NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ
Faculty of History
Society for Experimental Prehistoric Archaeology

EXPERIMENTAL ARCHAEOLOGY IN NCU
Newsletter

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EDITORIAL

Dear Readers, at the beginning I would like to thank you for the positive response on our initiative to create this Newsletter. I promise that we will try to not disappoint your expectations and we will do our best to report the experimental works carried out in our center with the utmost care. One more time thank You very much!

The first article of this issue describes the experiments conducted this winter, the purpose of which was characterization of the impact traces forming on bones, after hitting by different types of points and harpoons. These studies were aimed at interpretation of the origin of damage recorded on some seal bones, discovered within the complex of Subneolitic sites in Sventoji in Lithuania and conducted in cooperation with the National Museum of Lithuania and Lithuanian Institute of History in Vilnius. The second article reports a very interesting experiment implemented by our students in order to verify the theories of Dean R. Snow regarding the possible sex of artists imprinting their hands in the prehistoric caves. Most lecturers and a large number of students of our center have been involved in these works. The last article describes experiments with steel carburizing in a small shaft furnace, that can be considered undoubtly as very important for studies on the metallurgy in prehistoric and historical times. I hope You will enjoy our reports!

News & Events

Excavations and experimental archaeology in Poland :)

We warmly invite you to join our experiments during the excavations on Mesolithic sites Paliwodzizna 29 and Nowogród 26 this summer!

Excavations at Paliwodzizna 29 site.

We plan a multi-faceted experimental archaeology program focused at the interpretation of functions of two types of prehistoric osseous tools: Subneolithic "seal scrapers" from Šventoji (Lithuania) and very interesting late Neolithic knives from Bruszczewo (Poland).

The volunteers will also be able to try themselves in flint knapping, working in amber, bone/antler and wood with the use of replicas of the prehistoric (stone and bone) tools, pottery burning and birch tar production with non ceramic or ceramic methods.

Detailed information about the excavations can be found at the website of the project: www.searchingformesolithic.umk.pl.

INSIDE THIS ISSUE

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Harpoon? Or perhaps something different? New experiments with prehistoric projectile weapon

Experimental studies on the prehistoric projectile weapons and the destruction characteristics resulting from its use have a relatively long history at the Institute of Archeology NCU. From among the experiments carried out so far, special attention should be paid on the verification studies relating to the characteristic of use-wear traces that creating on various types of flint arrowheads (Nowak, Osipowicz 2012, the English version of the article is in press), as well as to the still unpublished, analogous experiments conducted for osseous projectile points. In both research programs bows and arrows were used to shoot the target.

The latest experiments carried out in our center, which relates to the issue of the ways of use of the hunting weapon in prehistory, are connected to the research program currently being implemented at our Laboratory of Traceology, relating to the technology of production and function of osseous artefacts, discovered in complex of the Subneolithic sites in Šventoji (Lithuania).

Among the many very interesting products found there, i.a. different types of harpoons and arrowheads, a collection of the seal scapulas were also gathered, with well readable holes in the surface, that are usually interpreted as a remnant of the use of hunting weapon (e.g. Luik, Piličiauskienė 2016). In the light of the results of microscopic, archeozoological and contextual research, it was hypothesized that such an interpretation of their genesis could be wrong.

In order to verify the true origin of the holes, it was necessary to characterize the wear traces creating on the bones as a result of breakthroughs by the various types of points. Therefore, in the winter of this year, an experimental program was planned and implemented, in which 16 different types of points were used to simulate the impact of the hunting weapon on the animal scapulas.

Experimental points and harpoon heads used during first stage of the experiments.

Left scapula of harp seal from Šventoji 4 site with healed trauma and deadly injury probably caused by harpoon. Site Šventoji, Lithuania (after Luik, Piličiauskienė 2016, 194, fig.8).

During the experiments were used: 3 harpoons and 5 points made from antler and 4 harpoons and 4 points made from bone. All projectile points used in the experiments find (closer or further) analogies in the archaeological materials from the Sventoji site complex. As the target were used 20 fresh pork scapulas, which were additionally wrapped in bacon. The points were placed into the shafts with a length of about 1.5 m. The weapon prepared this way was used against a target from a distance of about 0.5 m. Each scapula was pierced from 3 to 6 times, knocking out a total of 66 holes.

Examples of experimentally hitted scapulas during archery experiment.

Experimental hitting and pierced scapula.

