Reviewed Article:

Experimental Archaeology: Who Does It, What Is the Use?

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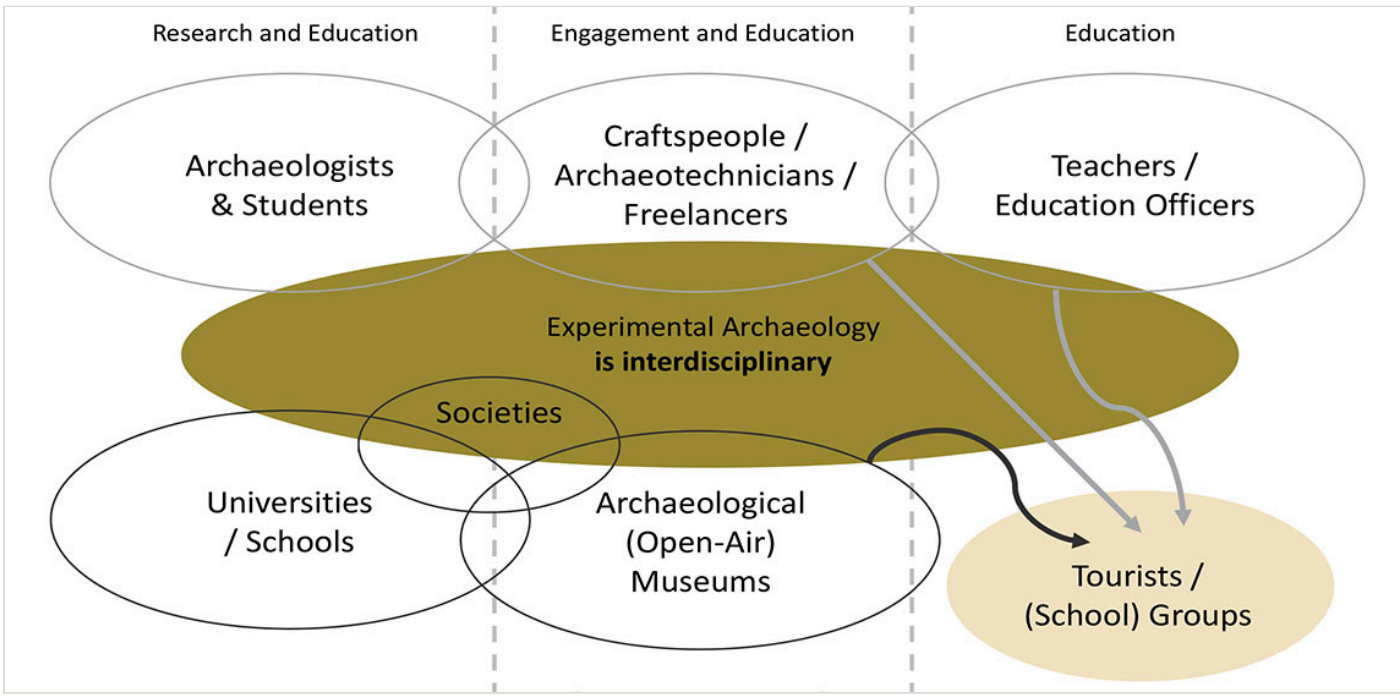
Author(s): Roeland Paardekooper [1] ✉

[1] EXARC, Frambozenweg 161, 2312 KA Leiden, the Netherlands.



In two surveys, several people working with experimental archaeology explained what they believe is experimental archaeology. They also described their activities. We asked universities, societies, freelancers and museums. Several adjacent activities are discussed, like archaeotechnique, making reconstructions and life experiments. After some confusing and clarifying examples, the future of experimental archaeology, as a discipline with use for not only science, but also society, is discussed.

This article is just a glimpse of the full discussion and research in this field. Lara Comis (EXARC member) is currently doing an IRC funded PhD at UCD (IE) exploring Experimental Archaeology and Archaeological Open-Air Museums. Her research started with a survey, which many EXARC members will be familiar with, on how experimental archaeology is understood. EXARC is an active supporter of her work. More details.

> A lot of experimental data is gathered, but only a fraction of this material is published. Most of the published material appears only in grey literature. EXARC took the initiative to collate this information through their Experimental Archaeology Collection, available through experimentalarchaeology.net.

Introduction

Experimental archaeology is as old as Archaeology itself. Coles describes 16th century examples as: *"any honest effort to understand ancient artifacts by actually working with them"* (Coles, 1979, pp.11-12). The focus in the beginning was to find out more about the provenance of artefacts: were these man made or did these have a natural origin? In more recent definitions, for example: *"A sub-field of archaeological research which employs a number of different methods, techniques, analyses, and approaches within the context of a controllable imitative experiment to replicate past phenomena [from objects to systems] in order to generate and test hypotheses to provide or enhance analogies for archaeological interpretation"* (Mathieu, 2002) the focus changed from a purely technical approach to testing a hypothesis by constructing a hands-on immersive comparison with the past. One cannot do experimental archaeology merely as a desk study. Learning an ancient technique from a book or video covers only a few aspects; when one experiences it in reality, this involves all senses, it requires agility and one gets an understanding of space, form and material.

Experimental archaeology per se does not lead to tangible products. The results of this process are data and knowledge gained by experience. Experimental archaeology is both a technical approach, a nature science, but also a human science. It is not only about research into artefacts; its aim is to find out more about the people behind these artefacts.

Experimental Archaeology in Europe: Who & Where?

EXARC is the ICOM affiliated organisation for Archaeological Open-Air Museums, Experimental Archaeology, Ancient Technology and Interpretation (Paardekooper, 2013). With currently 300 members in over 40 countries, it offers a strong supportive network of craftspeople, scientists, educators and artists. EXARC asked its members twice about their experience with experimental archaeology, in 2010 and in 2018.

2010 Survey

The nine answers in 2010 included some honest perspectives: people try to do experimental archaeology, but were aware of their own constraints as well as the limitations of the method (EXARC 2010). It is important to note is that eight of the answers came from organisations, mainly working with the public (museums and open-air centres).

According to Stefani (EXARC 2010), it is obvious that we do not have a complete knowledge of our past because the archaeological record is incomplete; it is like getting inside the minds of our ancestors and facing the same problems they had to solve (EXARC 2010).

> *"Experimental archaeology is a practical tool that can help you understand the past"*
> Vemming Hansen, Middelaldercentret, Denmark (EXARC 2010).

It can bring you close to how things could have been, but one can never know for certain Although experiments should be repeatable, this is often too difficult.

> *"You can't repeat the building of the house in exactly the same circumstances over and over again"*
> Frisk, Genesmons Arkeologiska Friluftsmuseum, Sweden (EXARC 2010).

Often, items and houses are made to look like the originals (Coles 1979, the first of the three stages of reconstruction) and are not made the original way or made and used the original way. This is partly due to building regulations and health and safety, but also because those houses often are not serving experimental archaeology, but museum purposes. That is not a problem, as long as museums are honest about it. Demonstration and education are not experimental archaeology, but experimentation can help activities in these two directions.

> *"Principles described by John Coles in his two books are still actual, and maybe answer on the question "How to use it?" might be like this - do not mix experimental archaeology with festival archaeology, always explain to visitors what is real experiment and what is not"*
> Piotrowski, Muzeum Archeologiczne w Biskupinie, Poland (EXARC 2010).

