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Lectures

The application of experimental archaeology to the modern world
Dr Roeland Paardekooper, EXARC

Experimental archaeology is not just the simple reinvention of techniques. It is both a research and teaching tool, applied at universities, open-air museums and in schools. A hands-on immersive comparison with the past is created. But archaeology is more than a simple answer to "who were the people who lived here in the past".
This lecture discusses the way experimental archaeology taught us ways of how we can learn insights from the archaeological past, but are relevant for the present, in German: Gegenwartsrelevanz. Can we make concrete as tough as the Romans did? Were Bronze Age houses in a way "smarter" then current sustainable building techniques? Are Stone Age techniques of food preservation the new hit because it is healthier?
Can experimental archaeology accommodate our modern life?

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The new "experimental archaeological working area" at the Archäologiepark Römische Villa Borg: glass workshop, pottery, forge
Bettina Birkenhagen, Frank Wiesenberg, Archäologiepark Römische Villa Borg

The Archaeological Park Roman Villa Borg is the only complete reconstruction of a pars urbana of a Roman villa rustica in the world. In Roman times these farms kept both crops and livestock. In addition to agriculture, various crafts were also practised, e.g. to carry out small repairs, or to manufacture products for their own usage.
As early as 2013, the first reconstruction of a Roman glass-workshop was built and has been operated regularly ever since. Since last year, this glass-workshop has been extended with another building with glass furnaces of a different layout, as well as a reconstructed forge and a pottery workshop. This year, for the first time, projects were carried out in the workshops; their results will be presented in this lecture. These programs are to be expanded further in the near future, so that the workshops can be used for both: for the demonstration of ancient craftsmanship as well as for the implementation of research projects, as already happened in the first glass workshop. Project partners are therefore very welcome.

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Prehistoric bronze casting and integrity: what can I know, what should I do?
Dr. Hans Joachim Behnke, Archäotechnisches Zentrum Welzow
Thorsten Helmerking

Swords were already cast at the very beginning of the Bronze Age in the second millennium in the Aunjetitzer culture. From the beginning of a sword casting project in 2018, supported by Kulturland Brandenburg and the Archaeo-technisches Zentrum Welzow the authors Dr. Hans Joachim Behnke and Thorsten Helmerking raised the question as to what means the founders of that time may have used.
After the relevant archaeological findings and finds in Central Europe had been evaluated, a casting apparatus was created, vessels and nozzles were manufactured, food was set up and swords were cast in the lost clay form.
The production of a bronze sword was filmed during the test phase in May 2018 in the Archaeotechnical Centre Welzow and during the presentation phase in the Archaeological State Museum on the occasion of Archaeotechnica in August 2018. The film will be shown to visitors at the Landesmuseum as a teaching example of bronze casting based on archaeological findings and finds.

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Gold in copper in bronze – metal technology of the early Bronze Age reconstructed
Markus Binggeli

The content of the Early Bronze Age tomb of Thun-Renzenbühl is one of the richest in Europe in design and size. The most exclusive piece of this tomb is a bronze axe with two copper bands inlaid lengthwise on both sides into the axe body, in which 198 small squares of gold are inlaid. This axe and the dagger belong to the most complex objects of the time around 1800 BC.
The application of Early Bronze Age tools is little researched today. Even rarer is the attempt to use such tools to produce objects in the same manufacturing quality as the originals. The reconstruction of the Renzenbühl objects has therefore brought a lot of new experience about the working techniques of that time.
The reconstruction of the axe's manufacturing technique was made possible by neutron tomographic examinations, which provide an accurate (non-destructive) image of the axe's internal structure.
The project was carried out in 2014 during the exhibition "Die Pfahlbauer - Am Wasser und über die Alpen" at the Historisches Museum Bern. During the exhibition, an early Bronze Age metal workshop was installed in a shelter on the museum grounds to give the public an idea of how magnificent objects such as those from Renzenbühl were produced in the early Bronze Age.
The workshop infrastructure was very simple and consisted of a casting and fire pit, stone anvils and hammers, grinding and polishing stones and only a few bronze tools, mainly for decoration techniques. In addition, there were auxiliary tools made of wood, water containers and containers for further material etc. Despite the simplicity of the equipment, the production of such magnificent objects as from Renzenbühl was possible.
In this workshop the visitors could see how complex works such as casting, forging, driving, chasing, polishing were possible with these simple tools.

