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Entry: Knowledge and inference
Michael Fotiadis

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Abstract
Archaeological knowledge consists of descriptions and explanatory hypotheses and is underpinned by images. Descriptions pertain to observations made during field and laboratory research, while explanatory hypotheses are the product of inferences relating observable residues of past actions to the nature of those actions. Knowledge encoded in images plays a decisive role in both descriptions and inferred explanations and it has done so since the eighteenth century. Explanatory hypotheses are drawn on the basis of a large stock of background knowledge pertinent to the observables at hand. They are guided at once by the expert's intuition and by the virtues of abduction, or inference to the best explanation, including parsimony. At times, abduction has been vitiated under the influence of biased theories.

Keywords: explanation, abduction, parsimony, visual knowledge

Knowledge and Inference

MICHAEL FOTIADIS
University of Ioannina, Greece

Archaeological knowledge consists of descriptive statements and explanatory hypotheses, and both of these are intertwined with images. Descriptions pertain to observations made during field and laboratory research. Explanatory hypotheses, on the other hand, are solely the product of inferences. The latter play a most fundamental role in the formation of archaeological knowledge. The everyday work of archaeologists entails that they infer from the residues of past actions the nature of those actions. Observing what is at hand in the present, they work back to the unobservable circumstances that could have brought it about. This process has repeatedly been considered to be analogous to the "method of Zadig" (briefly, the identification of an animal's species and condition from the tracks it leaves on the ground). In fact, it is considerably more complex. That complexity is due to the palimpsest-like nature of the archaeological record (see ARCHAEOLOGICAL RECORD).

Not all of the archaeologist's knowledge consists of inferences concerning past actions, however. A substantial portion of it consists of descriptions, in technical language, of observations made in the course of field and laboratory research. Such descriptions may at a later stage of the research be used in inferences about past actions. Even when they are not, however, they are still important in knowledge formation: They force the archaeologist to pay attention to details without judging in advance their significance. For that reason, the requirement for adequate descriptions is a standard part of the protocols to be followed in field and laboratory research. When researches do not adhere to it, their conclusions are likely to be regarded with skepticism, and even ignored by the scholarly community. Because of the importance accorded to descriptions, learning to describe the observable in appropriate technical terms is an essential part of a novice's training.

As a rule, descriptions (to a lesser extent, explanatory hypotheses too) are accompanied by images: photographs in various scales, from microphotographs to satellite imagery, drawings, and graphs. Such images carry considerable cognitive weight. They are of equal value to the descriptions and are to be consulted along with them. Their great virtue is that they contain knowledge that cannot be effectively rendered in propositional language, for example, textures, spatial relationships, and synopses of quantifiable data. Archaeology's knowledge claims have long been substantiated by reference to such imagery. Beside their documentary role in the archaeologist's research report, images have many other uses. They also serve, for instance, as aides-memoires for the professional and as working objects (*Arbeitsobjeke*) in modeling alternative explanatory hypotheses. They serve as devices for training the novice's eye. Placed side by side on the printed page, they enable comparisons among artifacts from different geographical locations and periods, and they make possible the communication of one's discoveries to the world at large. In short, imagery is present in every stage of the archaeologist's formation and professional life. It is essential for his/her training, in fieldwork, in the documentation of research results, and in their transmission to professionals and the lay public. Archaeological knowledge turns out to be to a most substantial degree visual.

Naturalistic, highly accurate images of archaeology's artifacts, the work of professional illustrators working together with archaeologists, were already in circulation in the eighteenth century. The crucial role of visual knowledge in archaeology was not, however, explicitly acknowledged until the turn of the twentieth century (Petrie 1904). Discussions at that time concentrated on the merits of photographs (reproduced in archaeological journals by half-tone technology since ca. 1900) in comparison with the virtues and limitations of drawings. Still, published illustrations of archaeological objects in the