Personal experiences, eureka moments if you like, happen all the time in archaeological open-air museums.

> *"log-boats are better with a flat bottom, a glass oven works better when it is round (rather than oval like a baking oven), vegetable oil is sufficient for hardening steel, and straw can really turn clay into a simple version of armoured concrete"*
> Kock, Geschichtserlebnisraum Lübeck, Germany (EXARC 2010).

These experiences are similar to the ones you will find among archaeology students getting their first experience with replicating archaeological material culture.

The perspective obtained from the survey in 2010 was that experimental archaeology was a purely scientific method, which should be treated as such. However already in 2010, demonstration and education were marked as adjacent fields, and personal experience too was regarded as a valuable element.

2018 Survey

In 2018, EXARC could dive deeper into the subject. In June of that year, we were asked to prepare a lecture about what experimental archaeology is and who does it where in Europe. For this purpose, we executed a survey. We contacted 36 organisations and individuals, of which 6 were not EXARC members, 23 answered (64%). Because of the low number, these answers should be regarded as anecdotal. The answers were divided into universities (6 out of 7 answered, 86%), societies (9 out of 15 answered, 60%), freelancers (4 out of 7 answered, 57%) and museums (4 out of 7 answered, 57%).

1. Universities

Worldwide, there are over one hundred universities offering education in experimental archaeology; sometimes this includes an immersive week to learn about material culture, in other cases, full PhDs are produced (EXARC 2018).

Some of the universities with the longest experience with experimental archaeology are the University of Exeter (UK), Madrid (Spain) and Leiden University (the Netherlands), others have only started recently with the subject, like York (UK) and Vigo (Spain). Most of them have clear boundaries in the subjects they work with, for example Stone Age / prehistoric technology (Madrid, Spain), hunter-gatherer material culture (York, UK) and the biography of artefacts (Leiden, the Netherlands).

EXARC manages a list of about 100 universities, working with experimental archaeology. Where some archaeology departments have a large staff, each of which occasionally work with experimental archaeology, in many cases worldwide, it depends on only one or two staff members, often with the assistance of postgrad students.
The universities in this research have embedded their experimental archaeology in a long-term approach, with many other archaeology department staff trying their hand at experimental archaeology at some time in their research (compare Hurcombe, in: EXARC 2018).

Most of the universities on EXARC's overview (EXARC, 2018) use it as a tool to teach archaeology students about archaeology, materials and techniques. The spill-over effect is evident: when only a limited number of MA, MSc and PhD students focus fully on experimental archaeology research methods, a much larger number of students get acquainted with these methods at some time in their study.

Taking it to another level by doing experimental archaeology research themselves, is seen a little less than teaching students about experimental archaeology. One reason may be that students produce a lot smaller experiments which are presented at conferences like the REARC Conference in the United States (www.REARC.us). Staff at universities often work on long term research projects which may lead to less publications, but witnessing more complex questions. Here a clear side effect also occurs:

> *"Most of my teaching is research-led so I give students projects which is derived from/feeds into my own research interests"*
> Little, University of York, UK (EXARC 2018).

Public outreach and impact is the final consideration. Universities can step out of their campus and take part in museum and other public events, where they will not just broadcast their message to the public, but also receive input from the audience.

> *"We have a very academic and research point of view. However, we also recognize that the knowledge acquired through experimental models in the enhancement of the Historical and anthropological heritage is essential. Therefore, we believe that Experimental Archaeology is a basic tool to investigate and disseminate knowledge of the human past"*
> Baena Preysler, University of Madrid, Spain (EXARC 2018).

> *"The transfer of ideas about the processes experienced by individuals, at a variety of events (public experimental demonstrations, thematic workshops, specific conferences), has generated not just interesting conversations, but also tested the complementarity between the languages of different spheres: the language of archaeology through paying greater attention to the register and the archaeological evidence; the physical-chemical and archaeometric language, greater attention to materials science phenomena; and finally the artisan language, that includes the relation of human contact with the material and experiential facets, which should be considered as a vital perspective"*
> Comendador Rey, University of Vigo, Spain (EXARC 2018).

2. Societies

There are several national societies related to experimental archaeology in Europe (for example VAEE in the Netherlands, Experimenta in Spain, EAS/AES in Switzerland and EXAR in Germany). At some universities, there is a student society on experimental archaeology (for example EXARN at the Newcastle University, UK, CEXA at the University of Zagreb in Croatia (See Figure 1) and Harjis at the University of Łódź, Poland). Finally, several living history associations also include experimental archaeology in their profile. The high number of groups in the survey is due to the fact that originally a division was made between

experimental archaeology groups (6 out of 6 answered) and living history groups (3 out of 9 answered, 33%), but later these two groups were merged. The national societies offer an umbrella for their members; they facilitate activities but do not plan their own. They are mainly a platform to showcase and cooperate with likeminded individuals. Limits in time and space are based on their members' interests.

For the individuals it is either a hobby, student research, or a professional interest. These national societies often have their own publication options, although these often do not reach very far beyond their own membership. They usually have one time per year when members meet in person.

The student societies also facilitate their member's research. Often these are incidental activities, even though these processes can take several years and their themes are well defined in time and space. Senior or graduated students often assist the newer ones; contact between the members is more intensive than between members of national societies. Outcomes are often presented at student conferences, the EAA or the international EAC conferences; publication depends on these conferences as well as the dissertations of the students themselves.

Many members of living history societies have an interest in replicating items, costumes and presenting activities in a fashion, fitting with their chosen period and location. Many of these groups include trained scientists, but not all societies are able to do proper research. One reason is the limited availability of primary sources as well as the lack of source criticism, leading to inaccuracies that are copied between living history societies. However, the number of living history associations executing quality literature research and experimentation is growing (See Figure 2). Following the survey, many groups have a good idea of what experimental archaeology can be applied to, both in long term and short term.

> *"It is complementary (to other archaeological methods) and a way to teach the public about our past in an appealing way"*
> Mariani, Popolo di Brig, Italy (EXARC 2018),

> *"We conduct projects that touch only a small aspect of experimental archeology that is the study for divulgation. With the term Experimental Archaeology, we should instead understand a real discipline that, through experimentations, succeeds in formulating hypotheses on objects and actions that without it would be mere artefacts without explanation"*
> Salviati, Sippe Ulfsson, Italy (EXARC 2018).

3. Freelancers

The freelancers in this survey are self-employed and expect payment as part of their business. For them it is not a hobby, but their part time or full time profession. Respondents

from Germany, Greece, the UK and Switzerland all have a long term approach and a clear understanding of limitations in time and space. Their work is mostly to satisfy their own interest, but often paid for by museums who like them to build or demonstrate something. Some of them have a background in the academic world, others in crafts or are self-educated. They know that a good reputation increases their market value with museums and universities. They work with archaeotechnique (see explanation below) as well as with experimental archaeology. These people take pride in doing things right and take the time to publish in blogs or articles.

4. Museums

There are also museums with an experimental archaeology research component. Because of the limited means museums can address to research, they have to define their research projects narrowly in theme, time and space; it needs to fit the interpretation framework of the museum and must be directly applicable into the museum presentation and events.

