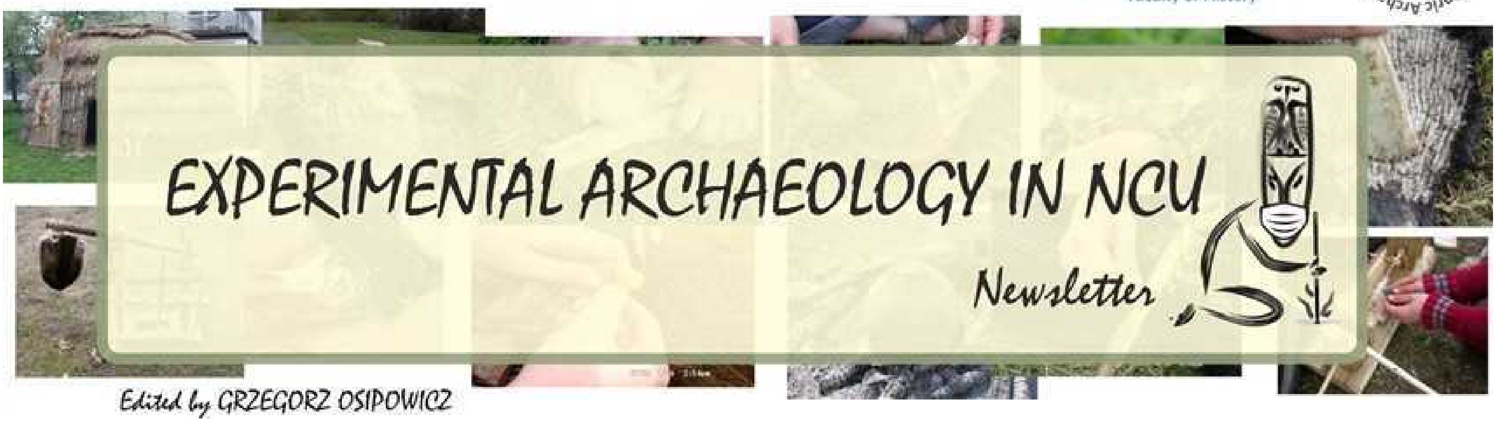
NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ
Faculty of History

Society for Experimental Prehistoric Archaeology



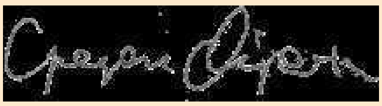
Edited by GRZEGORZ OSIPOWICZ

EDITORIAL

Dear Readers, at the outset, I would like to apologize for the delay in publishing issue no 10 of our Newsletter. The COVID pandemic and the confusion associated with it are to blame here and we hope all of You will understand problems created by the situation that is at least strange. Nevertheless, we are now offering you the two issues of our Newsletter joint in one, which I hope will also ultimately have positive results in the form of more articles to read.

In this issue, we have prepared the following texts. The first article describes our the oldest experiments with the production and testing of natural dyes, including experiments to test their durability. The second text continues the topic we have recently described (no. 2019/3) of the research we are currently conducting on production and function of the so-called Bruszczewo knives, i.e. specific bone tools from the Late Bronze Age. The third text recounts very interesting wool spinning experiments carried out at our Institute, using replicas of Lusatian culture spindle whorls. The fourth article has a slightly less research profile, as it is devoted to classes in experimental archaeology, which are currently conducted at our Institute. The fifth text refers to one of the oldest experiments carried out in our centre, i.e. the experimental production of medieval crossbow tips. The last text aims to describe some of our experiments related to the artefacts from more recent times, but at the same time very interesting, i.e. Early Modern glass bell-shaped beakers.

As one can see in this issue, we present a selection of our experiments related to artefacts from very different periods, which we hope will be interesting to you. Finally, we would like to invite everybody interested to participate in the International Camp of Experimental Archaeology, which we hope will not be stopped by a pandemic this time. Details inside the issue. On behalf of the team, enjoy reading!



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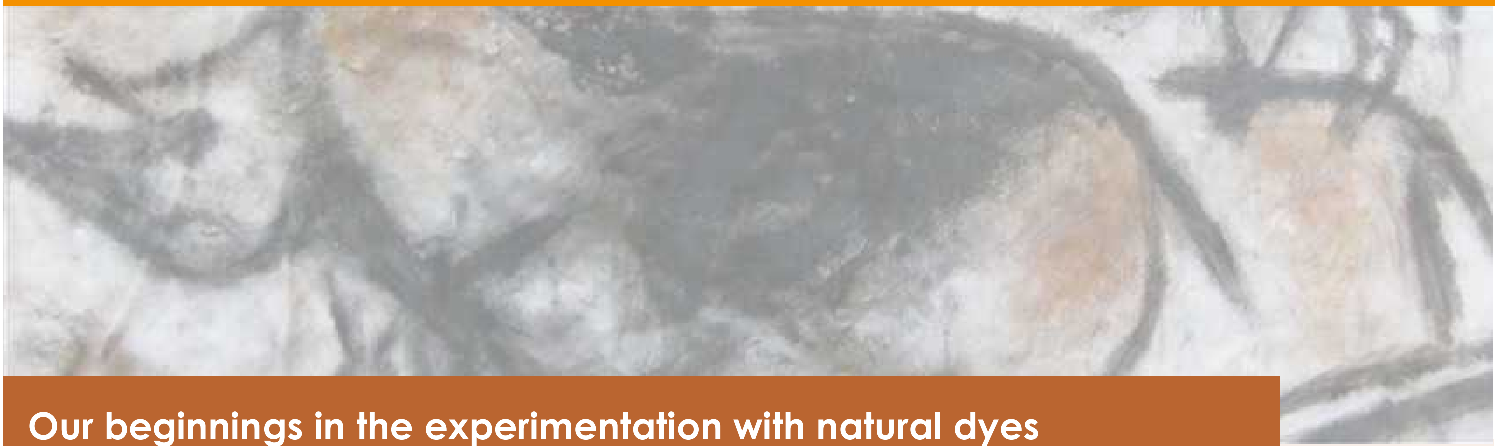
People of the experiment

Prof. Galina F. Korobkowa (1933 - 2007†)

For many years, Professor Galina F. Korobkowa taught students and employees of the Institute of Archaeology of the Nicolaus Copernicus University in Toruń the basics of the traceological method and the principles of the archaeological experiments, which are its inseparable element. In 1995 she organized "Traceology Camp" in Izhevsk, Russia, attended by our students and employees. She also came to our centre many times for educational and research purposes. In 1996 she organized a two-weeks traceological course in our Institute. Her students include Prof. dr hab. Jolanta Małecka-Kukawka and dr hab. Grzegorz Osipowicz, prof. UMK.
As a result of the cooperation with Prof. Korobkowa, Prof. J. Małecka-Kukawka translated her book on the traceology into Polish, which became one of the textbooks for our students exploring the secrets of this method.

The two-week course organized in the old building of Institute of Archaeology NCU at Podmurna Street in April 1996 – on left: Prof. Galina Fedorovna Korobkova.

We are very thankful to Prof. Korobkowa for her teaching and we will always appreciate her contribution to the development of the traceological and experimental archaeology research in our centre.