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Project Celtic Block: Explore, record, conserve, explain and experiment
Nicole Ebinger-Rist, Dirk Krausse, Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart

Eight years ago, the finding of the unlooted burial chamber of an early Celtic princess in the vicinity of the Heuneburg was a moment of glory for archaeology in the region. The exploration of the tomb of this unusual lady, who was buried in the Danube plain in 583 B.C.E., yielded a wealth of unique works of Celtic craftsmanship, including delicately decorated gold jewellery, artistically crafted amber objects and exceptional bronze works.
During the past years these outstanding finds were presented in a successful exhibition titled “The Secret of the Celtic Princess”. The striking feature of this exhibition is its conceptual design. The finds are not shown in a museum but rather as a travelling thematic exhibition arranged in mobile room modules. This makes it possible to bring the objects to the public instead of the usual procedure of bringing the public to the objects. While the centre of attention in any exhibition is of course on the finds, a further important goal of this exhibition was that it should also show in a compact, easily understandable way the process by which archaeological researchers arrive at their results. In addition to conventional documentation methods state-of-the-art computed tomography techniques were also used. These open up possibilities of visualisation in three-dimensions and thus of conveying a graphic understanding of complex find situations.
Providing a further perspective, the exhibition includes high-quality replicas of finds, faithfully reproduced by a renowned Swiss experimental archaeologist. However, the experimental project of the “Celtic Princess” was about more than just creating instructive replicas: It was also aimed at conveying an accurate understanding of the craft techniques used in Early Celtic artisan workshops. To document this work and give visitors a glimpse into the experimental project, a camera team accompanied experimental archaeologist Markus Binggeli over a period of 12 months.

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The chalice of duke Tassilos III. and his wife Liutpirc – Manufacturing technique and later repairs
Stephan Patscher, Römisch- Germanisches Zentralmuseum Mainz

In 2016 on initiative of the Archäologischen Museums Frankfurt/M. the Tassilo-chalice, this “first and most important eucharistic bowl of the early Carolingian period” (Victor Elbern), was investigated in the laboratories of the “Römisch-Germanischen Zentralmuseum Mainz” in detail to resolve it’s materials, making and history of restoration.
The chalice is made of fire-gilded copper with nielloed silver-inlays. The nodus was additionally adorned originally with 36 blue and green glasscabochons. The five silver-medaillons of the cuppa depict Christ in majesty and the four evangelists while the four silver-medaillons of the foot show four saints, from which the scientific research identified the saint „IB“ as John the Baptist and the “saint MT” as the Holy Mary. The inscription-frieze around the bottom of the foot bears the words “+ TASSILO DUX FORTIS + LIUTPIRC VIRGA REGALIS”.
The cuppa and the foot with the nodus are of hammered metal, whereas the massive ring between cuppa and nodus is casted. The ring is movable and on its visible side designed as a sequence of 24 pearls. Cuppa, ring and foot are riveted together by a massive tappet on the underside of the cuppa. Because the cross-section of the tappit is quadrangular and because there is no indication that the joint was ever unclamped, the position of cuppa and foot to each other is very likely the original one.
The inlays of the medaillons and the rhombuses in the nodus are composed mosaic-like out of bigger and smaller silver-sheets. The silver-sheets are not fixed with the copper-subsurface, but are kept in place by predominant unsystematically carried out undercuts between the surfaces of their sides and the adjoining copper, respective the sides of neighboring silver-sheets. Silver-sheets, which were difficult to fasten in this way, were riveted. This happed during the original crafting-process 28 or 29 times; all of those original rivets are placed inside of the medaillons. The inlays with niello seem to be all original, because the niello-lines cross the joints between the single silver-sheets inside the medaillons and rhombuses and even some of the rivets in the medaillons. The composition of the niello indicates also the authenticity of those silver-inlays, because the niello is a silver-copper-sulfur-niello; such niellos were replaced by lower melting silver-copper-lead-sulfur-niellos during the 11th century. The later repairs of the silver-inlays are riveted without exception and show no niello.
The alloys of the original silver-inlays differ among each other to an extent, which indicate that several tranches of silver were used during the progress of the inlaying-work. Several tranches of silver can be detected at the repairs too, but here someone has to consider, if not repair-actions at different times can be the reason for those differences. From one of these actions we are informed by an invoice of the copper-smith Paulus Hueber from January 1796, in which Hueber stated, that he “newly fixed the chalice at 18 places with silver and cleaned it”. Further there is a copper of the chalice from 1777, displaying a flaw in the Marcus-Medaillon above the head of the evangelist and two further flaws inside the inscription-frieze. In addition someone can count more or less 21 fixings among the silver-inlays of the chalice. According to the interpretation of those facts and the results of the material-analysis of the silver, two repair-

actions can be detected; one must have taken place between 1777 and 1795 and the second is the Hueber-action from 1795/1796. To assume more repair-actions might be possible, but is a speculation without proof.

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Foundation Stone Age Test: Glue"

Mirko Runzheimer, Philipps-Universität Marburg / Zeiteninsel – Freilichtmuseum Marburger Land e.V.