> *"Our activities in experimental archaeology are connected to Roman material culture and architecture, techniques and tools of varying crafts (...), its results and techniques are often suited to present aspects of ancient life to the public."*
> Schwarz, Saalburgmuseum, Germany (EXARC 2018).

Most of the almost 100 museum members in EXARC cooperate with nearby universities. It enables them to strengthen their network in academia and remain updated on scientific developments. It also provides them with students for internships. A side effect is that the aura of science adds to the museum's reputation.

In an open-air museum, one can perform activities one cannot perform in confined spaces. Also, these museums are very well fit for low cost, long term experiments. One example is experimentation with bows and arrows to check the damage on arrowheads or animal bones. Equally known are experiments with post depositional processes where certain artefacts are deposited in a controlled manner and later excavated. Finally, for decades, several museums (c.f. L' Esquerda in Spain, Butser Ancient Fam in the UK and Százhalombatta in Hungary) have grown cereals, known to be used in prehistory to find out more about crop yields.

What Is Experimental Archaeology

It must be emphasised, that the number of people using the phrase experimental archaeology as well as the number of contexts it is used in, is rapidly expanding. When aiming to describe the field of experimental archaeology in all its aspects it is clear that a full overview is almost unobtainable. I apologise for not addressing aspects of experimental archaeology which remained outside my own scope and look forward to any comments, adding to this discussion.

The time that experimental archaeology was confined to purely scientific exercises with a clear hypothesis, workflow and outcome is gone. This has also led to fierce comments and straightforward rejection by archaeologists. In my opinion, the definition of experimental archaeology depends on the context it is used in. On the one hand, there is an academic context with a strict definition in the sense of research and student education. There is however a second line of experimental archaeology, an applied form of it if you like. In the area of tourism, it means something entirely different and not many people think of the scientific value. Some experimental archaeology activities, like TV shows, are best described as social experiments, while pedagogic activities are again a completely different dimension. None of these parties can successfully lay claim to and monopolise the phrase experimental archaeology. There is a lot of added value when academic activities flow into other areas and vice versa (Paardekooper, 2010).

Most participants in the EXARC 2018 survey agree that experimental archaeology is a widely accepted and integrated method in archaeological science.

> *"It is becoming increasingly integrated with other archaeological approaches, such as bioarchaeology, zooarchaeology and digital imaging. As a result, experimental archaeology is following a more traditional scientific structure, with clearer emphasis on hypotheses and theory. This, to me, is a positive and exciting turn - resulting in a much broader and integrated approach to experimental research with "hard" and "soft" sciences coming together"*
> Little, Year Centre, University of York, UK (EXARC 2018).

> *"Experimental Archaeology is one of the most promising fields within archaeology as it includes innovative new (scientific) ways of approaching past material culture. The scientific experiment as the core of experimental archaeology creates a seriousness of the research in a way that connects to the natural sciences better than most of the traditional archaeological approaches"*
> Kropp, Experimentalarchäologisches Freilichtlabor Lauresham, Germany (EXARC 2018).

Where some people emphasise the research component of experimental archaeology, its power as a sensory, educational, method is clear. Experimental archaeology is easier to use as a tool to engage people with, rather than using it as a research tool. For many, its strength in engaging the audience is enormous, making research relevant and interesting for a wider audience.

> *"Every generation of experimental archaeologists HAS to go through the same mistakes, the same "beginner's status", the same "chewing up old stuff" – and the same proud smile to finally have succeeded!"*
> Fasnacht, Switzerland (EXARC 2018).

> *"Experimental Archaeology is not just about experiments in archaeology anymore, it is about the People of Today, their fascination of archaeology, their interest in the past, their engagement in research!"*
> Fasnacht, Switzerland (EXARC 2018).

> *"The role of experimental archaeology in academic research is to place models that have been proposed in theory into actual practice, with the goal of validating or modifying the premises tested, as well as to explore and obtain new ideas; at the same time, they bring significant information of a sensory and technical nature to the archaeological research projects"*
> Comendador Rey, University of Vigo, Spain (EXARC 2018).

> *"Without interpretation and public interface, with explanation, it is simply an academic exercise, and adds nothing to the overall understanding of our collective past"*
> Freeman, UK (EXARC 2018).

> *"In a university, it is a research tool for advancing archaeology but in wider circles, it is a powerful and effective tool for education and engagement at many levels"*
> Hurcombe, University of Exeter, UK (EXARC 2018).

> *"Experimental archaeology is still a practical way to gather knowledge about the past that cannot be received otherwise. Furthermore, its results and techniques are often suited to present aspects of ancient life to the public"*
> Schwarz, Saalburgmuseum, Germany (EXARC 2018).

In several countries there is more attention given to experimental archaeology, and more people to work with than in other countries. International contacts, also through social media, are a great help. However, more chances to meet in person at conferences and workshops would be a great step forward.

A good international infrastructure is needed, facilitating contacts and the exchange of resources, best practices and information. There is a need for the definition of ethics in experimental archaeology as well as the availability of handbooks. Too much information remains unpublished.

A lot of experimental data is gathered, but only a fraction of this material is published. Most of the published material appears only in grey literature. EXARC took the initiative to collate this information through their Experimental Archaeology Collection, available through www.experimentalarchaeology.net. This started as an online bibliography with 11,500 titles on experimental archaeology and is now part of tDAR, the Digital Archaeological Record. The system can now include any digital file related to experimental archaeology and is a useful tool for any experimental archaeology research.

Starting out from the scientific realm, I think experimental archaeology is an approach to the archaeological record, which starts with:

1. Good research into the primary sources;
2. This is followed by setting up a hypothesis, explaining certain aspects of the archaeological record or the people who were responsible for that record;
3. To test this hypothesis, an action, comparable to the presumed archaeological action, is created. For this, a correct level of experience is required, in crafts, well-fitting the time and space of the original archaeology;
4. This action leaves traces, produces data, which are documented in a way, fit for purpose;
5. These data are then compared with the archaeological record to better understand the hypothesised action from the past. One past action is compared with one present action by means of the data both actions produce. It is very hard to control or even describe the influence of all factors on the action.

Experimental archaeology is a versatile tool that connects museums, universities, societies and freelancers. It also keeps all of these in direct contact with an audience that loves to be amazed by the past and have their questions answered. If some parts of these cooperative activities are better structured, the added value is enormous.

Experimental archaeology is not limited to the academic world. With a few simple measures, many actions in archaeological reconstruction, ancient technology, living history or education and student training, can contribute immensely to our knowledge of the past, if these follow a simple experimental archaeology approach.

> *"What experimental archaeologists do is use their primitive technology skills, understanding of the archaeological record and replicate these tools and technologies to better understand how they were made, how they were used, how they functioned, how efficient they were and eventually, how they were finally discarded and became part of the archaeological record."*
> Schindler III, 2018

Many people are involved in experimental archaeology, from enlightened people, to adventurers. People from various backgrounds will participate and provide input including, archaeologists and students, craftspeople and archaeotechnicians give their input. Teachers, both in schools and in museums will also share their experience (See Figure 3).