Our beginnings in the experimentation with natural dyes

In one of the previous issues of the Newsletter (2/19), we reported on the experiments conducted by students of our Institute on dyeing fabrics with the use of natural dyes. In this issue, we would like to go back to 2004, when we started experimenting with natural dyes, testing their properties and durability. This text is a slightly modified version of Joanna Cywińska's report, posted on the website of the Society for Experimental Prehistoric Archaeology (www.keap.pl/en), the current version of which will soon cease to exist. Publishing it in our Newsletter will also allow remembering these works, the full results of which have not yet been published anywhere, but we hope will be continued soon.

One of the most interesting and spectacular elements of the prehistoric art are paintings discovered on the walls of some European caves, like for example Lascaux, Chauvet or Altamira. The creators of these, usually complex and stimulating the imagination works, have been using simple dyes acquired from materials available around. According to the results of the chemical analysis of samples taken from the particular colours, mainly mineral materials were used in the production of dye, most of all: hematite, manganese and charcoal. The dyes were also probably produced from materials like water, blood, protein, marrow, bird guano, isinglass (glue made from boiled parts of fish bladders) and urine. They were applied with brushes made of animal hair, fingers, tampons, sticks or by the mouth-blow.

The early experiments with dyes performed by SEPA members concerned both, the methods of obtaining particular colours and the methods of their preservation and suitability for dying various types of organic and inorganic surfaces. During the experiments, different colours were obtained from the well-known materials, e.g. black from charcoal or soot, red form hematite, white from limestone etc. However, we had conducted also the experiments with other, very specific substances that may help to obtain the desired colours, like different types of plants, vegetables or fruits.

Fig. 1. Preparing natural green dye from grass and its application to the leather.

Fig. 2. Application of a natural dye to the stone surface.

Mixing a dye with a perseverant, one obtains a paint, which is then applied to specific surfaces. The durability of a dye depends on the surface on which it is applied. It has different perseverance on ceramics and different on stone or wood. To test the durability of various types of natural dyes applied to various surfaces, we planned and implemented an experimental program. For its needs, we created several basic dyes (green, red, black, yellow), which we mixed with several basic types of organic fixatives and applied to several types of surfaces: ceramics, bone, hide and stone.

Fig. 3. Experimental samples covered with different types of dyes before deposition.

After the dyes had dried, the samples were buried in different soil contextes for 5 months. The results of these works require verification by further experiments and analyzes of prehistoric materials, specialized chemical research and many others, but their preliminary results seem to be interesting.

Fig. 4. Deposition in the soil for 5 monhs.

Fig. 5. Experimental samples after excavation.

Nevertheless, it can be stated already at this moment that depending on the type of dye and fixative the humid environment may cause both, a rapid dissolving of colour or, alternatively, preserve it permanently. The most durable seem to be dyes of mineral origin such as those found in prehistoric paintings in caves. Plant dyes are preserved to a much lesser extent. Observed was a very rapid degradation of pigments made of, e.g., grass, flowers or bark. Moreover, the colour obtained from these materials was often of small intensity and faintly visible on the surfaces. Also, the type of fixative determined the intensity of a dye and its durability. The best adhesion to the surface has been found in the case of heated bone marrow, while protein underwent rapid crushing (after application on leather) or degradation (remaining surfaces).

The works will be continued in the near future.

Fig. 6. The painting made by members of SEPA on the animal hide.

Bronze Age bone “knives” from Bruszczewo - on the way to understand their function. Part II

In 2019, in issue 7 (2019/3) of the Newsletter, we have published an article entitled: Bronze Age bone “knives” from Bruszczewo - on the way to understand their function. In that text, we presented experiments related to the production process of unique artefacts made of the animal scapulas discovered at the mentioned site. In the current issue, we would like to present the second stage of our experimental works, associated with using “Bruszczewo knives” for various economic purposes. The experiments aimed to answer the question to what activities these objects could have been used by the inhabitants of the settlement in Bruszczewo. The type of work performed and the processed raw material were selected based on the general characteristic of identified on the working edges of and the suggestions published in the (e.g. Northe 2001).

During the conducted experiments, 12 replicas of "Bruszczewo knives" have been used. They were made of pig and cow scapulas.

One of the first activities to be checked was the processing of flax. First, bundles of cut, dried and ground flax seeds were soaked in water for two weeks. After this time, the flax was thoroughly dried again, making it suitable for further processing. For this purpose, 2 tools were used to break the stalk, while separating the fibres. The tools worked effectively, and with their help, the flax fibre was obtained fast in a relatively easy way (Fig. 1).

Fig. 1. Experimental processing of the flax.

The tools were used for 60 and 90 minutes respectively.

Another experiment carried out was related to the use of "knives" as weaving tools. 100% sheep wool yarn was used here as the warp and weft. The work performed with the tool consisted of pushing the weft while weaving a narrow selvedge (Fig. 2). For this purpose, 1 replica of the "Bruszczewo knife" was used. The tool worked inefficiently and was bulky. As a result, the work was finished after 30 minutes.

Fig. 2. „Knives” used as a weaving tools.

The second experiment carried out connected with wool processing was felting. Wool from heather sheep was used for this purpose. It was felted with the hot water on a mould to obtain the shape of a container - a bowl (Fig. 3).

Fig. 3. Experimental felting.

In this case, the replica of the "knife" was used to press the wool against the mould while squeezing water and felting the surface. The work with the tool was finished after 90 minutes.

The next tested activity was wood painting with the mineral dyes - ocher and chalk. Both dyes were mixed with dissolved pure animal fat. A wall made of pine boards was painted with the prepared dye. The "Bruszczewo knives" served here as a kind of trowels (Fig. 4). For the painting with ocher, 2 tools were used, one of which worked 60 minutes and the second for 90 minutes. The covering of the surface with both, ocher and chalk dye was effective. However, it was much easier to paint with ocher, probably due to its strong colouring properties.

Fig. 4. Using „Bruszczewo knives" as a kind of spatula for painting

The usefulness of "knives" as tools for spreading and smoothing out the daub on the walls was also experimentally tested. To do this, a mixture of clay and sand was prepared. During the experiment, two replicas of "knives" were used to spread the daub on the wattle wall (Fig. 5). Both tools were effective and the work was finished after 60 minutes.

Fig. 5. Experimental spreading of the daub.

Additionally, one „knive" was used as a spatula for merging coils during the production of the pottery using the roller technique and smoothing its surface (Fig. 6). For this purpose, clay with crushed stone was specially prepared, corresponding to the mixture of clay which was used at the site in Bruszczewo. After that, w skilled person started making a large storage vessel.

Work with a tool was very effective and relatively comfortable and took approximately 60 minutes.

Fig. 6. Smoothing the pottery.

The "Bruszczewo knives" were also tested in animal skins processing, to activities as fleshing and hair removal. In both cases, fresh deer skin was processed. First, the remains of meat and flesh were removed from the skin with one of the "knives". The performed movement was similar to scraping. After cleansing, the skin was placed in water with ash for one week. Then, it was dehaired with the second tool (Fig. 7). Each activity lasted approximately 60 minutes.

Fig. 7. Dehairing of the deer hide.