A brief introduction will cover the definition of pitch/tar, various manufacturing processes, results from experimental archeology, archaeological finds and other adhesives, which were available in the Stone Age.
Pitch is the main material, which was used in the Stone Age, therefore the "kiln construction" used for the extraction of pitch (based on a project of Harm Paulsen) is briefly described. This kiln construction has already been used successfully several times at Archeotechnology events and in museum education. It produces a homogeneous quality that allows a good comparability in experimental contexts. This manufacturing process is preferred, because it is more transparent to spectators than traditional two-jar-methods. The production of pitch was successfully combined with the creation of small flint knives as a full-day event for school classes at the Zeiteninsel Open Air Museum.
The distillate produced in the kiln has to be further processed depending on the intended use. Therefore, it can be mixed with the production residues and/or other adhesive materials. This raises the question how the desired characteristics can be influenced by mixing with other adhesives available in the Stone Age. With this in mind, it was possible to produce adhesives in the experiment that can be compared to modern synthetic adhesives (such as epoxy resins). These adhesives were mixed with one another in different ratios and systematically examined for their bond strength and other characteristics. The results of the experiments will be presented in the talk with a focus on how to control the characteristics of the desired adhesive with certain mixing ratios.
At the end of the presentation an outlook on the continuation of the experiment in cooperation with the Institute for Chemistry and Material Analysis at the University of Marburg will be given as well as the hint to look out for ceramic goods with graphite on the inside — a regularly byproduct of the production process during the experiments and to investigate graphitized ceramics in the context of pitch/tar production.

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Students heat up! Reproduction and utilization of bloomerys (Rennöfen) during student internships at the Alamanni open-air museum Vörstetten (Alamannen-Freilichtmuseum Vörstetten).
Kai Bölstler, Alamannen-Freilichtmuseum Vörstetten

The Alamanni open-air museum Vörstetten and the Alemannen-Werkrealschule Denzlingen have been cooperating for several years by arranging student internships in order to strengthen the practice-oriented teaching in the middle school and at the same time conduct research using the methods of experimental archaeology. Because hints of iron smelting were found in the early Alemannic settlement of Vörstetten during the excavations, one of the emphases during the student internships is the reproduction of a bloomery according to the Iron Age model. Under professional guidance, the students are included in the production process of the bloomery, from its planning to its construction, as well as in the utilization of the reproduction. By working on the bloomery, students can practice how they can organize, coordinate and prepare a working process as a group or as an individual. During the work process, the students learn to split the workload within the group and how to deal with an upcoming problem or mistake. In this way, the students develop both social and methodological-practical skills and while doing so “learning by doing" becomes an archaeological experiment. The reproduction of a bloomery also shows the great amount of time, material and labour required to prepare the smelting-process. The archaeological experiment thus results in archaeological problems and questions, which are similar to an archaeological excavation. The success, as well as the failure of an experiment generates archaeological findings and at the same time raises new questions or brings forth new problems. Using the experience at the Alamanni open-air museum Vörstetten, the lecture aims to show that school and experimental archaeology are compatible and that cooperation for both sides can be productive. As an "investment in the future" by using the educational opportunity to inspire students for the past as well as for handicraft in the run-up to a professional orientation.

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Bees – honey – brood – wax. Experiments on prehistoric beekeeping
Herbert Gieß, Pfahlbau-Ausstellung Dingelsdorf
Peter Walter M.A. Pfahlbaumuseum Unteruhldingen

Humans love honey at all times. In the beginning, beeswax was a secondary product of the honey harvest. It became more important over time, as new research shows.
In Neolithic lake dwellings of southern Germany and Switzerland wooden tubes have been found, which have been interpreted as hollow logs used as beehives. Two were found in Wangen on the peninsula Höri, Germany (unpublished, information courtesy of Dr. H. Schlichtherle, Öhningen), two in House 11 in Arbon-Bleiche 3, Switzerland, dating to 3381 BC (De Capitani et al. 2002, 112-113) and one in the Zürich-Opéra site, Switzerland (3234-2727 BC) in which beeswax could be proven (information courtesy of Dr. N. Bleicher, Zürich). Thus, the keeping of hives close to Neolithic Lake Dwellings is likely. Honey and brood can be seen in the context of nutrition (food/alcohol). Recent experiments of the *Pfahlbauerleber* in Dingelsdorf, Germany shed new light on the possibilities of beekeeping back in the Neolithic period. Nine hollow logs were formed out of old trees. Five of them were populated with modern bee colonies (*Apis mellifera*) on April 20, 2018 during the fruit blossom. Another four in the following weeks. The bees immediately started with the construction of honey combs. The logs were positioned in different ways (hanging vs. standing). The colonies were observed with emphasis on their behaviour, the construction of honey combs, the production of honey and more generally the health of the bees. The conditions of harvesting the honey are important: how and how much of the honey and wax can be taken out of the log, how were the hives kept and managed? The role of pottery in beekeeping was examined and brought interesting results: pots were probably used to catch swarming hives and for a simple but efficient method to multiply swarms. Starting in summer the possibilities of prehistoric beekeepers to protect the hives until next spring will be checked comparing modern with prehistoric beekeeping.
Besides this the amount of wax relating to the proportions of the log and the size of the hive is examined. New questions arose in the run of the study concerning the use of beeswax in different prehistoric periods which can be the base for further experiments. For the moment we don’t know much about this, e. g. how much wax was needed for Bronze Age metallurgy? Nevertheless, the intensity of beekeeping in prehistory remains a difficult field. Therefore

modern, medieval and classical sources shall be evaluated in order to better describe the importance of the precious raw materials honey and wax.
Chemical analyses of beeswax on wooden objects or pottery has been established in the last years.
One task of this lecture shall be the sensitization of archaeologists to treat “suspicious” objects found on excavations carefully. When beekeeping could be the purpose of the object, e g. a hollow log or certain pottery, it is important not to clean the object, to keep it cool and wet, maybe freeze it to have the possibility later on to analyse the content and eventually prove beekeeping.