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first half of the twentieth century were as a rule of a diminutive scale and too sketchy to afford sharp views of the objects depicted. Visual knowledge at the time was transmitted less through published articles than by means of private communication: Archaeologists exchanged quality photographs with one another and also visited one another's excavations and inspected the finds. Their published knowledge claims were based on such first-hand experiences. This began to change in the 1960s, following, on the one hand, the institutional growth of archaeology worldwide and the ensuing rise in numbers of archaeologists and field projects and, on the other hand, the progress of the information age. Theoretical treatises in the 1960s insisted, for example, that ancient artifacts are "congealed information" of a great variety (Clarke 1968, 120) and that archaeological illustrations ought to be "selective"—that is, present the viewer with useful information free of irrelevant detail. Visual knowledge came of age in the course of the next 50 years. The process culminated in the first decade of the twenty-first century, as journals of international circulation began publishing their full content in electronic form. This allowed for the publication of color images of all kinds, including complex, multilayered graphs. Today, high-resolution color illustrations have in large part replaced black-and-white ones, and the trend will, no doubt, be carried further. The advent of color may have had little direct effect on the epistemic substance of archaeology's knowledge claims. It does, however, facilitate perception and, hence, the transmission of knowledge to colleagues, students, and the public. High-resolution color illustrations are, therefore, justifiably regarded today as an improvement over earlier modes of archaeological illustration.

Archaeological knowledge is multifarious par excellence. In the nineteenth century, even before the great antiquity of the human presence on our planet was confirmed by expert observations (in 1859), geology and paleontology were drawn upon in arguments favoring one or another view regarding that issue. Boucher de Perthes in the 1840s, for example, advocated the view of a deep human past on grounds that he had found primitive stone tools in geological strata that also contained fossil bones of extinct mammals. Provenience studies of prehistoric pots, based on petrographic examination of clay composition, were attempted by the 1860s. Geology, paleontology, and petrography continue to be important sources of archaeological knowledge in the present, but the spectrum of such sources has in the meantime, especially since the 1950s, greatly expanded. Research reports today are routinely coauthored by scores of experts, the majority of whom are devoted to fields only indirectly related to archaeology. Such fields range from palynology to paleogenomics and from the study of sediment micromorphology to stable isotope analysis of marine shell and human skeletal remains, not to mention studies of diet, based on the examination of food residues on ceramic cooking vessels or in Neanderthal dental calculus. In brief, archaeological knowledge in the present is the product of a synergy of agencies, associations that include experts in a variety of specialized fields, laboratories, and their equipment and institutional support, as well as the material agencies of the objects under study (see MATERIAL AGENCY).

While protocols specify procedures in the field and the laboratory, the development of explanatory hypotheses, relating the observable residues to unobservable sequences of past actions, is a creative process constrained by few rules. Furthermore, no enduring "gold standard" exists with regard to what constitutes an adequate explanatory hypothesis. In the heyday of processual archaeology (the 1960s and 1970s) it was first thought that explanations ought to appeal to general "covering laws" (e.g., laws of culture change), just as the natural sciences appealed to laws of nature. A subsequent, more pragmatic version of this stated that the plausibility of a hypothesis depended on its explanatory efficacy for cases beyond the one for which the hypothesis was originally developed (Renfrew 1982). With the turn to post-processual archaeology in the 1980s and 1990s, concerns with the generality of hypotheses receded to the background. Adequate explanations, it was now theorized, had to attend to the uniqueness of each cultural context and to take account of the power and authority embodied in material culture and in the features of the landscape. They also had to pay attention to the human subject, now thought to be historically and socially situated, and, more crucially, to be capable of negotiating

the meaning of material culture and, at once, people's place in the social world (Thomas 1996; Hodder 1992). In discussing his "contextual approach," Hodder (1992, 14) also made it clear that the context of an archaeological object is "all those associations which are relevant to its meaning." Hence, the task of the archaeologist was to identify as many as possible of those associations, whether they could be traced in a single excavation trench or they had to be sought across a continent. Crucial aspects of the object's meaning might thus emerge and important features of the context's configuration might at last be explained.