At the moment, the experimental work has been completed and now its time for making proper traceological analyses of the all tools. We hope that thanks to the conducted experiments we will be closer to solve the riddle of the function of the discussed Bruszczewo knives :)

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Northe A., 2001. Notched Implements made of Scapulae-Still a Problem. In: A. M. Choyke, L. Bartosiewicz (ed.), Crafting Bone: Skeletal Technologies through Time and Space. Proceedings of the 2nd meeting of the (ICAZ) Worked Bone Research Group, Budapest 31 August - 5 September 1999. BAR IntSer. 937, 179-184.

Experimental wool spinning

Spindle whorls are discovered at the sites dated from the Neolithic to the modern era. Studies on the relation between the weight of the spindle whorls and the parameters of the obtained threads have been conducted so far for the Bronze Age artefacts from Egea, Anatolia and Levant (Andersson et al. 2008, 171), and Austrian sites dated from the Neolithic to the Roman period (Grömer 2005, 107). This problem was also taken up by Magdalena Przymorska-Sztuka, a PhD student of the Institute of Archaeology, Nicolaus Copernicus University, whose research focused on the spindle whorls from Lusatian culture. The main goal of her experiment was to answer the question of what quality threads could be obtained with the use of Lusatian spindle whorls.

Materials, methods and the course of the experiment

Exact replicas of tools from the Lusatian fortified settlement in Gzin 1, Bydgoszcz County and the Lusatian open settlement in Ruda 3-6, Grudziądz County were used (Fig. 1). During the experiment, the rules developed by the team Tools and Textiles – Texts and Contexts (TTTC)* were followed (Möller-Wiering 2006, 2). The yarn obtained was wound onto elongated plates 5 cm wide and 24 cm long. The diameter, the twist angle and the length of the thread obtained in one hour of spinning were measured. The thread was wound around the plate, transversely to its long axis. For each thread sample, 20 measurements were made at the centre point of the plate. The distance between the measurements was 10 cm. The diameters and twist angles of all threads were measured at a total of 320 points. Two types of wool were used for spinning with the use of spindle whorls replicas from the Ruda site: South German Merino fleece and Polish Heath sheep fleece. Only Polish Heath sheep wool was used for spinning with copies of artefacts from Gzin site.

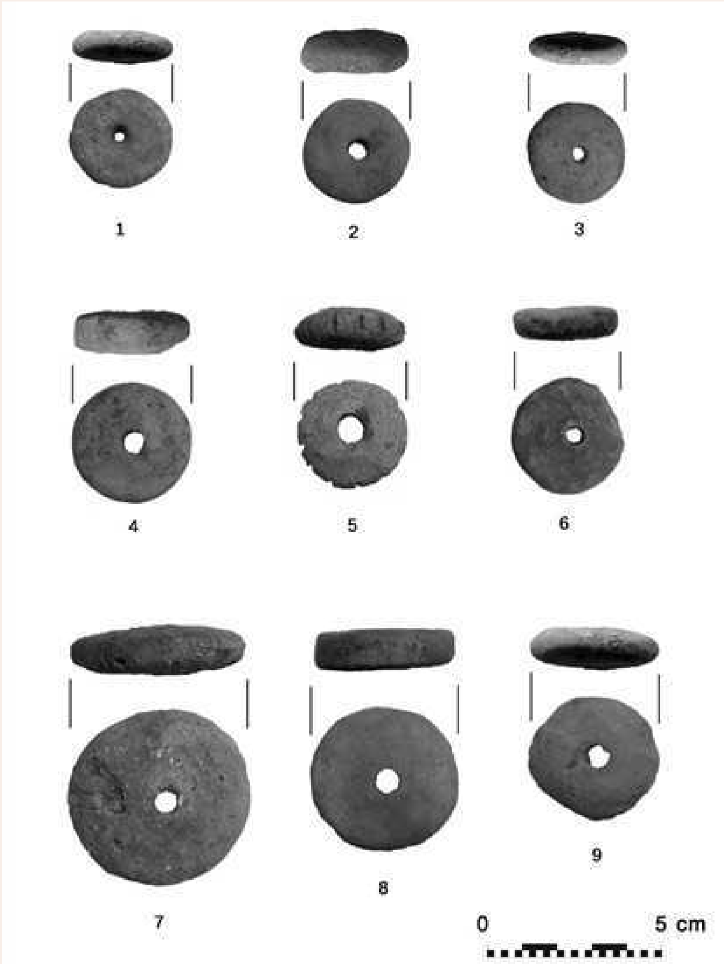

Fig. 1. Ruda site 3-6, Grudziądz County. Selection of spindle whorls from the settlement of the Lusatian culture (Phot. M. Przymorska-Sztuczka).

Two spinners took part in the experiment: spinner no. 1 (M. Przymorska-Sztuczka) had three years of experience in spinning during the experiment (September 2016), while the spinner no. 2 (J. Witulska from the Archaeological Museum in Biskupin) had five years of practice. After a series of tests, carried out by spinner no. 1 (Fig. 2), copies of the spindle whorls were given to spinner no. 2 to repeat the experiment and compare the results. At this stage, the use of Merino fleece was abandoned, and only Polish Heath sheep fleece was spun.

* The TTTC is a team established in 2005 at the University of Copenhagen, at the Center for Textile Research (CTR). The research was led by E. Andersson Strand and M.-L. Nosch with the participation of A. Batzer and L. Måstensson.

Fig. 2. Merino wool spinning on a spindle with a spindle whorl (Phot. R. Sztuczka).

Results

The conclusions obtained during the experiment are as follows:

1. The weight of the spindle whorl has an influence on the diameter of the spun thread. This dependence is especially noticeable in a case of the high-quality Merino fleece threads. These results are slightly different for the yarn obtained by both spinners from the fleece of Polish Heath sheep. As a general rule, the heavier the spindle whorl, the larger the thread diameter. These results are, therefore, in line with the overall results of the TTTC experiments (Möller-Wiering 2006). However, the observed differences are not clear enough to be able to unequivocally state that with a spindle whorl of a certain weight, threads with specific parameters will be obtained. The limit values are relatively fluid and often overlap. According to the conducted experiments, slight differences in the weight of the spindle whorls, such as 4 g, suggested by the TTTC, did not affect the parameters of the thread. On the basis of the tests performed, it can only be concluded that when using spindle whorls weighing from 9 to 27 g, the obtained threads have a diameter ranging from 0.34 to 0.74 mm. On the other hand, when using spindles loaded with spindle whorls weighing more than 30 g, the obtained threads have a diameter of 0.66 to 1.18 mm.

2. The quality of the fleece used for spinning has a significant influence on the quality of the yarn. The observed differences in the appearance of the threads (rough from the fleece of Polish Heath sheep and smooth from Merino fleece) result from the method of preparing the fibres and the breeds of sheep that provided the raw material. The more time was spent on preparing the wool for spinning (e.g. combing out and getting rid of low-quality fibres), the more regular the yarn was (Fig. 3).