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Prehistoric beekeeping – reconstruction and use of a wicker skep
Sonja Guber

The prehistoric beekeeping of Central Europe is currently attracting considerable attention due to the public interest in modern beekeeping. The use of scientific analysis methods allows already known archaeological finds to be examined for wax adhesion or to analyze new finds directly, which confirmed the connection with prehistoric beekeeping for several finds just last year.
As start of the archaobeekeeping project in 2017 wooden tubes were tested as Stone Age bee habitations corresponding to an archaeological find from Arbon Bleiche III (Lake Constance, Switzerland). This year the project focus lies in the construction, colonization and the beekeeping practice of a wicker skep. This reconstruction is based on the discovery of a fragment in the settlement of Feddersen Wierde (Cuxhaven district Germany) from 1./2. century AD. Working with skeps is furthermore interesting because it was a widespread and long used bee habitation but was forgotten as part of the beekeeping history of Central Europe.

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A journey to the stone age-people in the highlands of New Guinea – cooking with the earth oven and the process of salt extraction
Claudia S. Riedt

This report describes our 2 month visit in 1994 with the Dani tribe in the village of Soroba in the highlands of Irian Jaya, New Guinea, and includes our field experiments and observations to study their cooking method in an earth oven and salt extraction.
Sweet potatoes and other vegetables were a staple of the Dani diet, but communal events were celebrated with a pig feast, for which an earth oven was prepared to cook a slaughtered pig and various vegetables. Smaller earth ovens were also used for daily cooking of sweet potatoes, other vegetables and roots, as well as fish. All earth ovens used fire-heated rocks as the heat source. To better understand and document the cooking temperatures reached in these traditional earth ovens, we documented the preparation and construction of earth ovens a few times. Specifically, how they were stocked with vegetables and cuts of meat in various layers. We had wired temperature sensors into the foods and measured the temperature every 5 minutes throughout the entire cooking period, which we will discuss for the different foods cooked in the earth oven.

The Dani not only used salt as a spice, but in earlier days it was also used as a currency in trade. The Baliem valley had two 'salt springs' from which the Dani routinely extracted salt. We observed the process of extracting salt from the Hitigima spring at ~2000 m altitude. We detail the all-day process, which involved bringing various plant materials such as banana stems to the site of the spring, and then cutting, scraping, and smashing the plants to make them more absorbent. Those pieces were then soaked in the brine, taken back to the village where they were dried over several days, and then carefully burnt into salt-containing ash, providing up to a 4-week supply that was kept in banana leaf pouches.

Literature: not available

Battle axe vs. oak wood. A field experiment on Neolithic stone tool technology.
Wulf Hein
(Participants: Sebastian Böhm, Peter Bye-Jensen, Erik Drenth, Rengert Elburg, Anja Probst-Böhm, Peter Walter)

For the last eight years a team of enthusiasts have been meeting in an oak forest near Würzburg (Bavaria, Southern Germany) annually to test prehistoric woodworking tools and techniques. Numerous experiments were carried out in order to collect first-hand information about suitability, handling and performance of various kinds of axes, adzes, chisels and wedges not only made from stone but also from antler, bone and wood. A lot of data were recorded regarding handling, working time, use wear traces on tools and tool marks on processed wooden workpieces.
In 2017, we tried to check a thesis saying that Neolithic hammer axes were probably employed for felling trees by cutting their roots. We used replicas of two original perforated stone axes from The Netherlands not only for tree felling that way but also for cutting down a tree in the usual manner to compare effectiveness and differences in use-wear.
Moreover, we experimented with diverse techniques of hafting the axe heads, following the sparse archaeological record.

Literature: not available

Splitting timber with Neolithic tools (as part of the Ergersheim experiments)
Sebastian Böhm, Anja Probst-Böhm,
(Participants: Rengert Elburg, Wulf Hein, Peter Walter)

Cutting down trees and working the surface of wood with Neolithic axes, hatchets and adzes has often been tried experimentally. In contrast it is has been hardly tested so far how tree trunks could have been split in the Neolithic. However, finds from wooden wedges and split lumbers from various ages of the lake-dwellings of Southern Germany and Switzerland suggest that splitting must have been common part of Neolithic craftsmanship, be it for building houses, for various other constructions or everyday objects.
In order to be able to close this gap at least partially, several experiments in splitting trees with wooden wedges following archaeological examples were conducted as part of the Ergersheim Experiments.
Looking at the archaeological wooden wedges, there is a great variability in size and shape. Many wedges have a more or less pronounced asymmetry and a straight to round tip. What are the benefits of these features when splitting? From the archaeological record it is clear that specific types of wood have been selected for the production of the wedges in Neolithic times. Especially beech, oak and ash were used. This begs the question how many wooden wedges are needed to split a tree trunk and how intense the wearing is.
In the archaeological material, radially split wood is very common. However, there are also finds of tangential planks, which leads to the question of whether they were axed exclusively or whether they were initially split tangentially out of the trunk and then additionally reworked. The presumption that splitting tangentially is not possible, could be disproved by our experiments. On the contrary, we could show that this is done quite easily with Neolithic tools.
Beside the splitting technique the surface of the split wood was of interest. While we find extensive smoothing of the planks, for example at the well of Altscherbitz, split wood found in pile-dwellings that has been used as floor, was seldom reworked. When is reworking of the cleavage surface necessary and to what extent?
We would like to report on the results, insights and considerations gained from our experiments.