The biggest value emerges from cooperation between different experimental archaeology worlds. Often, the different entities discussed previously are already cooperating in various ways: living history actors study archaeology, academics work part time in museums, freelancers join experimental archaeology projects et cetera. However, although they all do

long-term research projects, cooperation with other stakeholders usually is of shorter term. Experimental archaeology becomes a module in a wider strategy of research, education or communication; it often is part of something larger. It is interdisciplinary and links archaeology with the public.

Confusing Examples

There are several activities, linked with experimental archaeology which carry importance, often leading to well-founded experiments. Often these subjects emerge when discussing experimental archaeology: in museums, conferences and at university. It is extremely difficult to draw a line between what falls within experimental archaeology and what does not – mainly because experimental archaeology is an interdisciplinary field and, as previously stated, is practised in various contexts with different aims and objectives.

Archaeotechnique - Demonstrations of Ancient Technology

Demonstrations of ancient technology for tourists can best be defined as archaeotechnique: here somebody presents techniques, for example, bronze casting or flint knapping to a wider audience. They explain to the public how these techniques were executed and the context of these techniques, materials, and tools in the society in the past (Hein, 2000). Archaeotechnique also includes ancient or primitive technology (a phrase used widely in the United States, for example by the former Society of Primitive Technology). It is part of the Maker's Culture where old crafts are cherished so they do not disappear. Archaeotechnique is more than a mere demonstration in museums, it is not just polishing the tools, but using them for anything useful. An archaeotechnician usually is a skilled craftsperson with a good knowledge of the archaeological sources.

These activities are very important, and many of these specialists also execute experimental archaeology. However, archaeotechnique and experimental archaeology are two different activities, with different purposes and conditions.

Reconstructions

A reconstruction alone is not an experiment. The results (clothing, tools, or a house) serve other purposes. An archaeological experiment leads to data that is comparable with archaeological data. Building house (re)constructions or life size models, especially in archaeological open-air museums are an important activity, where one makes props for telling a story, but for experimental archaeology purposes, these are a by-product only, not the main goal.

Reconstructions of, for example, clothes can be of high quality, often showing the skill of the craftsperson, both in techniques and materials and in the knowledge of the original archaeological data. These can work great as exhibition material, or in a live interpretation

scene, where the person using the clothes explains everything about the production, the time and place it depicts as well as how it is used. This however does not make it an experiment.

Life Experiments

So-called 'Back to Old Times' Summer camps or 'Life Experiments' are either interesting as TV shows, or if there is no press involved, very interesting times for groups of individuals to try out their gear while doing a social experiment. Two good examples of this are "Steinzeit das Experiment" (ARD/ZDF) and "Seven in the Past" by Ratobor (http://ratobor.com/en/projects/seven-in-the-past/). These camps can lead towards experimental archaeology in the sense that the experience gathered there is a good background for structured experiments, but should not be called Experimental Archaeology. Gathering personal experiences is not an experiment. This counts as well for pedagogic activities where children make personal discoveries.

Experiments in Archaeology

Scientific experiments should follow a well-structured approach (c.f. Lammers-Keijsers, 2005). However, a scientific approach alone is not enough: one needs to be both a scientist and an experienced craftsperson, knowing enough about the state of experience of the archaeological society one works with: time and space restricts what materials one can use and up to what level certain techniques can be introduced or not.

The construction of a replica Viking ship in Roskilde – why was it an experiment?

The construction of a replica Viking ship in Roskilde, Denmark, the Sea Stallion of Glendalough and its travel to Ireland and back in 2007 served several goals besides science: tourism, nationalism and nostalgia certainly played a role as well. It was too expensive to only be used as a scientific working model. However, an important side effect of building this ship and sailing with it, was that with such a working reconstruction or model, archaeologists, constructors and the crew are forced to return to the archaeological data to answer specific questions which otherwise would never have been posed. One question often leads to a dozen others.

When is the reconstruction of a house an experiment?

An early example of constructing a house inspired by archaeological remains is Hans-Ole Hansen's 'Stone Age house' (Hansen, 1959). Much of his early work was based on trial and error, and on gaining experience. A house construction is only an experiment if it enhances archaeological interpretation (Comis, 2010, p.10). The construction, if set in an open-air museum, is mainly a scenery for activities. However, if the decay of these houses can be monitored and these houses can later be excavated, we can compare the remains with archaeological examples (Rasmussen, 2007). Here, much is to be gained with simple

documentation (See example in Figure 4, and for example the documentation forms developed by J. Flamman (Flamman, n.d.).

Since the 1950's, experimentation has yielded a lot of information to help archaeologists better understand archaeology itself. Take for example archaeometallurgy. Many craftspeople, artists and teachers have been involved in this form of experimentation; these activities have partly bridged the gap between archaeologists, artists and craftspeople, sometimes leading to new research. Experimental archaeology has become an important tool in understanding the archaeological past. Experimental archaeology is appealing and has much to add to mainstream archaeology, it can decipher parts of the past we could not understand otherwise. Using experimental archaeology enlarges our frame of reference and therefore, our hypotheses become more probable, our analogies become less ambiguous (Lammers-Keijsers, 2005, p.22).

The Future of Experimental Archaeology

If we take a holistic approach to archaeology, seeing it as the science of 'everything human' as far as we can learn this through excavated remains and information, is it not about time that we see what we can learn from the past through archaeology for our present society? Archaeology would not be the first science to contribute to improving our current life; several colleagues refer to this scenario, for example Holtorf: "archaeology should also accept the larger challenges of society and the societies of future generations" (Holtorf, 2018, p.29, translation rp), for example by "helping refugees from warzones to process their traumatic memories" (Holtorf, 2018, p.25, translation rp).

Can we make concrete as tough as the Romans did? Austrian contractors are currently looking into archaeological experiments (Maier, et al., 2018). Were Bronze Age houses with insulated double walls "smarter" then current sustainable building techniques (Staeves, 2016)? Are Stone Age ways of food acquisition, processing, and preservation the new hit because these foods are healthier than what we find in the supermarket?"

Archaeologists cannot just sit in their Ivory Tower; they are increasingly judged by the impact their work has on society. Not just about how appealing archaeology is to the public, but how relevant to solve modern day problems.

So, what is archaeology's contribution to modern society? Many modern issues also existed in the past: environmental disasters, economic crises, cultural integration.
We should look at solutions ancient societies produced and learn what did and what did not work back in the past.

Example: Indoor Air Quality

There are about 415 archaeological open-air museums in Europe alone which together see 19 million visitors per annum. The total number of reconstructed houses they manage may be close to 1,000. A large number of these dwellings are used for education groups, and living history or other activities. Often, the fireplace burns several hours a day, with people inside the house, sometimes even sleeping there.

There are major questions about living conditions and indoor air quality. This is not just important to the people actually using these reconstructed houses presently, but it is also useful to understand similar situations in Asia, Africa and Latin America, collecting exact data on how unhealthy this is.

One thing we have to consider in relation to these houses, is if the modern use of these reconstructed habitation, especially with regard to how people handled fire, has any reference to the way people managed fire and smoke in the past, or elsewhere in the world.

Christensen (2013a, 2013b, see Fig. 5) selected two similar reconstructed “Viking Era” houses and monitored the living conditions inside the houses over 15 weeks in wintertime. The purpose of the experiment was to examine how the indoor environment in a Viking Age house behaved and to find out how it affected the inhabitants. Both houses were inhabited, and they were made of wattle and daub with thatched roofs and a fire in the centre of the house. Three to five participants inhabited the houses, but they had little experience with the use of a fireplace, reconstructed houses and/or archaeology.