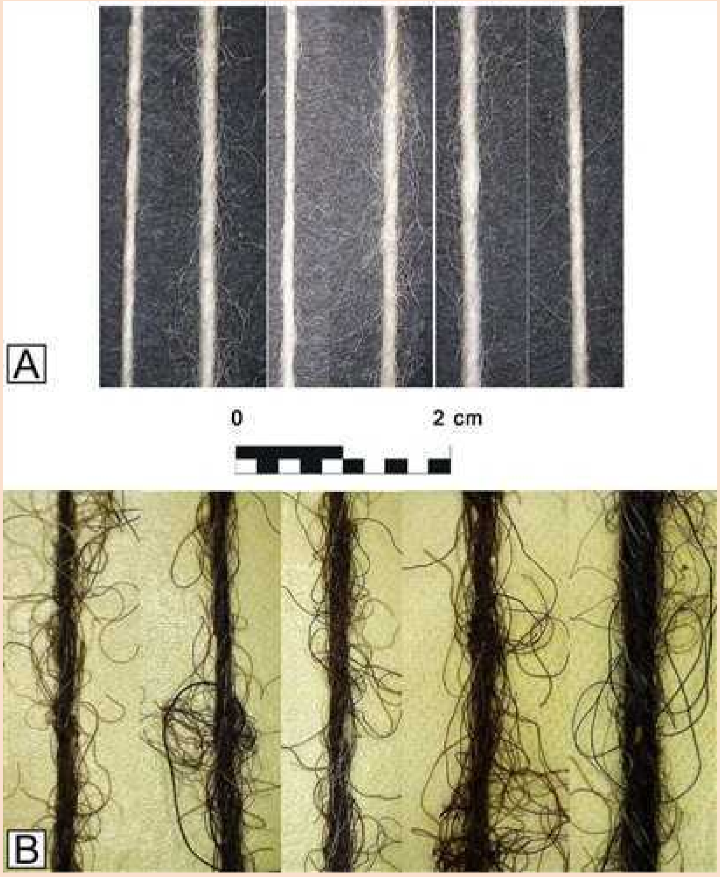

Fig. 3. Threads made of two types of wool: A - Merino sheep, B - Polish Heath sheep (Phot. M. Przymorska-Sztuczka).

3. The differences in thread diameters and twists obtained by both spinners with the same tools and the same yarn are probably due to different skills and yarn purpose. Spinner no. 1 initially did not specify what the threads would be for, while spinner no. 2 spun as in the case of warp thread (yarns with a higher twist angle are better suited for the warp because they are stronger). The differences in the length of the threads obtained are also partly due to the degree of twist. Spinner no. 2 spent more time tightening the spun yarn, resulting in its threads being usually slightly shorter and thicker than those made by spinner no. 1. It also seems that spinner no. 2 pulled more fibres from the fleece, which resulted in a larger diameter and a higher twist.

Conclusions

The conducted experiments confirm the relationship between the weight of the spindle whorl and the diameter of the threads, but the obtained results also indicate the importance of other parameters, such as the raw material used and individual skills of the spinners. The research also showed that using the same tools and the same yarn, it is possible to produce threads with different purposes and parameters.

The thread lengths obtained in one hour are also consistent with the results reported by the TTTC team. Experimental work shows that, depending on the weight of the spindle whorl, it is possible to spin 35 to 50 m of thread in an hour (Andersson Strand 2010, 12-13). However, these values had to be much higher for people with many years of experience.

A comparison of the performance of amateur and professional spinners shows a 40% difference in performance between them (Tiedemann, Jakes 2006, 303). Based on the efficiency estimates obtained by TTTC, it can be assumed that to get a fabric 1 m wide and 4 m long with a density of 20 threads/cm, about 8000 m of yarn must be used. (Andersson Strand 2015, 50). So a spinner that can spin 50 meters of thread per hour must spend 160 hours on it.

The full results of this research can be found in the doctoral dissertation of Magdalena Przymorska-Sztuczka entitled: *Gospodarka włókiennicza późnej epoki brązu i wczesnej epoki żelaza w Wielkopolsce, Kujawach i na ziemi chełmińskiej.* [Unpublished doctoral dissertation] Nicolaus Copernicus University in Toruń, 2020

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Photo from the past

Members of the Society for Experimental Prehistoric Archaeology during the IXth Science Picnic of Polish Radio BIS which tookplace on June 4, 2005 in Warsav. The team received the 2nd prize for the most interesting scientific stall which was pepared together with the District Museum inBrodnica :)

Experimental Archaeology in the Institute of Archaeology, Nicolaus Copernicus University: Classes

As we try to present in our newsletter, the Institute of Archeology of the Nicolaus Copernicus University in Toruń have a very long tradition in conducting research in the field of experimental archaeology. This method is taken seriously at our Institute, which is reflected in the fact that for 9 years it has been taught in several types of didactic classes for our students. In this short text, we would like to present their profile and goals. Perhaps they will interest the readers of the Newsletter and inspire them to visit us (e.g. as part of an internship) or to undertake similar activities in their centres.

The first type of classes, simply called "Experimental Archeology", is conducted for 30 hours per semester (Fig. 1). Its aim is to present experimental archaeology as one of the fully-fledged scientific methods of archaeological research. This is done by showing its cognitive and analytical capabilities. The course participants are familiarized with the methodology used in correctly conducted archaeological experiments. Particular importance is placed on developing among the students a critical view of the hypotheses tested by the experimental method and the sensitization of the need for a multi-faceted approach to the archaeological sources. The classes consist of four parts. First, the methodological foundations of experimental archaeology are discussed. Then, there is a stage of critical analysis of the experiments described in the literature (chosen independently and freely by the students). The third stage is planning and preparing its own experimental program, based on the interests and individual research plans of students. Each of the planned experiments (carried out individually or in groups) is discussed and reviewed publicly. Experiences are usually based on the latest archaeological discoveries or the results of interdisciplinary research. The last stage of the course is to conduct the planned experimental research with adequate scientific rigour and with full documentation of the experimental process. We published the results of some of this work in our Newsletter.

Fig. 1. Students taking part in the „Experimental Archaeology" classes.

The next two classes are of a slightly different nature, as they are focused on exploring the knowledge of prehistoric (primarily related to the Stone Age) techniques of processing various types of natural resources and those that allowed our ancestors to survive in the difficult environmental conditions. The classes are aimed at using the interest in survival techniques to introduce the ways of life in the Stone Age and experimental archaeology as a scientific method. There are two courses (30 hours each), one in Polish, entitled „Być jak Bear Grylls! Archeologia doświadczalna - poznaj techniki, które pozwolą ci przetrwać" (Be like Bear Grylls! Experimental Archeology - Learn the techniques that will help you survive), second in English "Get the prehistoric skills! Experimental archaeology – the way to understand past". Classes have a profile of practical laboratories supplemented with the appropriate dose of the theoretical knowledge. In the first place, students are familiarized with the methodology of experimental studies in archaeology and basic information about life in prehistoric times. Subsequently, we have practical classes, where participants are presented with different survival techniques used in everyday life in prehistory. During these meetings, we discuss and test some basic prehistoric techniques and tools used for processing of various types of raw materials, such as stone, wood, leather, bone, antler, clay, amber, etc (Fig. 2).


Fig. 2. Students during the „Być jak Bear Grylls!" classes.


Fig. 3. Students preparing the firing of the pottery during the „Być jak Bear Grylls!" classes.