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Subsistence strategies at Göbekli Tepe – creating an experimental reference collection of Use wear traces on grinding stones at the Museum Village Düppel
Julia Heeb, Museumsdorf Düppel, Stiftung Stadtmuseum Berlin
Laura Dietrich, Deutsches Archäologisches Institut (DAI)

What has the famous more than ten thousand year old site in southeastern Anatolia „Göbekli Tepe“ and the Museumsdorf Düppel in Berlin in common? The Stadtmuseum Berlin presented its new vision for the future for all its locations in July 2016, one of which is the open air museum in Düppel. One of the main strategic aims of the site is to become established as a living research lab for experimental archaeology. In this context the Orient Abteilung of the Deutsches Archäologisches Institut (DAI, German Archaeological Institute) approached the Museumsdorf Düppel to start an experimental project for creating a reference collection for use wear patterns on grinding stones. Göbekli Tepe, first and foremost famous for the earliest monumental architecture of mankind, also deserves the superlative for another reason. More than 10.000 grinding stones tell a tale of large scale plant-based food production in a hunter-gatherer context. One of the aims of the sub-project „Plant food management at Early Neolithic Göbekli Tepe“, which is part of the DFG-Projekt „The Prehistoric Societies of Upper Mesopotamia and their Subsistence” at the Orient Abteilung of the DAI, is to gain new insights into the dynamics of the processes of domestication. At the moment it is difficult to study the use wear traces since, there are no reliable long-term reference collection of grinding stones. The experiments carried out the Museum Village Düppel were therefore designed to create a reference collection over a long period of time and to find out what was really processed on these grinding stones. In a first series, basalt lava from the Eifel was used to process einkorn in order to document the different use wear stages.

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Archaeological smelting experiments as a foundation for the development of stable metal isotope applications in archaeology
Thomas Rose, Deutsches Bergbaumuseum Bochum

Reconstructing the ore provenance of metal artefacts with stable metal isotopes requires a profound understanding of the isotope’s behaviour during the smelting process, as well as during metalworking and corrosion. Linking the artefacts and its metal with ores and mining districts requires identical chemical behaviour of the isotopes, which differ only in their atomic weight. In regard to copper, comparable geological processes imply a chemical fractionation during the smelting process (Huang et al., 2017; Rose et al., 2017; Zhao et al., 2017). Nearly twenty years after the first measurement of copper isotopes in archaeological materials (Gale, 1999; Woodhead et al., 1999), experimental and/or analytical evidence is still missing.
Suitable material for such an analysis can only be gained by archaeological experiments. In contrast, archaeological materials do not allow the reconstruction of whether the excavated metallurgical products and/or by-products belong to the same smelting campaign or not. After conducting successful small-scale experiments in the lab (Rose et al., 2017), the presented full-scale smelting experiments carried out at the RGZM Laboratory for Experimental Archaeology will provide for the first time a suitable set of samples for the detailed investigation of copper isotope behaviour during the smelting process. The experiments with sulphide ore will be based on the Mitterberg processs (e. g. Hanning and Pils, 2011). Additionally malachite ore will be reduced in crucibles which are placed in a fire pit (e. g. Bourgarit and Mille, 1997; Hanning et al., 2010). Extensive sampling of all materials will allow an understanding of the behaviour of copper isotopes during the smelting process with so far unprecedented detail.
In addition to the smelting experiments, the presentation will briefly present the scheduled analyses and, if first results should be already available, will also present them. Nevertheless, the second big topic of the presentation will be the mass balance model of the smelting processes. Based on our observations during the smelting experiments and our

analyses, such a model allows one to extrapolate the behaviour of copper isotopes in comparable smelting processes. Additionally, it will be shown how the model can be optimised from observations during our experiment.
This approach allows not only for the first time a reliable estimation of the copper isotope fractionation during the smelting process and the contribution of each substep to the overall fractionation. It finally provides the urgently needed evidence-based fundament for the development of new applications of stable metal isotopes and the refinement of existing applications (e. g. Klein et al., 2010).