The parameters monitored during the experiment were air quality (combustion products; fine particles, carbon monoxide, carbon dioxide and nitrogen dioxide), climate (temperature and relative humidity) and air exchange rate. Also registered were light, firewood consumption and its moisture content, the use of the adjustable roof hole plates and the weather conditions (See Figure 5).

The World Health Organisation (WHO) has Guidelines for indoor air quality. Both the 24-hour particle concentrations and the one-hour nitrogen dioxide concentrations inside the houses were above the guidelines from the WHO. The long-term exposure to carbon monoxide inside the house was also above the guidelines, though the risk of short-term carbon monoxide poisoning was low. The short-term guideline for exposure to carbon monoxide was never exceeded.

So yes, long-term presence in reconstructed houses with an open fireplace is not good for you. The main health risks stem from fine particles (PM2.5) and carbon monoxide. However, the houses are very leaky (shown by the air change rate of 10-15 per hour and a relative humidity exactly like outside the houses), even though it is possible to heat up the interior of the houses well enough (by 10 degrees over the outside temperature).

The concentrations measured in the two houses are comparable to similar houses in for example south Asia or sub-Saharan Africa with a fire or a stove in the primary room (Lim, et al., 2012, pp.2247-2249). Here most women and children get acute lower respiratory infections and lung diseases in homes where cooking and heating are done with the use of a fire made from solid fuels (Lim, et al., 2012, p.2245). Currently, exposure to smoke from solid fuel used for cooking and heating in open fireplaces in homes is to blame for about 3.5 million deaths a year globally (Lim, et al.,2012, pp.2227-2251).

The experiments in the reconstructed Viking houses confirmed data from ethnographic research but now we have good measurements and it is not just anecdotal.

Example: Sod Houses

As part of his PhD research, in 2012 Postma built a house of grass sods, using ideas from the Iron Age and Early Middle Ages in Northern Netherlands. He did research into construction data like strength of the material, insolation value, water permeability and product life. Here lies the scientific, economic and social value, which goes well beyond plain archaeology.

The construction sector soon showed interest in the old techniques, used by Postma. It is a case study at the technical University in Eindhoven for sustainable building. Living in such a house is a way of life, embraced by the self-build, slow build and eco build communities.

However, Postma sees some concepts are also used in more mainstream ways of building. At the University of Edinburgh, archaeologists and architects jointly look into how knowledge about old building traditions and modern building, paired with the omnipresent safety regulations, can inspire each other (Postma, 2015).

Flexibility in Building in the Caribbean

The islands in the Caribbean region often experience nature's hard hand: there is an annual hurricane season (for example Hurricanes Irma and Maria in 2017) and sometimes the islands suffer from earthquakes or volcanic eruptions (Hofman and Hoogland, 2015). We know that Caribbean communities interacted intensively with one another sharing goods, ideas and techniques across the archipelago (Hofman, Bright and Rodríguez, 2010). Archaeologists demonstrated the presence of common characteristics in structures within the region in the past, which together form the "Caribbean architectural mode" (Samson, et al., 2015; NEXUS1492.eu, 2015). The pre-colonial Caribbean structures consisted primarily of secure foundations and support posts combined with light materials, suggesting that these houses would have performed well both in surviving a storm and speedy reconstruction afterwards (Samson, et al., 2015).

St. Vincent is an island in the Windward Islands of the Caribbean archipelago. Here, a team from Leiden University under the direction of Corinne Hofman and Menno Hoogland excavated a 16th century village in 2009 and 2010. Based on the posthole configurations and descriptions of 17th century missionaries and travellers, the team in collaboration with local partners constructed one experimental house (See Figure 6, NEXUS1492.eu, 2016). Four others were soon after built by St. Vincentians. The village is a contribution to the island's heritage, documenting its earliest inhabitants and is an extremely good example of cooperation in the preservation of archaeological heritage (Hofman and Hoogland 2016, pp.15-16). In September 2016, these houses successfully withstood tropical storm Matthew that passed the island. Construction was very flexible and when necessary, parts could easily be changed and repaired (Hofman, 2018) .

The flexibility of the structures was a critical characteristic of pre-Columbian housing. This feature enabled the houses to endure a considerable length of time through rebuilding and/or replacement of parts. These characteristics can serve as a lesson for construction in the unpredictable Caribbean climate, in particular for humanitarian aid organisations in their continuous struggle to provide adequate and lasting shelter (Samson, et al., 2015).

Example: Why we should be building like the ancient Greeks

Many ancient walls over the world (from Greece to Peru) look cobbled together haphazardly – roughly fitted together with minimal clearance between adjacent stones and no use of mortar (See Figure 7). These are drystone walls, a more sophisticated building technique than you would think. This building style consists of massive polygonal stones fit irregularly but precisely together, despite their diverse sizes and shapes. Their assembly is so dramatic that it conjures up myths of the Cyclops; a race of one-eyed giants, known for constructing massive stone walls, hence these walls are called Cyclopean Masonry.

Of the numerous civilizations that produced these megalithic stone works, the Inka constructed without a preconceived design. This architecture emerged through a sequential logic informed by the constraints of resources. When materials were scarce, stones were re-adapted into new works. Much of the construction material is re-used: older ruins or defunct constructions were taken apart and people would look at the rubble to figure out how to make a new construction out of it. These walls appear random and illogical. However, that randomness is a by-product of a very intelligent way of recycling their previous buildings. In fact, people cannibalised old buildings, consuming their own cities.

In today's urban context, we generate unprecedented quantities of waste. The construction industry is one of the most wasteful industries. In the U.S. 534 million tons of building debris are shipped each year to landfills (USEPA, 2014), more than twice the amount of generated municipal solid waste. There is an impending crisis hinging on how we deal with this debris from the building industry.

In order to more intelligently reconsider the existing building stock, we could learn a great deal from cyclopean constructors. These construction methods force us to relinquish pre-determined design composition in exchange for a systemic, intelligent design, capable of responding to unknown conditions.

Professor Clifford (Massachusetts Institute of Technology) researches ancient methods of construction and translates them into a modern context. He experimented with floating 1,000 kilo stones on the water, showing a proof of concept of transporting the Stonehenge stones and replicated the physics used to create the Easter Island stone sculptures.

When Clifford looked into Cyclopean Cannibalism (2017), he deciphered the ancient building technique by measuring the exact geometries of cyclopean walls around the world and then modelled how the stones fit together. He put this into a set of algorithms.

Clifford's eight different algorithms can measure the sizes of stones or rubble one might have, and then suggest a type of cyclopean wall design that would be able to transform that debris into a wall.

To demonstrate the concept, an architectural stone company selected rocks from its pile of cast-offs and leftovers, as well as some rubble from a local demolition site, and then scanned them using Clifford's algorithm. Then, they chose one of the recipes and built the wall. It was completed in less than a week. Of course, not everything has a perfect pattern - a reminder that humans built these walls, not machines.

Future cities demand a creative cannibalization of their accumulating debris and stagnating structures. Can urbanism of the near future be re-imaged as architecturally self-sustaining? Can our future cities digest themselves? Cyclopean cannibalism contributes to a larger conversation about sustainability in the way we build. Experimental archaeology gives a proof of concept, applicable to a modern and pressing issue. This is an example of engineers looking to solve a modern problem, finding inspiration with archaeological sources.