Fig. 4. Experimental drilling in stone axe.

Also, the techniques more complicated are presented, e.g. bone and antler softening, making and firing the pottery (Fig.3), drilling techniqes in stone (Fig. 4), destructive birch bark distillation (to produce birch tar; Fig. 5), different ways of making the fire, hunting techniques, methods of plant processing (e. g. ropes production), building techniques et cet. Participants are required to active, practical participation in all conducted activities. All of them are held with the observance of the relevant methodology of experimental studies. During all classes, we use only raw materials, techniques and tools available in the Stone Age.


Fig. 5. Students preparing kiln for birch tar production.

The last two types of classes, in which we largely present and use the results of research in the field of experimental archaeology, are related to one of the methods of analyzing prehistoric tools, i.e. traceology.

In this regard, there are also two courses (15 and 30 hours), including one in Polish, entitled "Traseologia" (Traceology) and the second in English entitled “Traces of culture and environment through traceology (microwear) of flints, stone and organic-tools”. The main aim of lessons is to show the basic assumptions of a use-wear method and the procedures and equipment applied during the analyse. All participants have a possibility to learn how to distinguish the basic types of use-wear, technological and post-depositional traces, that can be noticed on tools made of flint and other types of raw materials (also organic ones). We discuss a history of the method and the different kind of problems connected with the results of use-wear analyse of prehistoric tools. During the lessons, we work mostly on experimental but also Stone Age tools. At least half of the time of each lesson is spent on work with microscopes. All the participants have to make the archaeological experiment with a flint tool used to work in some kind of material known in prehistory i.e. wood, amber, bone, antler or other (Fig. 6, 7). The observation made during this work and use wear analyse of the traces created in the experiment are a good platform of getting knowledge about traceology and experimental archaeology (Fig. 8).

Fig. 6. The „Traceology” cource. Experimental cutting of the reed with a flint tool.

Fig. 7. The „Traceology” cource. Experimental cleaning of the hide with flint scrapers.

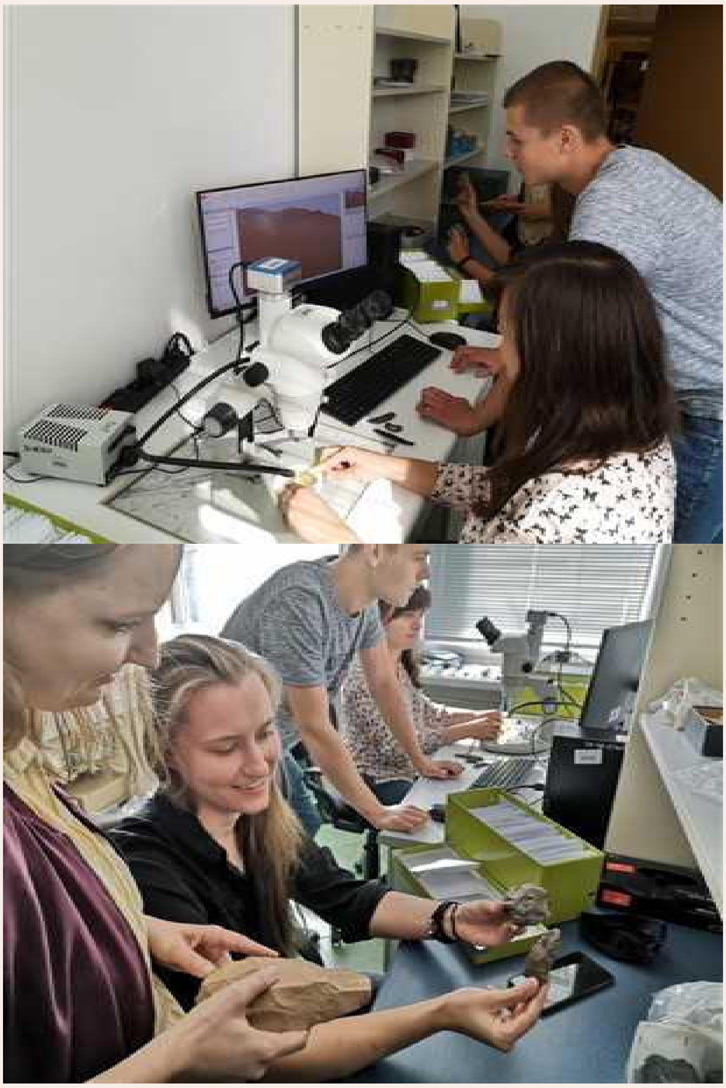

Fig. 8. The „Traceology” cource. Students during the classes.

We hope that soon we will be able to propose the new type of classes of this type.

Experimental production of the Middle Ages crossbow bolt heads

This article presents the results of the experiment carried out in 1974, at the Institute of Archaeology, Nicolaus Copernicus University in Toruń. Its initiators were Andrzej Kola and Gerard Wilke. The starting point for works described below was the discovery of the 784 crossbow bolt heads, in a Late Medieval stronghold in Słoszewy (Brodnica commune), (Fig. 1).

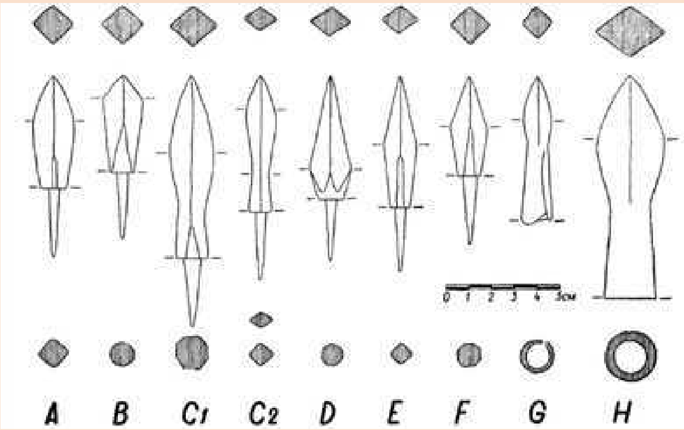

Fig. 1. List of types of crossbow bolt heads from Słoszewy, Brodnica commune.

The aim of the experiment was to check the hypothesis formulated in relation to the methods used to preparing the raw material and producing the different types of crossbow bolt heads. The second aim was to verify a function of the cylindrical bars discovered at the site in Słoszewy, initially interpreted by the authors of the study as half-products for the production of crossbow bolt heads (Fig. 2).

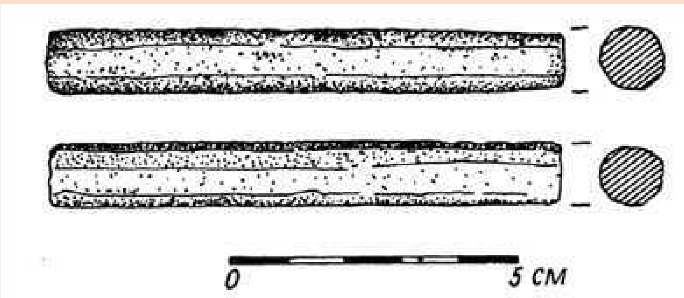

Fig. 2. Half-products for the production of bolt heads discovered in Słoszewy.