In its insistence that explanations ought to explain the configuration of individual contexts (though not in its emphasis on the importance of meaning), post-processual archaeology reaffirmed the value of what archaeologists had already been doing and would continue doing in the new millennium. Today's scene is, however, very different from that of the late twentieth century. Researchers now adopt a more pragmatic attitude toward the objects of their research and are more concerned with obtaining sound results from their projects than with applying complex theoretical paradigms. They often revisit, for instance, old problems and enlist newly developed scientific techniques in exploring them. The reexamination and redating of the stratigraphic sequence at Arcy-sur-Cure, Burgundy, France, is a good example, especially since that sequence has long been considered crucial for appreciating the interactions of Neanderthals with Modern humans in Europe and, even, the symbolic capacities of Neanderthals (Hublin et al. 2012). The recently published research on ancient DNA extracted from the skeletal remains of Aegean and European Neolithic farmers also sheds light on a long-standing problem, the process of Neolithization of Europe. These and countless other recent studies are empirical throughout; they have clearly broken away from the theoretical quests of the previous century. Explanatory inferences now are increasingly based on the findings of the natural sciences.

It has long been recognized in the philosophy and praxis of science that theory is underdetermined by observation and, similarly, that observation is theory laden (see PHILOSOPHY OF SCIENCE; Wylie 2002). The underdetermination thesis holds equally for explanatory inferences in archaeology, no matter how extensively they may draw on the findings of the natural sciences. Simply put, this means that more than one explanatory hypothesis may account for the same set of observations, though perhaps not all equally well. In theory, one decides among rival hypotheses by resorting to *abduction*, that is, inference to the best, or most plausible, explanation. Abduction is by no means a peculiarly archaeological form of reasoning. It is omnipresent in everyday thought and is also regarded by philosophers as a cornerstone of scientific methodology (Douven 2011). Like induction, abduction is ampliative: Its conclusions claim more than is logically guaranteed by its premises. Leaving aside the philosophers' conundrums concerning abduction, the practical question still arises, what makes some explanatory hypotheses better (more plausible) than rival hypotheses? Criteria for this are not altogether absent, but they are too abstract to serve as guides. For instance, a hypothesis that explains more observations is preferable to others that leave crucial observations out of account. But such a hypothesis may also be too general (it may explain too much) to be scientifically interesting. The inexact nature of criteria here may puzzle and dishearten the novice, but not the professional. For the latter, not impressed by the absence of sharply rational criteria, the process by which plausible explanations emerge is still a delicate, one but it del has none of the mystique it entails for neophytes.

The expert indeed draws on a large stock of background knowledge relevant to the observables at hand, and his/her expertise consists in part of the ability to rapidly and more or less intuitively dismiss unpromising hypotheses and concentrate on others that deserve serious consideration. Some of the latter may be further corroborated, or weakened, by thought experiments and, further yet, by new empirical evidence. Thought experiments are ubiquitous in archaeological reasoning, but they normally reach the published page in an abridged form that does not readily reveal their hypothetico-deductive structure. An illustration of this practice is found in Arsuaga et al. (1997, 125) which pertains to the processes of accumulation of human and other mammal bones in Sima de los Huesos, Atapuerca, Spain, ca. 430,000 years ago. Were thought experiments of the kind to be analytically described,

it would become clear that they take the form of models from which expectations (E) are deduced, such that "if a hypothesis H is valid, then E_1, … E_n should be archaeologically observable," where E_1, … E_n are likely material outcomes of the conditions specified in H. If those outcomes are disconfirmed by observations, the hypothesis is weakened; else, it gains in plausibility, even though, according to the underdetermination thesis outlined above, its truth will remain provisional and negotiable, subject to reappraisal upon further empirical research.

Reasoning through thought experiments is a typically rational way for reaching a plausible explanatory hypothesis. Its hypothetico-deductive structure brings to mind the "deductive-nomological" model of scientific explanation that was advanced by mid-twentieth-century logical positivists and was championed as an ideal by some archaeologists during the early days of processual archaeology in the 1960s. The two should not be confused, however: While the deductive-nomological model requires invocation of "covering laws" of nature (or culture), hypothetico-deductive thought experiments make no appeals to laws of any sort. They pertain instead strictly to local archaeological contexts, as do the explanatory hypotheses that emerge from them.

