

ARCHAEOLOGY VS. ARCHAEOLOGICAL SCIENCE

Do we have a case?

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THE PROBLEM

The last three decades have seen a steady growth of application of natural scientific methods to archaeology. The interdisciplinary approach of archaeometry has found increasing appreciation by the archaeologists and is now considered indispensable and an integral part of archaeological studies. Interdisciplinary collaboration requires a multidisciplinary background. It is becoming increasingly difficult for the individual to grasp the whole field of archaeometry with its rapid developments. (website of *Natural Science in Archaeology*, Springer)

From an archaeological-science perspective, this is a positive statement, but is it really true? Do all archaeologists really think that archaeometry is indispensable to archaeology? To be honest – no. The quotation comes from the publication series *Natural Science in Archaeology*, specialized in archaeometry, with the aim “to bridge this information gap at the interface between archaeology and science”, as expressed by its editors Bernd Herrmann, a physical anthropologist, and Günther Wagner, a geophysicist. It is obvious that they believe that it is only by collaboration in the form of interdisciplinary work that it is possible to fully utilize scientific methods to study archaeological material. And they seem to regard this as totally uncontroversial – something which we empirically know it is not.

Thus, we have to ask ourselves: Why is it that natural science in the service of archaeology is so provocative or even threatening to some archaeologists? This question has, of course, often come to our minds, so when we were invited to write a keynote article on this topic by one of the editors of *Current Swedish Archaeology*, we thought we should try to understand why we encounter this reaction every now and then. Working at the Archaeological Research Laboratory, this has sometimes bothered us, and sometimes even amused us.

A reaction to archaeological science that we occasionally encounter is what we informally refer to as “the filter”. When this happens, a mental shield is held up against us, effectively preventing any communication, because everything we say has to pass through this filter, and once it is in position, very little seeps through. Our understanding is that the appearance of this filter is usually triggered by either of two lines of reasoning: (i) “as an archaeologist, I don’t understand these natural science things, so I don’t need to listen”, or (ii) “the archaeological scientist by definition does not understand archaeology, so I don’t need to listen”. We also sometimes face the filter reaction while talking to scientists who work with archaeological remains, who then seem to think that we make things unnecessarily complicated by arguing that archaeological context and cultural aspects have to be taken into account. Although we feel that this behaviour is both unprofessional and unfair, perhaps there lies some truth in all types of justification? We will consider the evidence here, and then make a decision.

THE INTERDISCIPLINARY NATURE OF ARCHAEOLOGY

But let us first start by stating that the interdisciplinary nature of archaeology is nothing new – in fact the use of methods and theories from other disciplines was there right from the early days of archaeology. Hence, any controversy in this might have been there from the very beginning.

In connection with the 100th anniversary of the Swedish archaeological journal *Fornvännen*, one of us was invited to write a paper on this subject, demonstrating that the use of scientific methods in archaeology goes back in Sweden as far as 1797, being almost as old as the discipline itself (Lidén 2006). Articles employing natural scientific methods in *Fornvännen* appeared from the very start, already in 1906, and have regularly continued to do so. Many new scientific methods, such as radiocarbon dating, were introduced remarkably early in *Fornvännen*; e.g. Olof Arrhenius published a paper on the possibilities of using ¹⁴C

for dating in 1949 – only two years after the initial publication of the method by Anderson *et al.* (1947). It is also interesting to note that the frequency of articles including scientific methods in *Fornvännen* has varied over time, peaking approximately at 20-year intervals (Lidén 2006).

Kristian Kristiansen (2011) has also described cyclic patterns of change in archaeology, where short and dynamic periods of innovation, resulting from interdisciplinary interaction, are followed by longer periods of consolidation and implication. He illustrates two such global periods of invention: the mid-19th century, seeing the formation of modern geology, biology/zoology and archaeology, and the mid-20th century, with the development of modern pollen analysis and the invention of radiocarbon dating. Broadly speaking, the new techniques, in particular radiocarbon dating, were embraced by the archaeological community and soon became common practice. Kristiansen even suggests that we are actually experiencing such a period of innovation right now, “where new natural science based innovations pave the way for new global knowledge and interpretations” (Kristiansen 2011:74). One of the new innovations Kristiansen refers to is “archaeogenetics”, a phrase coined by Colin Renfrew to denote “the study of the human past using techniques of molecular genetics” (Renfrew 2004:3). If Kristiansen is right, and we are facing what could be described as a paradigm shift, why is the reception of these new techniques so different from the reception of the previous innovations, such as radiocarbon dating?

We will follow here three strands of evidence, centred on the researcher, the methods and the results, respectively – all of which potentially evoke negative reactions.

THE RESEARCHER

Starting with the researcher, could the scepticism be due to the individual advocating archaeological science? Then it is linked to who has the privilege of interpretation. Now, since archaeometry is, and should be, interdisciplinary, the person providing the interpretations could be either a scientist or an archaeologist. We will provide some examples of both.