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Development of a recipe of Opus Caementitium for use in a hypocaust, influence of the starting materials
Klemens Maier, Versuchsanstalt HTL Innsbruck
(Participants: Oskar Hörtner, Alexander Hanser, Daniel Draxl, Matthias Leismüller, Manuel Muigg)

First considerations and attempts to replicate a formulation of Opus Caementitium for use in hypocaust in the years 2016 and 2017 show that the problem is much more difficult than originally assumed.
In recent studies, the different starting materials have now been analyzed much more in detail. After it has been shown that a stronger hydraulic component is needed, at the University of Innsbruck by Dr. Diekamp and her employees analyzed different types of bricks, including samples of archaeological finds. So the experiments to get a recipe of Opus Caementitium for use in a hypocaust were carried out with a brick batch burned by Dr. Immenkamp. Furthermore, starting from quicklime to hydrated lime and slaked lime various limes were analyzed. Special attention was paid to the extinguishing process of quick lime.
Based on these current analyzes and material experiments, the detailed implementation of a reconstruction of Opus Caementitium will be worked out in the course of a further diploma thesis in the coming year. Finally based on all these investigations a reconstruction of a hypocaust should be carried out.
This presentation shows the current status of the investigations and the experimental results of the new reconstructed Opus Caementitium.

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The „Noric Nischenofen“ studied – tried
Mag. Hannes Lehar, Universität Innsbruck

This oven is known to us so far in two construction types only via roman findings in the area of present-day Kaernten, from East Tyrol and near Salzburg – i.e. from the southern part of the province of Noricum. It actually does not have any relationship with other roman heating systems, it is a singular appearance, with which the professional world hasn't dealt with so far. This article presented a description as well as the (so far unpublished) results from heating experiments carried out by the author with a replica of such an oven in March 2012. This experiment was conducted with the help of the municipal fire brigade Innsbruck in a run-down house. In doing so, it was investigated whether a warming of the room could be reached, or whether the warmth was only palpable in the area of its heat radiation. The development of noxious substances was also documented. The results will also be used for explanation of the positioning of these ovens in the forum of Aguntum (East Tyrol).

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The protection of the wax – Test of an ancient marine paint
Jan Hochbruck

“FAN” is short for “Friedericiana Alexandrina Navis”, and is a replica of a Roman river warship of the Oberstimm type, a gift to itself by the Erlangen University. Like its predecessor “Victoria” ten years earlier, the project is being set up as a public event with student, and volunteer participants and a good deal of local attention. Partaking in this project, I researched the possibilities of a ship paint from antiquity in 2017.
This research is based upon sources from Pliny the Elder and Vegetius as well as the archaeological findings of the ships at Pisa, especially the “Nave C”. The encaustic paint found on its hull is composed of wax and resin. Taking my own research of an antique “artist’s colour” from 2014 into consideration, I set up a series of experiments which led to a workable “ship’s paint”, in accordance to both antique sources and findings.
This paint was used to realise the vividly discussed colour scheme in February, 2018. The paint itself led to numerous interesting insights regarding its caulking and drying properties, test-runs of the ship brought insights regarding exposure to cold, water and sun. Almost all assumptions concerning modern “hull paint” weren’t just not met, but turned upside down.

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Crossbow triggers made of antler. Insights into material, production and function
Fabian Brenker

For some decades, angled antler objects have been recognized as triggers for high medieval crossbows. So far, however, hardly any critical examination of their production and functioning took place. Comparisons in paleozoological collections, as well as an experiment to produce such triggers were able to clarify the material question unambiguously and give exciting insights into the material understanding of the time. Exact observations on the originals, allow to imagine two possible ways of production, which were checked in a replica. All work steps could

be carried out with contemporary technologies. Even with some morphological abnormalities experiments could give interesting insights into the development of early mechanical distance weapons.

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Reconstruction of an Early Modern Wood-fired Chemist's Furnace
Anna Axtmann, Erica Hanning, RGZM, Labor für Experimentelle Archäologie

Both chemistry and fire assaying require a very controlled heat source and atmosphere in order to properly control the chemical reactions taking place. Before the advent of modern electrical furnaces and measuring equipment, specialized wood and charcoal burning furnaces were used. Duhamel du Monceau, in his book "L'art du Potier de Terre" (1772), dedicated a chapter to the work of the furnace and kiln makers, in which he describes several chemists and fire assaying furnaces. One of these, a "fourneau de réverbere potatif" (pl. XV Fig 5) was used as the basis for the reconstruction.
After a brief introduction to known examples of chemist's and fire assaying furnaces. We will present the process of reconstruction of the furnace, its firing and use.

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3D-Scan and 3D-Print in archeology of music. Possibilities and practical examples from experimental archaeology
Michael Praxmarer, AGMAI / Leopold Franzens Universität Innsbruck
AGMAI (Christina Bürger, Elias Flatscher, Michael Praxmarer, Wolfgang Recheis, Michael Schick)

Archaeology of music is a small branch in Archaeology that did not receive much attention up to now. Especially in regard to experimental Archaeology, it poses special requirements that come with their own set of difficulties. Even completely preserved musical artefacts must not be played on due to conservatory reasons; furthermore, some raw materials are extremely hard to acquire (especially bones of certain and sometimes endangered animal species with specific characteristics and measurements), as well as the skill of the instrument maker have been major limitations. To solve these problems the Arbeitsgruppe für Musikarchäologie Innsbruck (AGMAI) at the Institute for Archaeologies of the Leopold-Franzens University, in cooperation with the Medicinal University Innsbruck and Svarovski Wattens performed experiments with 3D-models of musical instruments from archaeological contexts (especially aerophones), which were 3D-printed. This method enables acoustically and functionally identical reproductions of the complete original artefacts in any quantity (with a certain degree of variability in the timbre), and last but not least opens up new scopes for reconstructing fragmentary finds. In order to compare the sound of bone and plastic, replica bone flutes were scanned and the resulting 3D-prints compared to the "originals" via Frequency Analysis. In addition to measuring the possible acoustic spectrum and blowing technics, these replicas make it possible to reconstruct tonal patterns playable on the instruments in solo- or group-performances.