Parsimonious explanations, that is, explanations that rest on a minimum of assumptions, are intuitively more appealing than explanations that invoke a greater number of assumptions. In line with its intuitive appeal, in archaeology parsimony is invoked with remarkable frequency in support of one's favorite explanation. Caution is needed, however: Archaeologists often use the adjective "parsimonious" in lieu of "plausible" or "satisfactory," while "parsimonious" is at best a synonym of "economical" and "simple," so that "the most parsimonious explanation" is in fact the simplest explanation (i.e., the explanation that depends on the least number of assumptions). In such cases, it is not clear that one's favorite explanation is indeed the simplest of a set of rival explanations, nor is it clear that its alleged parsimony makes it more probable than the other explanations in the set. The main merit of a parsimonious and elegantly articulated hypothesis is their perspicuousness. But perspicuousness is a pragmatic virtue, not necessarily an epistemic one; it does not by itself render a hypothesis more likely than rival hypotheses. In conclusion, it makes sense to bring parsimoniousness into the discussion *only* where two or more hypotheses explain the same set of observations equally well. Even in that case, parsimony and elegance of articulation can be thought of as methodological devices, not necessarily as justifications for ontological commitments.

Abduction in archaeology is by no means a value-free process. Entrenched beliefs about the moral order of the social universe, but also prestigious, broadly shared theories may limit the range of explanatory options in a given case by strongly favoring options compatible with themselves. The epistemic effects of such biases on the archaeologist's inferences are by no means negligible (let alone their political consequences; see SCIENCE AND POLITICS). African archaeology of the colonial era, when Africans were believed to be incapable of self-improvement and all innovations in the continent had to be the work of colonists from elsewhere, is a well-known case in point. Comparable, if more muted, biases can interfere with archaeological inferences in the present as well. But today's archaeology is characterized by an unprecedented plurality of voices and critical points of view, as well as by a fast pace of publication. In these conditions, biased inferences do not remain undetected for too long and their faults are critically appraised soon after they are published. Whether the future will be like the present in this respect is not clear.

REFERENCES

Arsuaga, J. L., I. Martínez, A. Graci, J. M. Carretero, C. Lorenzo, N. García, and A. I. Ortega. 1997. "Sima de los Huesos (Sierra de Atapuerca, Spain). The Site." *Journal of Human Evolution* 33: 109–27. DOI:0047–2484/97/080109 + 19.

Clarke, David L. 1968. *Analytical Archaeology*. London: Methuen.

Douven, Igor. 2011. "Abduction." In *Stanford Encyclopedia of Philosophy*, Spring 2011 ed., edited by Edward N. Zalta. Stanford, CA: Stanford University. Accessed February 3, 2018. http://plato.stanford.edu/archives/spr2011/entries/abduction/.

Hodder, Ian. 1992. *Theory and Practice in Archaeology*. London: Routledge.

Hublin, Jean-Jacques, Sahra Talamo, Michèle Julien, Francine David, Nelly Connet, Pierre Bodu, Bernard Vandermeersch, and Michael P. Richards. 2012. "Radiocarbon Dates from the Grotte du Renne and Saint-Césaire Support a Neandertal Origin for the Châtelperronian." *Proceedings of the National Academy of Sciences of the United States of America* 109: 18743–48. DOI:10.1073/pnas.1212924109.

Petrie, William Mathew Flinders. 1904. *Methods and Aims in Archaeology*. London: Macmillan and Co.

Renfrew, Colin. 1982. "Explanation Revisited." In *Theory and Explanation in Archaeology: The Southampton Conference*, edited by Colin Renfrew, Michael J. Rowlands, and Barbara A. Segraves, 5–23. New York: Academic Press.

Thomas, Julian. 1996. *Time, Culture and Identity: An Interpretive Archaeology*. New York: Routledge.

Wylie, Alison. 2002. *Thinking from Things. Essays in the Philosophy of Archaeology*. Berkeley: University of California Press.

FURTHER READINGS

Baker, Alan. 2013. "Simplicity." In *Stanford Encyclopedia of Philosophy*, Fall 2013 ed., edited by Edward N. Zalta. Stanford, CA: Stanford University. Accessed February 3, 2018. http://plato.stanford.edu/archives/fall2013/entries/simplicity/.

Chapman, Robert, and Alison Wylie, eds. 2015. *Material Evidence: Learning from Archaeological Practice.* New York: Routledge.

Fotiadis, Michael. 2013. "Naked Presence and Disciplinary Wording." In *Modernity's Classics, Transcultural Research—Heidelberg Studies on Asia and Europe in a Global Context*, edited by Sarah C. Humphreys and Rudolph G. Wagner, 293–313. Berlin: Springer. DOI:10.1007/978-3-642-33071-1_13.