Example: Experiments with Grave Excavation Methods

In her book: Forensic Archaeology, Dr Evis from the University of Exeter includes experimentally testing existing archaeological excavation techniques and recording methods to validate their suitability for use in forensic casework (Evis, 2016).

When excavating, not all artefacts and their information are recovered, but how much of this information are we talking about exactly? A famous example that addresses this questions is the Overton Down Experimental Earthwork, where an experimental site was built in 1960 and was slowly excavated, each time at longer time intervals (Bell, et al., 1998). This sounds like a nice archaeological exercise, but it is not only important for archaeology as it also considers

what happens if the evidence retrieved is used in a court of law. How can a judge decide what the presence or absence of certain features means in the context of a burial, if there is no controlled experiment to rely on, analysed by professional forensic archaeologists?

Four archaeologists with a range of experience each excavated two similarly constructed experimental 'single graves' using two different excavation methods: the arbitrary level excavation method and the stratigraphic excavation method. The results from the excavations were used to compare recovery rates for varying forms of evidence placed within the graves.

The arbitrary level excavation method (See Figure 9) is the standard excavation method for forensic excavations (Komar and Buikstra, 2008). During the arbitrary level excavation of a grave, first the size of the grave is estimated, followed by soil removal in predetermined layers. As evidence is identified, the surrounding soil is removed leaving each item upon a soil 'pedestal'. These items are only removed when they are hindering the progress of the excavation (Connor, 2007). This method ignores any stratigraphy present. The primary emphasis when utilising this method is often upon the recovery of artefacts and human remains, rather than understanding the entirety of the grave formation process.

When one excavates using the stratigraphic excavation method (See Figure 8), one works in separate archaeological stratigraphic contexts. These are recorded and excavated as individual stratigraphic phenomena. The entire grave is considered as an archaeological feature (Evis, et al., 2016). The advantages of this method include the assessment and recording of each stratigraphic context and the revealing of interfaces between deposits. The main problems with this method are that it is more complicated, slower, and demands more experienced archaeologists to undertake the work.

Experiments showed the stratigraphic excavation method resulted in higher rates of recovery for all evidence types, with an average of 71% of evidence being recovered, whereas the arbitrary level excavation method recovered an average of 56%.

These findings raise questions about the reliability and suitability of these established approaches to excavation and use in a court of law.

Conclusion

When asking EXARC members, universities, societies, museums and freelancers, it became clear that most experimental archaeology research is still done without structural support, by individuals who do it as a side activity, next to their usual work. Not only does experimental archaeology bring "hard" and "soft" sciences together as Little puts it in the 2018 survey (EXARC 2018), it also is a meeting place for scientists, craftspeople, educators and artists alike.

Many EXARC members are well-versed in the subject. They are professional and honest about what they do: research, education and public outreach all are important and if planned right, can be executed within one activity.

There are several activities, which pop up each time when there is talk about experimental archaeology, like archaeotechnique, making reconstructions and life experiments. While these are valuable activities, they have their own purpose and are different from experimental archaeology per se.

Good experiments can often serve more goals than only a scientific agenda. That is partly due to the high costs. A well-structured experiment, with good documentation and publication is of utmost importance to bring experimental archaeology into the public forum. Experimental archaeology has become an important tool to help understand the archaeological past. Thanks to the extensive amount of experiments, we are coming closer to understanding how life may have been in the past.

The aforementioned examples of the application of experimental archaeology to the modern world has taught us several things. Archaeological open-air museums are great sites for monitoring experiments, offering a solid base together with ethnographic data. There are many variables one can experiment with and try to feed back to archaeology and to modern society. It is also possible to collect large-scale data on the construction and management of reconstructed houses, which would in turn tell us a lot more about wooden construction methods around the world.

Archaeologists need to take an interdisciplinary approach to this area of research: some of the best experimental archaeologists are engineers or craftspeople, cooperating with archaeologists. Forensic archaeology is an important field, showing us that we cannot see archaeology as a separate field from the world around us.

Archaeology serves an increasingly important role in societal development through public activities (Boom, 2018). If experimental archaeologists can include an element of being relevant in modern society in terms of their approach, they can, not only attract more funding but with their scientific approach, are useful to both archaeological science and modern society. We have to make sure however, that the good ideas from archaeology seep through to modern society.

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Keywords experimental archaeology
methodology

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Fig 7. Inka Wall. Picture: Colegota - Slide taken, scanned and post-processed by author and post-processed with The GIMP., CC BY-SA 2.5 es, https://commons.wikimedia.org/w/index.php?curid=805771

Corresponding Author

Roeland Paardekooper
EXARC
Frambozenweg 161
2312 KA Leiden
the Netherlands
E-mail Contact

Gallery Image

FIG 1. PROJECT PREHISTORIC POTTERY: INTERDISCIPLINARITY AND EXPERIMENT, CENTER FOR EXPERIMENTAL ARCHAEOLOGY, ZAGREB. PHOTO: I. ANDRAŠIĆ

FIG 2. METAL WORKING IN THE MUSEO ARCHEOLOGICO ETNOLOGICO IN MODENA, BY ASSOCIATION POPOLO DI BRIG. PHOTO: ANDREA MORETTI / POPOLO DI BRIG