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From soil into fire – A possibility to make replicas of prehistoric pottery
Erika Berdelis
Gisela Nagy

For almost 30 years Erika Berdelis has been doing practical research on prehistoric pottery shaping and firing methods. Doing so, she looked for techniques reproducing the structures of original sherds. Also, these techniques should consume as few resources as possible, because she is convinced that true craftsmanship reveals itself trough «simple finesse».
By thorough examination of originals and in close contact with archaeologists and ceramicists, she has reached a high level of authenticity in making pottery of a prehistoric kind. Her replicas can be found in many museums and institutions in Middle Europe and are also used in historical enactment projects. She shares her knowledge with fascinated visitors of practical demonstrations on cultural events.
Her experiments on the making of prehistoric pottery, in general and detail, contribute important basics to archaeological research.
In this presentation, Erika Berdelis would like to pass on her approach, her proceedings, her tricks and hacks to an interested audience.

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Archaeological Experiments concerning the construction of log boats using tools, methods and techniques of the past
Mag. Dr. Wolfgang Lobisser, VIAS – Vienna Institute for Archaeological Science Archäologie-zentrum, Universität Wien

Log boats are mostly built of single trees and were used nearly all around the world. The oldest known log boats from Europe were already used in the Mesolithic. From the Neolithic and Bronze Age, a lot of pirogues have been found (Béat 1995). Prehistoric log boats have mostly been carved with axes and adzes of stone and later on with bronze or iron tools. Maybe also controlled fire setting was a common technique. From Austria, we know of prehistoric log boats from Carinthia (Gleirscher 2006) and from Salzburg (Pohl 2006). In the Mondsee area, log boats were used up to our days; some examples are presented in the ethnological open-air museum of Mondsee (Angerer 1927). In some exotic regions of the world log boats are still built and used nowadays.
The experimental archaeological team of VIAS (Vienna Institute for Archaeological Science) from the University of Vienna has constructed three log boat models in scale 1:1 up to now: In 2005 at Lake Mondsee a log boat with a total length of 7 m was carved out of a conifer tree. Already then we tested replicas of prehistoric tools made from stone, bone, bronze and iron. In summer of 2014 we finished an oak log boat on Lake Keutschach in Carinthia following an original finding from Sattnitz. There we used mostly Bronze Age tools for our practical working studies. The tool types we tested were original replicas of axe blades, adze blades, drawing knives, drills and chisels of bronze with about 6 percent of tin inside. Some working processes we figured out by using ethnological iron tools of the 19th century to have an “equivalent” corrective of modern times. In 2016 we were invited to form a big log boat with a total length of 9 m and a diameter of up to 1.20 m in Seewalchen on Lake Attersee. This boat was carved out of a conifer tree as well. The original Iron Age finding for this model stemmed from Lake Wallersee and was actually restored. During this project we experimented with tool types from Neolithic Age up to the 19th century. Our focus was on the practical use of adzes during the times. Concerning log boats we learned a lot about the construction and the working process during our practical studies. The presentation gives an overview about our latest results.

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The reconstruction of a Roman provincial women's costume after a painted grave plate from Brunn am Gebirge/Austria
Mag. Helga Rösel-Mautendorfer

As a supplement to their exhibition the museum “Heimathaus” of Brunn am Gebirge in Lower Austria required a reconstruction of a provincial Roman costume after a find of a painted panel of a tomb facing. The figural polychrome painting from the cist grave 18 from Brunn am Gebirge is depicted on a rectangular sandstone panel. It shows a woman with a long-sleeved undergarment, a fibula-fixed cloth, a scarf, legwear and a headdress. A horizontal line below the chest indicates a belt. The depiction of the local woman shows an unusual way of wearing the provincial Roman costume. Noticeable is the broad neck opening of the upper garment.
In the area of the shoulder and the chest, appearance of the garment is difficult to recognize due to the degraded colour pigments. In order to get a more accurate picture, relief depictions of so-called servants were used, which also wear an undergarment in combination with an overcoat, for example from Zollfeld and Frojach.
The challenge was to implement the depiction of the known garments from this period and to check whether such a way of wearing reconstructed garments in original sizes is possible.
The reconstruction of the clothing consists of a blue long-sleeved tunic with a red border, a fabric belt, blue stockings after the finds of Martres de Veyre, braided garters, based on a find from Hallstatt, a madder red tubular cloth, a rectangular shawl and a headscarf, which was wrapped in a Noric hood. By different draperies of the tubular garment a possible wearing method could be determined which corresponds to the representation on the stone panel.