Exhibit A – archaeology as cosmetics

Let’s start with the scientists interpreting the data allegedly using an archaeological perspective. Recently a paper was published presenting the entire dog genome (Axelsson *et al.* 2013). In this paper the authors “identify candidate mutations in key genes and provide functional support for an increased starch digestion in dogs relative to wolves” (Axels-

son *et al.* 2013). We will not comment upon the techniques used in this paper, nor will we comment upon the interpretation of certain genes being uniquely derived in dogs compared to wolves; the point here is how the authors have interpreted their scientific results in relation to prehistoric human activities.

The main objection here regards their claim that “as humans changed from a nomadic to sedentary lifestyle during the dawn of the agricultural revolution, wolves may themselves have been attracted to [starch-rich] dumps near early human settlements to scavenge” and “Our results show that adaptations that allowed the early ancestors of modern dogs to thrive on a diet rich in starch, relative to the carnivorous diet of wolves, constituted a crucial step in early dog domestication”. This goes on without referring to one single archaeological article or book, or even quoting an archaeologist, and without including any co-author with an archaeological background. In the paper it is claimed that it is impossible to say anything exact about the timing of dog domestication other than that dogs must have been domesticated before 10,000 BP. This of course would be close to the timing of the domestication of plants. However, fossil bones interpreted as coming from domesticated dogs have been dated as far back as to 33,000 BP (Ovodov *et al.* 2011). Further, the authors make a big issue of the difference in diet between hunter/gatherers and farmers in terms of starch intake, but dogs domesticating themselves by feeding off Mesolithic village dumps (Coppinger & Coppinger 2001) is not necessarily the same as dogs feeding off starch-rich dumps in farming villages. They provide no evidence for the presence of Neolithic starch-rich dumps, nor do they provide evidence for domesticated dogs feeding off starch. It is obvious that the reason why the authors added the archaeological twitch to their paper was not a genuine interest in archaeology, but rather a desire to improve the general interest of their important genetic study. Papers like this definitely catalyse a provocative behaviour against scientists interpreting archaeology. That this paper was published in one of the most prestigious scientific journals of course makes it even more provocative.

It is regrettably easy to find more examples of how archaeology has been used to boost interest in an article by scientists without any genuine interest in understanding archaeology.

Exhibit B – ignorance of cultural implications

Here is an example that we often use in our teaching of undergraduate students. In a study by Haak *et al.* (2008) performed on a skeletal material from Eulau in Germany, dated to the Neolithic, they claim that they have found the oldest evidence for the nuclear family. To quote: “A

direct child-parent relationship was detected in one burial, providing the oldest molecular genetic evidence of a nuclear family” (Haak *et al.* 2008). They based their statement on aDNA analysis in combination with strontium analysis. The study in itself is solid and trustworthy, but it is the final interpretation that is on a shaky ground. The concept of nuclear family was introduced in the latter half of the 20th century, and does not necessarily imply a genetic relationship between parents and offspring. Not only is the use of the term “nuclear family” anachronistic, but the archaeological context here does not allow any conclusions regarding the kinship system. We are thus not questioning that these individuals were actually genetically related, but rather the cultural implications of it. Moreover, although it is impossible to control the use and misuse of your research, it is perhaps not surprising that this paper has been frequently cited on Christian websites in the US.

THE METHODS AND MATERIAL

Continuing with the methods and material, we have to return to “the filter”. For a person without scientific training, it is sometimes difficult to practise source criticism; thus the filter turns up. A most unfortunate modification of the filter is to totally embrace the available methods without employing rigorous scientific thinking and source criticism.

Exhibit C – lack of source criticism

Ever since radiocarbon dating was invented, it has been a blessing for archaeologists. This method has provided archaeologists with a tool to date objects from previously living objects, lacking stratigraphic or morphological information, with a fairly high precision, for instance allowing absolute dates for human skeletal remains. The method has continuously been developed with higher precision in the actual measurement, better calibration going further back in time, and also better extraction of the carbon used for dating. One large drawback has been that it has only been possible to date uncremated bone. The protein part of bone, collagen, used for dating, is destroyed during cremation, leaving the inorganic part of the bone in a fairly stable state. For collagen there are well developed quality criteria to identify diagenetic alterations or contaminations. During the past decade it has been claimed that it is possible to use the inorganic part of the bone for dating (Lanting *et al.* 2001). This is of course an even more welcome invention for archaeologists since the majority of all human remains are cremated. However, there are some serious drawbacks with using cremated bones for radiocarbon dating.

As for now, we have no or little means of testing for diagenesis in the inorganic part of the bone, meaning that we do not know if the obtained radiocarbon date reflects the original carbon in the bone, or if it reflects the carbon of the surroundings or a mixture of these. It is argued that if a bone was cremated at temperatures above 600 degrees Celsius the carbon is bound so hard to the hydroxyapatite that there will be no exchange with the environment (Olsen *et al.* 2007). However, to identify at what temperature the bone was heated it is necessary to analyse the bone either with Fourier Transformed Infrared Spectroscopy (FTIR) or X-ray diffractometry (XRD) (Blücher 2009), and even then will we only get a rough estimate of the cremation temperature. Unless this is done we cannot tell whether the bone was heated above 600 degrees and thus is resistant to contamination of exogenous carbon. The lack of collagen in cremated bone further makes it impossible to trace any possible reservoir effects – and we know that both marine and freshwater reservoirs can generate substantial radiocarbon date offsets.