Materials and methods

The experiment was carried out in a blacksmith's workshop in Toruń. It consisted of two parts, which concerned the production of spindle and socketed crossbow bolt heads:

Part 1 of the experiment consisted of three stages:

Stage one: the first one was related to the preparation of raw material along with forging the two test spindle bolt heads;

Stage two: the second one assumed the production of a series of ten spindle bolt heads to determine their size and weight parameters along with the time measurement of individual production phases;

Stage three: the third, concerned explanation of the method for making bolts from bars defined as the half-products.

Part 2 of the experiment was associated with the production of socketed bolt heads and included the method of their manufacture along with the time measuring of these works.

The experimental program

Part 1 of the experiment

a) *Stage one*

The raw material for the production of the bolt heads were iron rods with a square and round cross-section, in both cases about 10 mm thick. The blacksmith prepared two 43 mm long bars from a round iron piece and cut them after heating on a blacksmith cutter installed on the anvil. Then, from the prepared bars, he began forging the two test spindle heads of the crossbow bolts. The production cycle of the first specimen is presented in Table 1.

The length of prepared test spindle bolt heads was 87 mm in the case of the first specimen, and 90 mm in the case of the second one. The size of the tang was 29 and 30 mm, while the maximum width/ thickness was 13 mm.

The production phase	Description of activities	Time (in sec.)
Ia	Heating up	20
Ib	Partial forging of the tang	30
IIa	Heating up	10
IIb	Further forging of the tang and initial forging of the bolt head	30
IIIa	Heating up	15
IIIb	Shaping the shank in the nailer and shaping the lower part of the bolt head	25
IVa	Heating up	15
IVb	Forming the top of the bolt head	40
	Total	**185**

Table 1. The production cycle of the first specimen of test spindle bolt head made during stage one of the experiment.

The most striking fact here was the length of the bolt head, given that the blank (bar) used to make it was only about 40 mm long. Apart from the considerable length to the obtained product, attention was drawn to the almost complete similarity of the form of both test bold heads, thus indicating the possibility of the manufacturer producing large series of specific types of bolt heads. This supposition was to be confirmed by the implementation of the second stage of the first part of the experiment discussed here, which involved making a series of 10 spindle bolt heads.

b) *Stage two*

When commencing this task, the blacksmith prepared, as before, ten iron bars with a round cross-section of 10 mm in diameter and about 43-44 mm long. It should be noted here that these bars, despite their almost equal length, were cut off by a blacksmith from a long bar without the use of a measuring tool. The production cycle of the bolt heads made during this part of works did not differ much from the previously presented test ones, both in terms of the production phases and their time parameters (see Table 1). The production time of a series of 10 spindle bolt heads was about 40 minutes, which is about 4 minutes per 1 piece. As one can see, the average production time for one specimen was slightly longer here than during the production of the test specimens. Although time parameters of individual production phases did not change significantly, the increase in the average production time consisted of short, intended by the blacksmith breaks between the production of individual copies. All forms of the forged in this series spindle bolt heads were analogous to the previously produced test specimens (Fig. 3).

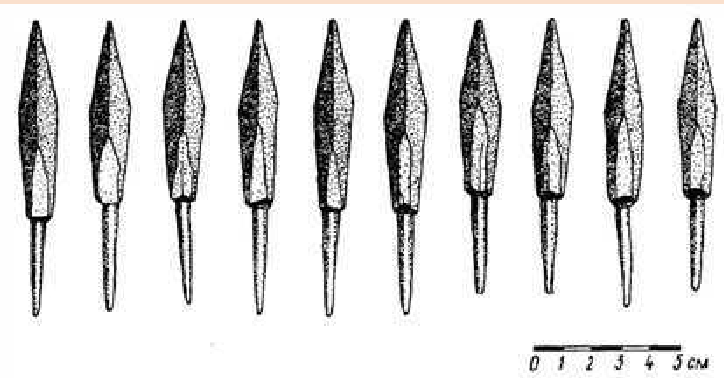

Fig. 3. A series of 10 spindle bolts made during an experiment in a modern blacksmith's workshop.

c) *Stage three*

A fascinating issue that was expected to be clarified in the next part of the experiment was function of the long cylindrical bars, initially defined as half-products for making crossbow bolt heads. The blacksmith also defined them unequivocally as the half-products, however, not as was believed for forging one, but two copies of bolt heads. The practical tests were conducted. After heating the bar, the first step of mechanical processing was the partial forging of the tang at one of its ends (Fig. 4 - phase II). After further heating of the processed blank, the blacksmith partially forged the tang from the other end of the bar (Fig. 4 - phase III). Using the still hot enough iron, he cut the partially formed blank into two equal parts and also pre-treated the point of one of them. After the next, third heating, the work of the blacksmith went towards the final shaping of the tang (Fig. 4 - Phase IV). The consequence of the last, fourth heating was shaping of the tip of the bolt head and giving it its final shape (Fig. 4 - phase V).

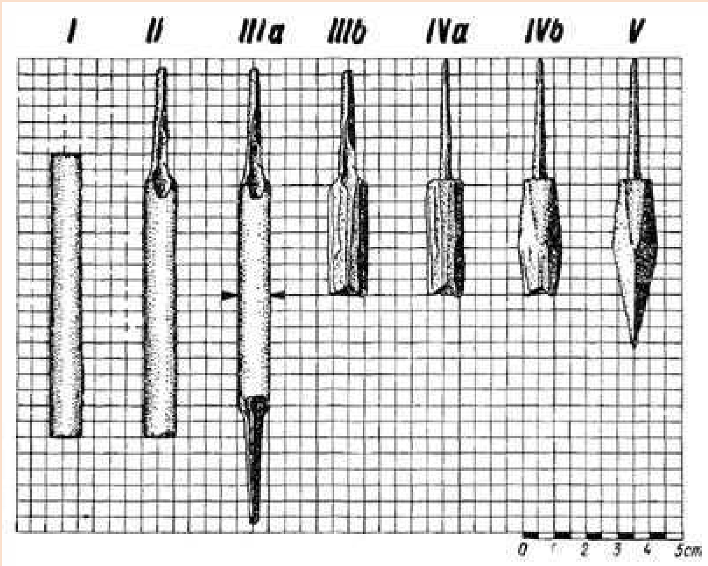

Fig. 4. Diagram of the production phases of spindle bolts for a crossbow (based on a modern experiment).

Part 2 of the experiment

The second part of the experiment concerned the method of production of the socketed crossbow bolt heads. The starting product was an iron, cylindrical bar with parameters analogous to those used in the production of the spindle bolt heads (Fig. 5 - phase I). After the bar was heated, the blacksmith's first action was to tap one of its ends into the plate (Fig. 5 - phase II). A similar operation was carried out after reheating with the other end of the bar. At this stage of production, while still using the heated iron, the bar was cut into two parts on the blacksmith's chisel (fig. 5 - phase III). After another heating up, the plate was rolled up into a socked. In the first phase of this activity, the side edges of the plate were vaulted only with a hammer on the anvil, in the final stage, the socked was formed on a blacksmith chisel (Fig. 5 - phase IV). After the last, fourth heating, the tip of the bolt head received its final form (Fig. 5 - phase V).