In order to verify the origin of some of the holes identified on prehistoric bones, deviating in shape and size from the standard observed, a bow and arrows were also applied in the second stage of the experiments. To accomplish this stage of study, 6 bone and 3 flint arrowheads were used, with forms typical for Sventoji sites and a straight bow with a tensile strength of about 37 lbs. Also in this case, the targets were pig's scapulas, which were shooted from a distance of about 5m.

Bone and flint arrowheads used during archery experiment.

As a result of the conducted experimental work, it was found that the damage created on bones with the hit of harpoon or arrowhead is very characteristic. The conclusions drawn deviate partly from the common scientific knowledge and allow for a new look both, on the issues of the possibility of identifying impact traces on the osseous archaeological materials, as well on the very origin of the holes on scapulas discovered at Sventoji sites. The full results of this work will be published in the near future. **G.O.**

Experimental scapula with holes created by harpoon head.

References:

Luik H., Piličiauskienė G. 2016. Bone tools at the neolithc sites of Šventoji, Lithuania: raw materials and working methods, In. S. Vitezović (ed.), Close to the bone: current studies in bone technologies, Belgrade, 188-200

Nowak D., Osipowicz D., 2012. Krzemienne zbrojniki broni miotanej z ziemi chełmińskiej w świetle analiz traseologicznych i badań eksperymentalnych, Acta Universitatis Nicolai Copernici, Archeologia 32: 57-112, Toruń

Archaeological experiment “HANDS”

The first forms of art were created during Palaeolithic and they still evoke in people admiration. Among them, one of the most interesting are rock paintings depicting human hands, known from such famous archaeological sites like cave Gargas, Pech Merle and Lascaux in southern France, Altamira in northern Spain or Cueva de las Manos in southern Argentina. Preliminary research on the hand stencils found in the Upper Paleolithic cave sites of France and Spain, conducted by Dean R. Snow (Snow, 2013), showed that sexual dimorphism in the human hands mapped there is expressed probably strongly enough to allow empirical determination of the sexes of their creators. The scientist developed an algorithm in which he used the data about the size of the hands of people of European origin and showed that hand stencils in the Palaeolithic caves were made predominantly by females. An attempt to verify the results of Dean. R. Snow research during specially prepared experiments was undertook by a group of students Jakub Kubiak, Daria Dębicka, Mateusz Serafin, Marta Kacprzak, Adam Kozieł and Marta Melerska, as a part of the experimental archaeology classes.

The first stage of the project was the preparation of the dye and the method of its application, as well as the appropriate surface for the hand stencils. The base for applying the pigment was a specially prepared board covered with a mixture of lime and water. At the beginning, an air-filled compressor was used to apply the dye (the idea was to do it always with the same strength). However, the force with which the air flow achieved was too strong, what caused the pigment to focus locally. The minus of the method was also its modernity. After several unsuccessful attempts with the compressor, it was decided to applicate the dye with mouth blowing. One person put his hand to the prepared surface while the other one bloated ocher at various angles. The best results have been achieved by blowing ocher in the right angle to the hand.

Making outlines of hands using ocher (photo by Dębicka, D.).

It also gave the best cognitive values when comparing sizes of the real hands, their scanned images and their inprints, created during the experiments.

Hands at the Cuevas de las Manos, Santa Cruz Province, Argentina. The art in the cave dates from 13,000 to 9,000 years ago. By Mariano (Own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0/)