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On the limits of representability in Living History
Rüdiger Schwarz, Römerkastell Saalburg

Within staged history presentation, different categories are present, which are not always clearly distinguishable in practical work. Historizing roleplaying, history theatre and museum theatre, as well as reenactment are among the varying kinds of presentation that have been described conceptually and contextually. Depending on the type of representation, specific difficulties occur in respect to acting and comprehensibility for the audience.
The theoretical discourse about different types of presentation is mainly conducted among museum professionals and academics in the relevant subjects. Among the – in many cases very engaged and well-informed – reenactors this discussion is often less pronounced.
Based on examples from the practical museum work, problems are described that occur with the embodiment of certain persons, subjects and contents. These concern questions of practicability and representativeness as well as authenticity. Can characters like Julius Caesar or Emperor Wilhelm II. be represented convincingly? How and in which environment? To what extent are historic presentations with several levels possible, virtually a story in the story or a role in the role? And were there actually children in former times? These questions will be pursued with all due caution.

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Mediation and reception of experimental archaeology using the example of a series of events „Experimental archaeology of Europe – Experiencing knowledge“
Vera Edelstein, Pfahlbaumuseum Unteruhldingen

The project «Experimental archaeology in Europe – experiencing knowledge» is comprised of a series of events, in which specialists from different European countries present their knowledge and experiences at the Pfahlbaumuseum Unteruhldingen on different eight dates, starting in May 2018 and ending in September 2018. Each event focuses on different topics, covering common and ubiquitous materials like wood, bone and antler, as well as materials which can only be found in specific regions and were already exchanged or traded over long distances during the Stone Age and Bronze Age like metals, salt or amber. The different materials are presented together with their respective techniques of workmanship and finished objects. Simultaneously learning stations are developed and the events are documented via social media and the website of the museum and to guarantee a long-lasting mediacy. The events target families and classes in particular. The reception of the single events and the complete series will be examined on the basis of surveys, the website and social-media-channels.

Literature: not available

Poster

Knots in Stone Age and Bronze Age
Matthias Baumhauer, Pfahlbaumuseum Unteruhldingen

The Gordian Knot, Alexander the Great 333 BC Chr. cut with a sword, is one of the most famous knots in world history. Due to the conservation conditions for organic materials, knots in the archaeological context are rarely detected. Early archaeological evidence for this was the "pile dwelling knot". Recent publications, such as those from Arbon (Canton Thurgau), have shed light on the multitude of knots known in prehistoric times. The special conditions of the bog finds of the Baltic region make it possible to analyze the known knots. A large number of knots also provided the excavations in the salt mines of the Alps, especially from Hallstatt and Hallein, in which many textile objects were preserved.

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The Bronze Age sickles. The manufacturing of clay mould and the influence of surface preparation on the object microstructure
Kamil Nowak, Institut für Archäologie Universität Wrocław
(Participants: Justyna Baron. Institute of Archaeology University of Wrocław, Jacek Puziewicz, Małgorzata Ziobro. Institute of Geological Sciences University of Wrocław)

The results presented are based on the experiment, which was able to answer questions about the manufacturing methods and the strength of bi-valve clay mould. The clay mould were made, then the sickles were cast. The influence of the high temperature on the mould surface was investigated, as well as the possibility to compare the negative with the casting. Archaeometallurgical analyses was carried out by scanning electron microscopy (SEM). The reconstructed sickles were used to make a samples from the cutting edge. The microscopic observations form a group of the microstructure images. The results could be compared with the analyses of the original objects.

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You can do research – Citizen Science in Experimental Archaeology
Julia Weidemüller, Römisch-Germanisches Zentralmuseum

Citizen Science is defined as scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions in order to generate new scientific knowledge. By setting up the project “Du kannst forschen” in the Roman Mining Museum in Kretz (“Vulcano Park Osteifel”,Rhineland-Palatinate /Germany) archaeologists of the Roman-German Central Museum Mainz (RGZM) are putting this agenda to the test.
With the long-term scientific experiment, the performance capacity of ancient machines is supposed to be analysed. During the presently conducted first (= pilot) phase of the experiment roman and celtic rotary querns were chosen due to the fact that these constitute an important research topic of the “area of responsibility Volcanology, Archaeology and History of Technology (VAT)” of the RGZM.
“Du kannst forschen” intends to shift the role of the participant from simply being a spectator to becoming an active citizen scientist by being involved practically and by carefully documenting experimental findings while archaeologists constantly moderate the course and documentation of the experiments.
The principles of Citizen Science are being taken into account by the fact that the participants can contribute to the experimental design by discussions and by bringing in own ideas as well as by an optional long-term participation or by following the regularly updated project-blog. A close adjustment with the Citizen Science-network “Bürger schaffen Wissen” (citizens create knowledge) also assures the Citizen Science standards. A participant of “Du kannst forschen” can have the individual first-hand experience of ongoing scientific research, which is in accordance with PUSH (Public Understanding of Science and Humanities) and PUR (Public Understanding of Research). Thus, especially young people can be interested in and recruited for science and research.

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