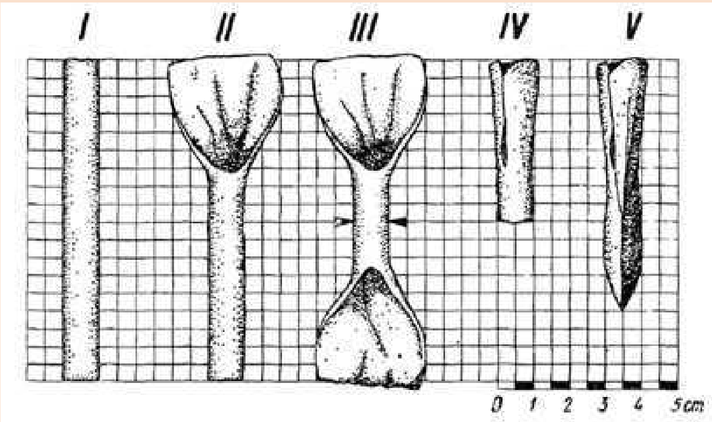

Fig. 5. Diagram of the production phases of crossbow socketed bolt heads (based on a modern experiment).

Conclusions

Thanks to the conducted experiments, interesting data was obtained on the supposed efficiency of the work of a medieval blacksmith producing elements of the armaments. Received data also allowed to reproduce the production process of certain types of crossbow bolt heads. What important, the set of blacksmith tools used during the experiment found its equivalents in archaeological, iconographic and ethnographic source materials.

Detailed information about the experiment can be found in article written by Andrzej Kola and Gerard Wilke, entitled: *Produkcja grotów bełtów do kuszy w średniowieczu w świetle współczesnych prób eksperymentalnych. Uwagi o odkryciach na grodzisku póżnosredniowiecznym w Słoszewach, pow. Brodnica, w 1973 r.,* published in 1975 in the journal Acta Universitatis Nicolai Copernici (Kola, Wilke 1975).

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Kola A., Wilke G., 1975. Produkcja grotów bełtów do kusy w średniowieczu w świetle współczesnych prób eksperymentalnych. Uwagi o odkryciach nagrodzisku późnośredniowiecznym w Słoszewach pow. Brodnica w 1973 roku. Acta Universitatis Nicolai Copernici. Archeologia V, 161-180.

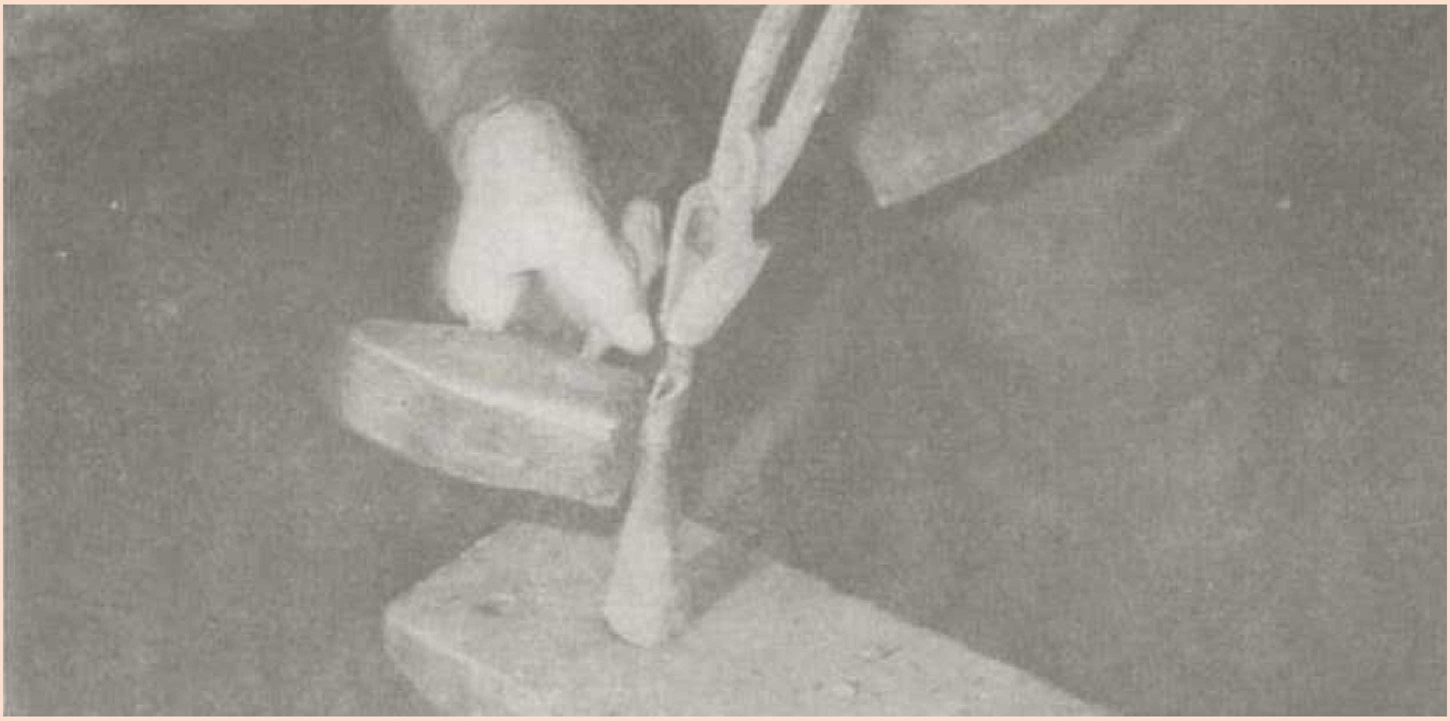

Fig. 6. The final phase of the production of crossbow socketed bolt heads during the experiment.

Experimental forming of the Early Modern bell-shaped glass beakers

In the years 1982-2015, at the Institute of Archeology, Nicolaus Copernicus University in Toruń, under the supervision of Jerzy Olczak, and later Małgorzata Markiewicz, the Laboratory of Glass History functioned.

Its employees researched the history of glass and its manufacturing in Poland and Europe from the Antiquity to the Modern Times. These studies included issues such as the history of production, technology, function and role of glass in the culture. Production techniques have been reconstructed using various methods, including experimental archaeology. An example of this type of research is the experiment conducted by Małgorzata Markiewicz in 2001, aimed at reconstructing the techniques used in the production of bell-shaped glass beakers. The basis for this experiment were Early Modern vessels used in Poland from the end of 16th to the 18th century (Fig. 1).

Fig. 1. The bell-shaped beaker from Trzemeszno (phot. W. Ochotny)

Materials and methods

The experiment was carried out in the conditions of a modern glassworks – Irena Glass Factory in Inowrocław. Thus, both the glass mass and the tools used during the experiment were adapted to the current production in the glassworks. The experiment was based on the free-blowing technique described in the literature (Ciepiela 1996, 248-249; Olczak 1978, 136-137). As part of the experiment, it was also decided to test the technique of using wooden moulds. Three basic shapes of the bodies of these popular vessels were taken into account: bell-shaped, tulip-shaped and cylindrical (Olczak 1978, fig. 6). They were openable, two-piece moulds made of hard beechwood (Figs. 2A, 2B). When using wooden moulds, the vessel body, leg and foot were formed by the blower in the mould (Fig. 2C, 2D). Then, in the same way, as in the free-blowing technique described below, the pontil was attached, the excess glass was removed, and the lip was formed.