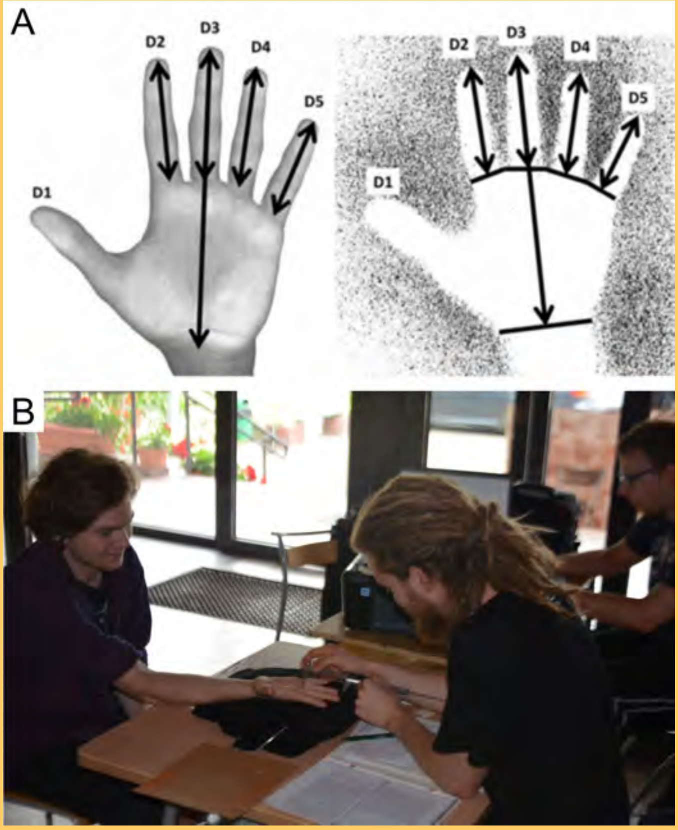
After the preparation stage of the experiment, the organizers began to perform its main part, which took place in the courtyard of the IA NCU in Toruń. The experiment was attended by students and lecturers of the Institute. At the beginning, the dimensions of the right and left hands were taken from everyone joining the project. Then, the scans of their hands were made. All paricipating in the experiment received an identification number needed in further documentation. Then, each participant applied his hand to the previously prepared board covered with lime, which was moistened with water. At the same time one of the students was blowing the ocher from a paper cup. In this way, hand contours made of ocher were created. A total of 57 people participated in the experiment, both women (27) and men (30) - all in different age, which gave in total 114 hand stencils. All hands varied in size.

The final stage of the experiment was to compare the dimensions of the hands with their experimental contours. The results of the experiments carried out showed that the collected data regarding the length of the index finger and the ring finger (data D2 and D4) of the hands as well as the experimental contours were similar for women and mens. Given it and the necessary margin of error, students noticed that the method proposed by D. R. Snow was insufficient to state clearly, whether Paleolithic hand stencils belonged to women or men. During the experiment, students also had an opportunity to get acquainted with ocher and its coloring properties as well as various methods of its application. The results of the described study will be further presented in detail and discussed in the planned publication.

J.O.

References:

Snow, D. R., 2013. Sexual dimorphism in European Upper Paleolithic cave art. American Antiquity, 78(4), 746-761.



A - Measurements taken directly from the hand (left), measurements taken from hand contours (right), according to (Snow, 2013); B - taking hand measurements from participants of the experiment (photo by Dębicka ,D.).

Photographic documentation of the experimental hand stencils (photo by Sosnowski, M.).

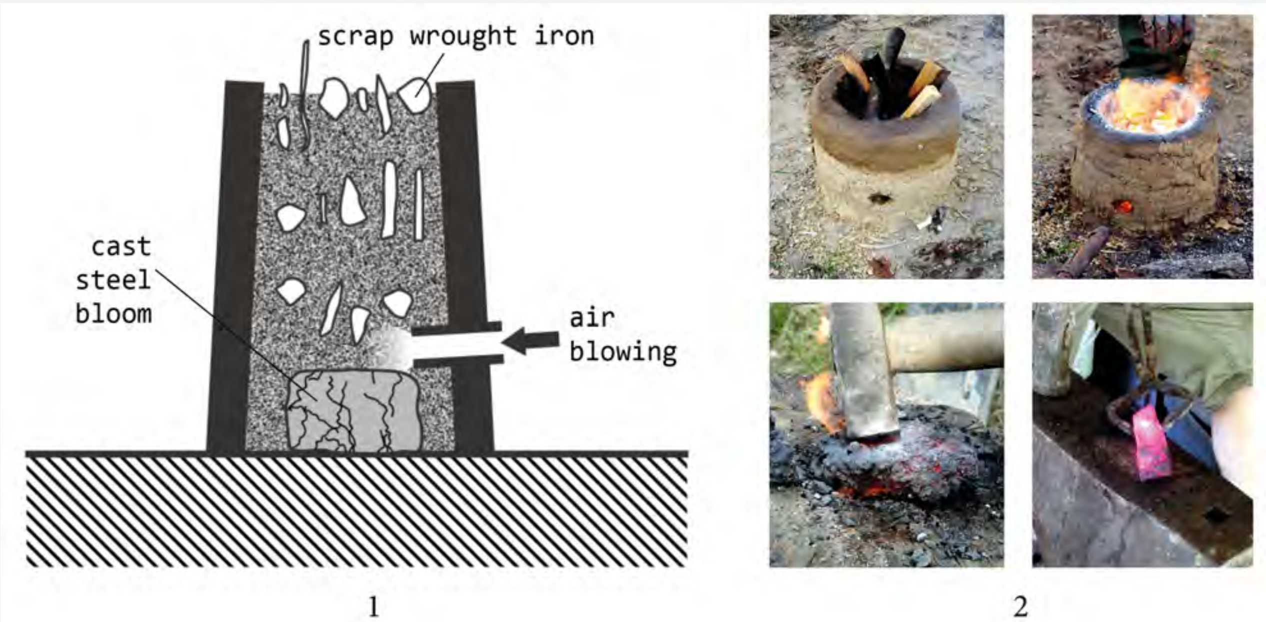
Steel carburising in a small shaft furnace. The so-called "Aristotle process" – its possibilities and limitations