So what do most archaeologists do? Well, they submit their cremated bone for radiocarbon dating and when they receive the expected result they tend to accept it, whereas when they get unexpected dates they tend to refute them, arguing that it must be due to contamination or reservoir effect or something else! This we find puzzling – a date is accepted as scientifically sound if it is within the expected time of interest, but rejected if it is outside the expected time of interest. The question is then: why bother to submit a sample for dating at all, if you already know the date from the beginning? And how do you know that the date is correct even if it is as expected? Here we wish for archaeologists to be more critical of the scientific methods they are using, and at least collaborate with someone with a better understanding of the methods used.

Exhibit D – pots and people

It is obvious that some scientific methods are more accepted among traditional archaeologists than others, as with the example of radiocarbon dating. Another such example of well-accepted scientific methods is the use of lipid residue analysis. There are numerous recent studies on lipids or other organic residues in ceramics, providing information on the previous content of the vessel, such as milk, beer, aquatic food, etc. (McGovern *et al.* 2004; Evershed *et al.* 2008; Isaksson & Hallgren 2012; Craig *et al.* 2013). Although there has been little controversy regarding the results of organic residue analysis, there are a lot of things that archaeologists could be more critical about, for example: what do the analysed ceramics represent in terms of style, technique and last but

not least in the number of individual pots. Why do we not see more discussion about this?

It might be that organic residue analysis is uncontroversial because it provides information on the economy of a society. However, this is not entirely true, since residues in pots also mirror the culinary practice (Isaksson 2010) and cuisine and dietary habits are significant expressions of culture and should not be reduced to mere economy (e.g. Anderson 2005). No matter what, pots are material culture, that is, pots are not people.

Turning to another field of archaeological science, stable isotope analysis of human skeletal remains, it was rather uncontroversial in its early days, perhaps because it was also regarded as providing information on the economy of a certain group of people. However, as the method has been refined and we are able to get more and more information on individual behaviour in terms of breastfeeding, diet, physiology and mobility (Lidén & Angerbjörn 1999; Howcroft *et al.* 2012; Fornander *et al.* 2014), it is as if this field too has become increasingly provocative to some archaeologists.

Is this because we are now dealing directly with people and not just the material culture left by them? If so, how can this be controversial?

THE RESULTS

Well let's move on to the most provocative techniques of all science methods used in archaeology, aDNA analysis on human skeletal remains.

Exhibit E – unwelcome results?

A paper by Skoglund *et al.* (2012) became enormously exposed in the media worldwide, quite unusually so, being based on Swedish material and performed by a group of Swedish researchers. In this study, skeletal remains of three humans assigned to the Pitted Ware culture and one individual assigned to the Funnel Beaker culture, the former having an economy based on hunting and gathering and the latter an economy based on farming, were analysed. The conclusion of the study was that the introduction of farming in Europe was due to migrating people rather than indigenous adoption, an issue that has been debated for ages in archaeology. Further, it was concluded that these immigrants were of Mediterranean European descent.

So why are these results so provocative? Is it the mere fact that the authors claim to have solved a long-debated archaeological question? The issue of whether the introduction of farming was caused by migra-

tion or indigenous development is not only an empirical one, but also closely connected to different schools of thought, or paradigms. And perhaps their answer does not fit into the present theoretical paradigm.

There have been no concerns regarding the scientific techniques used in this study, nor of the use of statistical methods. However, there have been concerns regarding the representativity of the material, i.e. there is only one individual representing a whole cultural group, and three representing another cultural group. Further, there have been concerns regarding the dating of the four individuals; since the Pitted Ware culture does not predate the Funnel Beaker culture, the latter cannot replace the former.

Another potential trigger is aDNA analysis on human remains. Again, we face the same problem as with stable isotope analysis – we are dealing with people, not pets or pots.

CLOSING ARGUMENT

When we consider the evidence, it is clear that there *are* examples of misuse of archaeological science – both from the purely archaeological side and from the science side. However, what seems to be the biggest problem is a lack of communication. And a question of vital importance seems to be who has the privilege of interpretation.

A constructive way to solve the problem would be to realize that neither archaeologists, nor “scientists” or evolutionary biologists, are Renaissance people, but rather that we all need to cooperate. We should try to engage in a more fruitful and constructive way of making use of these new tools that the natural sciences offer in order to address really interesting archaeological questions. We cannot let the evolutionary biologists (e.g. Jared Diamond) have the sole privilege of interpreting human and cultural evolution.

Collaboration is not effortless; it is a matter of being able to speak a common language, and a matter of being more susceptible to what “the other” has to, or wants to, say, or quite frankly: remove the filter!

THE VERDICT

What we are asking for is not only appreciation, but genuine collaboration. And a condition for successful integration is an effort from both parties involved – it takes two to tango. Or, to cite Karl Popper: “We are not students of some subject matter, but students of problems. And

problems may cut right across the borders of any subject matter or discipline” (Popper 1963:88). And this is what archaeology is all about.

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