Fig. 2. Production of beakers using wooden moulds: A, B – two-piece moulds made of beech wood; C, D – forming beaker in moulds (phot. A. Janowski)

The course of the experiment

Fig. 3. Production of beakers using the free-blowing technique: A, B – shaping the glass bulb; C – shaping the leg; D – shaping the foot; E – attaching the pontil; F – removing excess glass; G – cutting the lip; H – forming the lip (phot. A. Chęć, A. Janowski)

Making the beakers using the free-blowing technique required great skills and attention from the blower, because he had to model the body, leg and foot without using a mould. After blowing the glass bulb into a round shape (Fig. 3A) and then elongating it (Fig. 3B), the end of the bulb was squeezed with tongs to form a leg (Fig. 3C), which was flattened to form the foot of the vessel (Fig. 3D). A heated pontil was attached to the foot (Fig. 3E), and then the excess glass was removed from the top of the vessel (Fig. 3F). This way, one of the very characteristic production waste was created, which was often reused. The beaker was reheated to cut off the excess glass (Fig. 3G) and to model the lip (Fig. 3H).

Conclusions

The beakers produced during the experiment (Fig. 4), due to the different viscosity of the glass mass, differ from artefacts, mainly with a much greater wall thickness and the appearance of the leg, foot and bottom. In all cases, they are full, which was caused not only by other features of the glass mass used but also by the use of an improved type of pontil. It gave the effect of a conical bottom with walls glued to different degrees and with a fragment of glass on the bottom.

Fig. 4. Bell-shaped beakers made during the experiment (phot. A. Chęć).

Summary

The above experiment allowed to observe the details of the production technique of these interesting vessels, the function of which remains unknown (Olczak 1997, 225-228; 2000, 621-623). It also confirmed the hypothesis of their mass production. These vessels did not require high qualifications from the glassworkers who made them. It was also not a time-consuming process, nor did it require the use of a glass mass with better properties than for other products. The experiment associated with production of beakers using wooden moulds showed that it was possible to produce beakers in a different, more effective way, giving more shapely, than often very lopsided, hand-made products . However, no confirmation of the use of wooden moulds was found in the archaeological material.

Detailed information about the experiment can be found in article written by Małgorzata Markiewicz, entitled: *Doświadczalne, hutnicze formowanie szklanych pucharków dzwonowatych na podstawie wczesnonowożytnych oryginałów*, published in the journal Acta Universitatis Nicolai Copernici (Markiewicz 2005).

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International Camp of Experimental Archaeology

Toruń 2020

International Camp of Experimental Archaeology
Toruń 2020 Poland

We invite everyone interested in experimental archaeology to participate in a two-week ***International Camp of Experimental Archaeology***, connected with a seminar presenting the state of art of this method in Poland and accompanying traceological workshops.

The event is organized by the Department of Prehistory of the Institute of Archaeology, Nicolaus Copernicus University in Toruń, in cooperation with the Society for Experimental Prehistoric Archaeology (SEPA).

Papers presented during the seminar and the results of experimental work carried out during the camp will be published in the book entitled ***Experimental Archaeology in Poland***. The event is directed to all people who want to deepen the knowledge in the field of experimental archaeology, as well as in the traceological method.

June 14-27, 2021

(initial date, depends on the pandemic situation)

More information about the camp, including the number of places and fees, can be found on the event website: **http://www.exarchcamp.umk.pl**

EXPERIMENTAL ARCHAEOLOGY IN NCU Newsletter

NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Society for Experimental Prehistoric Archaeology

Our recent publications

Grzegorz Osipowicz, Justyna Orłowska, Mariusz Bosiak, Mikael A. Manninen, Piotr Targowski, Jarosław Sobieraj

Slotted bone point from Tłokowo – rewritten story of a unique artefact from Mesolithic Poland

Abstract: The article describes the results of the interdisciplinary studies of a unique bone slotted point from Tłokowo, north-eastern Poland. The artefact was discovered in 1989, and indirect dating suggested an Early Mesolithic date. In this article we present the results of direct radiocarbon dating of the point, which shows that it is almost 2000 years younger than previously suggested. In addition, physical-chemical studies of the adhesive used to mount the flint inserts inside the point were conducted. The results of gas chromatography mass spectrometry (GC-MS) and attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FT-IR) analysis indicate that the adhesive is birch tar. Finally, the article presents the results of detailed traceological studies that allow interpretation of the technology of production and possible function of the point. For the analysis, as well as various types of microscopes, optical coherence tomography (OCT) was used. In the discussion the results of all the analyses are considered alongside our current knowledge of this type of Mesolithic points in Europe.


DE GRUYTER

Grzegorz Osipowicz, Justyna Orłowska, Mariusz Bosiak, Mikael A. Manninen, Piotr Targowski, Jarosław Sobieraj

Slotted bone point from Tłokowo – rewritten story of a unique artefact from Mesolithic Poland

The article provides information on the results of chemical analysis of birch tar obtained during our experiments with methods without the use of ceramic vessels.

In Journal: Praehistorische Zeitschrift (2020); https://doi.org/10.1515/pz-2020-0023

Łukasz Kowalski, Aldona Garbacz-Klempka, Jacek Gackowski, Dominik Ścibior, Małgorzata Perek-Nowak, Kamil Adamczak, Piotr Długosz

TOWARDS DIRECT CASTING: ARCHAEOMETALLURGICAL INSIGHT INTO A BRONZE MOULD FROM ELGISZEWO, POLAND, 900–700 BC

Abstract: This study reports the results of archaeometallurgical investigations performed on a complete two-part bronze casting mould discovered in the village of Elgiszewo (north Poland). The mould was part of the so-called Lusatian founder's hoard deposited on the southern borders of the Chełmno group territory between 900 and 700 BC. The investigations involved the employment of spectral (ED XRF, SEM-EDS, X-ray) and microscopic (SEM-EDS, OM) analyses. The experimental casting of the model mould and socketed axe was carried out in this study as well. The chemical composition of the mould indicates the use of fire-refined (oxidized) fahlore scrap bronze, which could originally be composed of North Tyrolean copper fahlores. The metallographic results furthermore indicate deliberate tin abandonment by the Lusatian metalworker to maintain a thermal resistance of the mould during direct metal casting. Having analysed the results of the performed research, we can state that the mould from Elgiszewo was capable of ensuring direct casting and was in fact used by the Lusatian metalworkers for this purpose before the mould was finally deposited.


Archeologické rozhledy LXXI–2019

Towards direct casting: Archaeometallurgical insight into a bronze mould from Elgiszewo, Poland, 900–700 BC

K přímému odlévání: bronzová licí forma z Elgiszewa, Polsko, 900–700 př. n. l.

Łukasz Kowalski – Aldona Garbacz-Klempka – Jacek Gackowski – Dominik Ścibior – Małgorzata Perek-Nowak – Kamil Adamczak – Piotr Długosz

1. Introduction

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