The so-called "Aristotle furnace," named due to a specific description given by Aristotle in his Meteorologica, is a small shaft furnace used for indirect production of steel from scrap iron. The process consists of passing low carbon iron alloy, varying from unrefined bloom fragments to scrap metal, through liquid state in temperatures above 1500°C, in which it takes up carbon, gets homogenised and looses most impurities (slag) (Sauder 2010; Evenstad 1790, 437-441; Wagner 1990).

No remains of prehistoric or early medieval furnaces were found, which can be clearly identified as "Aristotle furnaces." Features with apropriate shapes and sizes are known, but they are never a definite, as similar constructions could have been used for the metallurgy of colour metals. Other helpful indicators would include the in situ presence of cast steel, usage of such a material in local blacksmithing production, vitrification of surviving furnace's inner shaft walls caused by very high temperatures. In terms of material characteristics, similar structures can be observed in direct bloomery steel, which underwent at least partial liquefaction, as well as in Central Asian and Indian crucible steel, possibly imported to Europe.

To proceed, the process requires melting of iron secured by high enough blast rates. Different variables – each to some extent – play a role in the total amount of carbon absorbed by the forming bloom, its final quality (purity) and weight. These include primarily the furnace size, its proportions, blow hole position, as well as shape and size of the feedstock, its chemical composition, burn rate, residence time and temperature during after final metal charge.

Five experiments were carried out on different occasions. Each time, a shaft furnace of ca. 25 cm height, ca. 15 cm inner diameter was built from sand tempered red clay.



The carburisation procedure in the " furnace": 1 – schematic representation; 2 – photography.

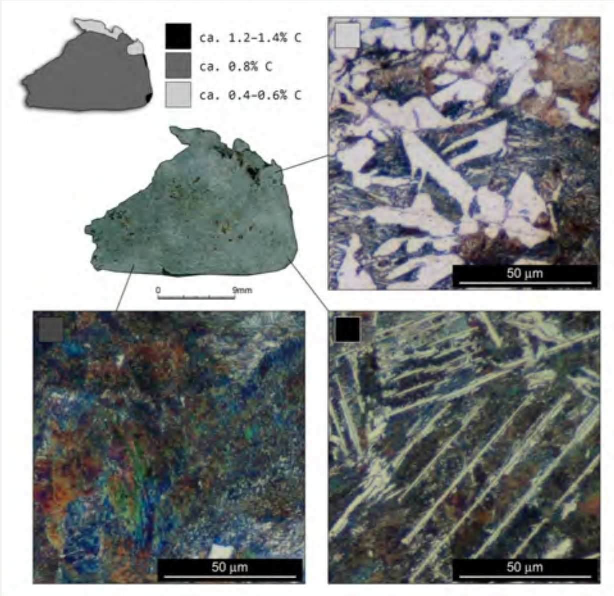
In subsequent constructions, the holes (ca. 2 cm diameter) were placed 3, 5, 7, and 10 cm above the furnace bottom. The table presents the type and weight of feedstock, blowing apparatus, air rates, fuel type and its amount, as well as the produced blooms. The figures include subsequent phases of the process, forging of bloom into a bar, and metallographic examination of one lump (no. 140523), which was compressed in the later stages of the experiment.

Each time a cast steel bloom formed below the blow hole, touching the front wall through which the air was introduced into the installation. It was not always possible to remove them withouth taking the furnaces apart, although in many cases the furnaces were still reparable. In every case, material losses were constant and very low (ca. 100 g). Every bloom varied in carbon content, but in general they were homogeneous and free of bigger slag inclusions, securing their great mechanical properties and making them perfectly suitable for working parts of different sorts of tools and weapons. In accordance to the level of their carburisation, they were moderately difficult to very difficult to work with during compression, forming, drawing, and heat treatment.

Steel blooms acquired during the experiments.