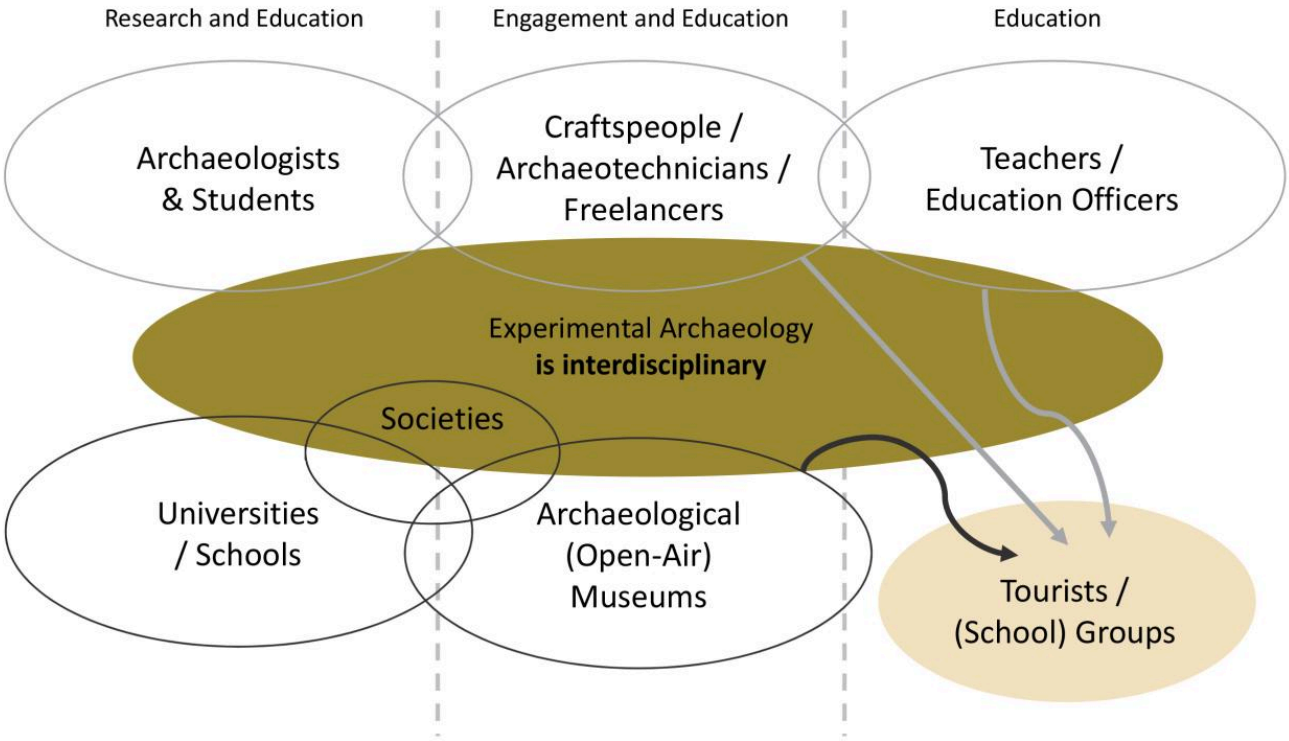

FIG 3. THE DIFFERENT FIELDS OF INTEREST AND STAKEHOLDERS INVOLVED IN INTERDISCIPLINARY EXPERIMENTAL ARCHAEOLOGY. PICTURE: MAGDALENA ZIELINSKA

FIG 4. HUT CONSTRUCTION AT SWIFTERKAMP (NL). PHOTO: Y. DE RAAFF, WORKGROUP EXPERIMENTAL ARCHAEOLOGY GRONINGEN (NL)

FIG 5. THERMAL IMAGE SHOWING THE ASYMMETRIC SURFACE TEMPERATURE ON A PERSON'S CLOTHES (APPROXIMATELY 15-50 °C) AND ON THE INTERIOR (DOWN TO 10-25 °C). PICTURE: CHRISTENSEN 2013A

FIG 6. AMERINDIAN KALINAGO VILLAGE, RECONSTRUCTED AT ST VINCENT. PICTURE COPYRIGHT: NEXUS1492

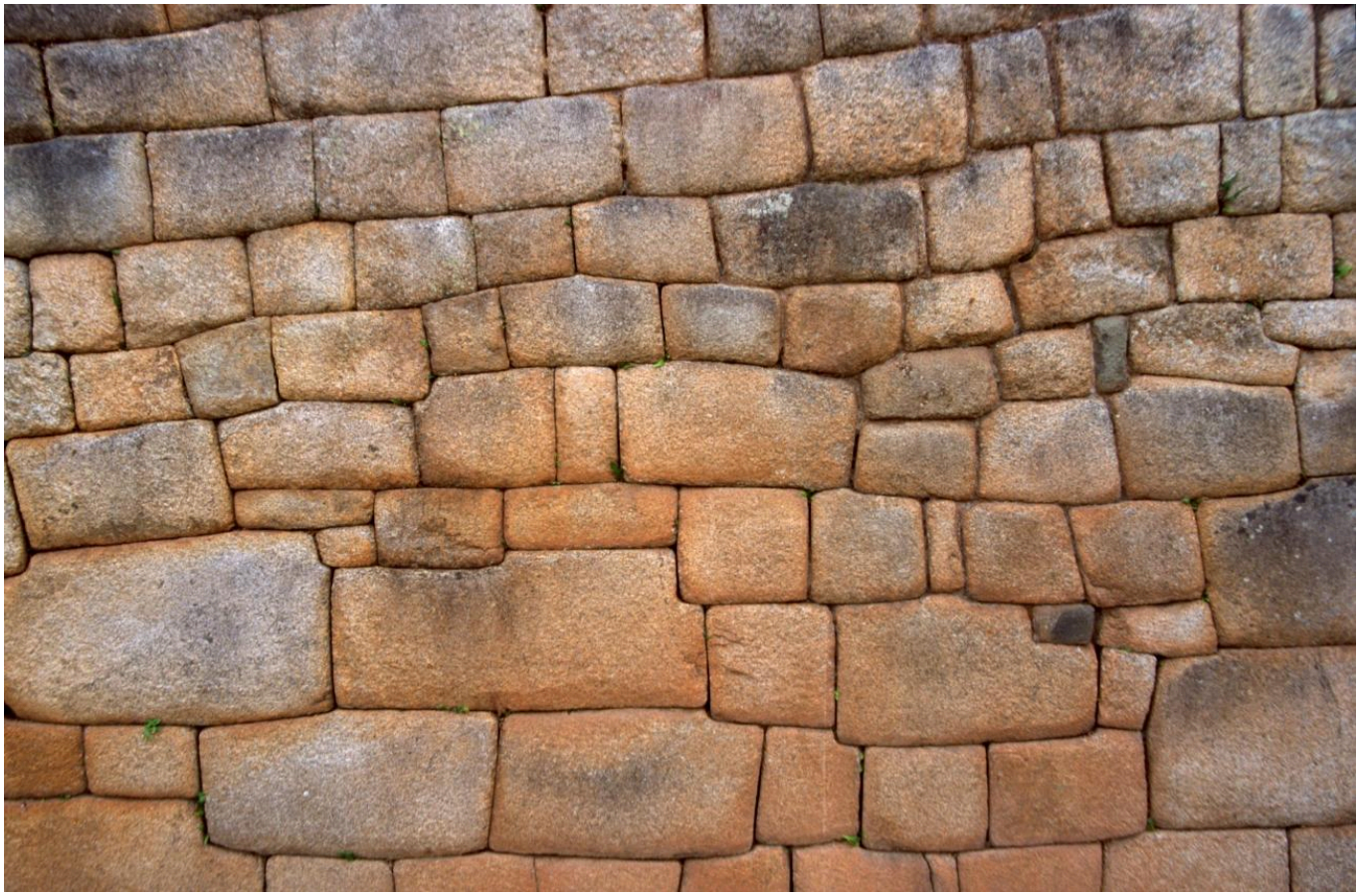

FIG 7. INKA WALL. PICTURE: COLEGOTA - SLIDE TAKEN, SCANNED AND POST-PROCESSED BY AUTHOR AND POST-PROCESSED WITH THE GIMP., CC BY-SA 2.5 ES, HTTPS://COMMONS.WIKIMEDIA.ORG/...