Experiment No.	Duration of the actual smelt [l\min]	Blowing hole position above furnace bottom [cm]	Blowing apparatus	Air rate [l/min]	Type of fuel	Amount of fuel used for actual smelting/casting [kg]	Type of feedstock	Feedstock weight [kg]	Bloom weight [kg]
140523	60	4	set of hand bellows (40 l each)	2000 (varied)	pine charcoal	9 (ca.)	SAE 1008 nails (<0.1% C, <0.03% P, <0.3–0.4% Mn, <0.07–0.60% Si, <0.05% S)	1.00	0.90
140531	80	7	centrifugal fan (max 10000 l/min)	4000	hardwood (beech) charcoal	8 (ca.)	archaeological bloomery iron scrap (variable; <0.4% C, <1% P, <0,04% Mn, <0,02% Si, <0.01% S)	1.60	1.48
150107.1	60	5	centrifugal fan (max 10000 l/min)	3000	hardwood (beech) charcoal	7.90	SAE 1008 nails (<0.1% C, <0.03% P, <0.3–0.4% Mn, <0.07–0.60% Si, <0.05% S)	1.00	0.91
150107.2	60	10	centrifugal fan (max 10000 l/min)	3000	hardwood (beech) charcoal	7.70	SAE 1008 nails (<0.1% C, <0.03% P, <0.3–0.4% Mn, <0.07–0.60% Si, <0.05% S)	1.12	1.00
150108	60	3	centrifugal fan (max 10000 l/min)	3000	hardwood (beech) charcoal	6.00	archaeological wrought iron (blast furnace, imperfect fining; <0.20% C, <0.60%P, <0.05% Mn, <0.05% Si, <0.01% S)	1.17	1.09

Experiment parameters and post-process.



Metallographic examination of one bloom. The material is characterised with high carbon content, high homogeneity and little to none highly dispersed slag inclusions.

It can be concluded that the method allows to easily obtain small quantities of high quality cast steel of controllable carbon content. It is very time-effective, the consumption of fuel is relatively low, so are the material losses coming from metal burning. The carbon content can be controlled with positioning of the blow hole lower or higher in the shaft wall, allowing to obtain the desired level of carburisation between mild steel and hypereutectoid steel. The maximum intake of feedstock is below 2 kg, this value depends on how high the blow hole is placed. Without the introduction of additional blowholes and/or tuyeres, the 15 cm furnace shaft diameter should be considered as the maximum, whereas 10 cm seems to be optimal.

R. Kazimierczak & P. Kucypera

References:

Evenstad O. 1790, Afhandling om Jern-Malm, som findes i Myrer og Moradser i Norge, og Omgangsmaaden med at forvandle den til Jern og Staal, af Ole Evenstad, Lænsmand og Bonde af Aamods Præstegield i Østerdalen i Norge. Et Priisskrift, som vandt det Kongelige Landhuusholdnings-Selskabs 2den Guldmedille, i Aaret 1782, København.

Sauder L. 2010, Making Steel in the "Aristotle Furnace", [In:] HMS 2010 Conference proceedings, <http://www.leesauder.com/pdfs/Aristotle%27s%20Steel.pdf> [read 2017-10-14].

Wagner D. 1990. Ancient carburisation of iron to steel: a comment, Archeomaterials 4 (1), 111-117.

Get the prehistoric skills!

New classes on experimental archaeology in the Institute of Archaeology NCU

We have just started our new classes on experimental archaeology in the Institute of Archaeology NCU. The classes entitled *Get the prehistoric skills! Experimental archaeology – the way to understand the past* are 30 hours course in English that have a profile of practical laboratories, supplemented with the appropriate dose of the theoretical knowledge.

Experimental fleshing of a deer hide with flint tools.

Covering the container filled with birch bark with clay during the experimental birch tar production.

In the first place, students are familiarized with the methodology of ex-perimental studies in archeology and the basic info-rmation about life ways in the prehistoric times. Subsequently, they have a series of practical classes, where are pre-sented different survival techniques used in the everyday life in prehistory.

During the meetings it is discussed and tested 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. Also, the techniques far more complicated are tested, e.g. bone and antler softening, destructive birch bark distillation (to produce birch tar), different ways of making fire, making and firing the pottery, hunting te-chniques, methods of plant processing (e.g. ropes pro-duction), building techni-ques etc.

Participants are required to active, practical participation in all conducted activities that must be held with the observance of relevant methodology of experimental studies.

During the meetings are going to be used only raw materials, techniques and tools available in the Stone Age.

These classes are already forth type of the official meetings with students closely related to experimental archaeology in our Institute. Keep it up! :)

G.O.

Photo from the past...

Members of the Societey for Prehistoric Experimental Archaeology in 2003