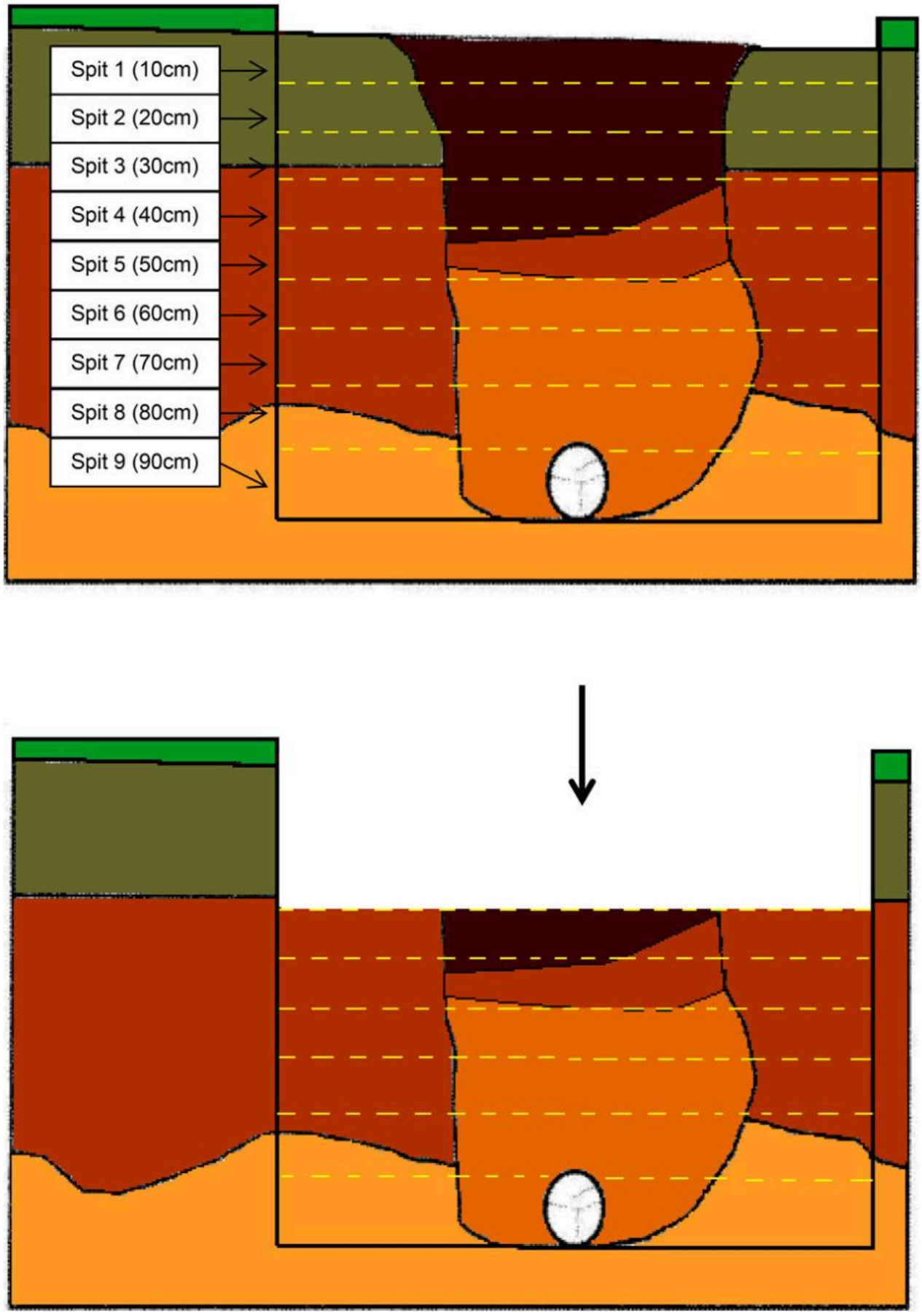

FIG 8. THE STRATIGRAPHIC EXCAVATION METHOD (AFTER HANSON 2004). PICTURE: EVIS ET AL. 2016

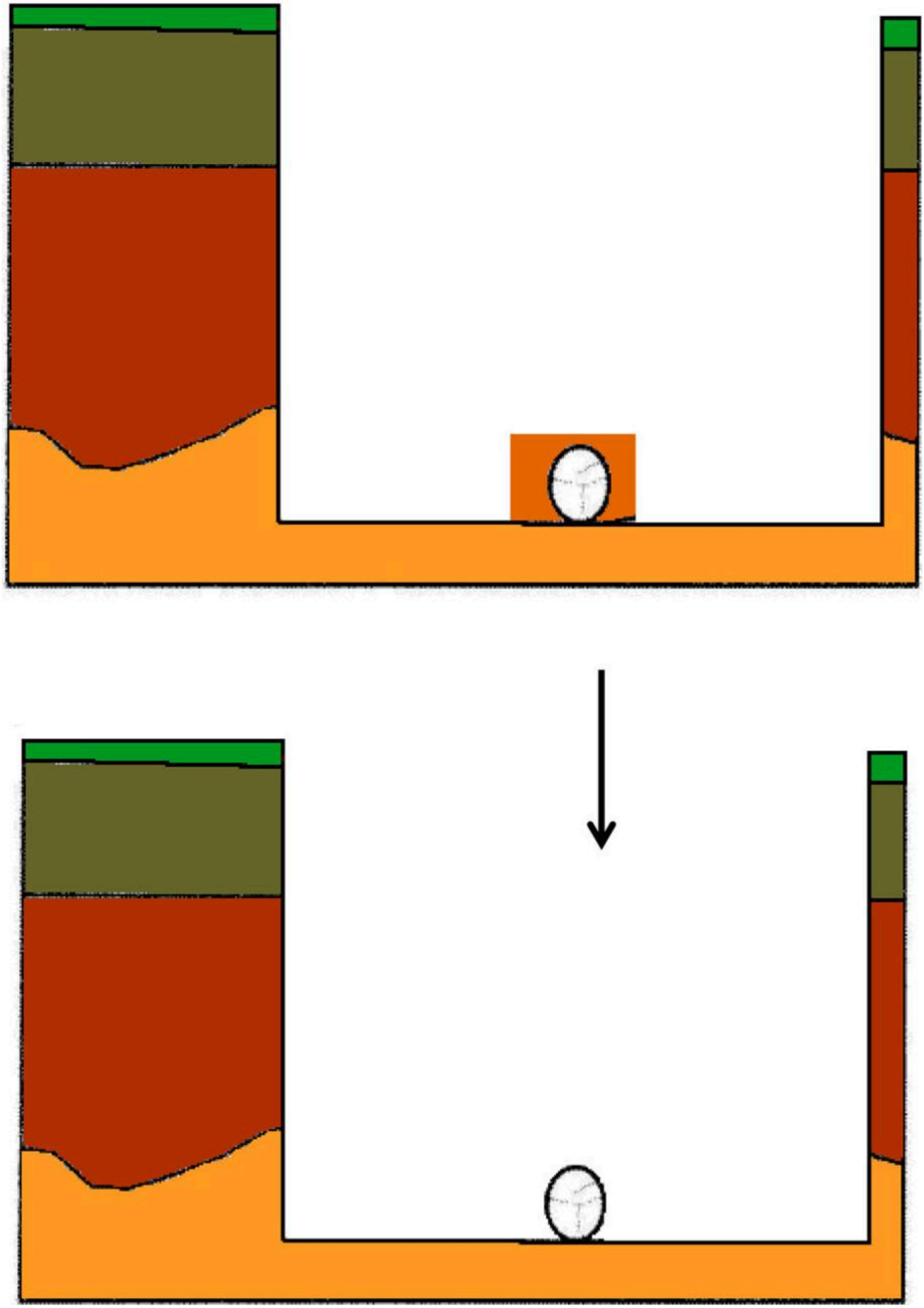

FIG 9. THE ARBITRARY LEVEL EXCAVATION METHOD (AFTER HANSON 2004). PICTURE: EVIS ET AL. 2016