



Introduction: Scientific knowledge of the deep past



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Historical scientists, from cosmologists to archaeologists, tackle important but difficult tasks: reconstructing the events and entities which populate the deep past, understanding their formation and development, and learning how to see our contemporary world in terms of its long history. Of late, philosophers have paid increasing attention to these epistemic challenges and the nature of such sciences (see [Turner, 2014](#)). The papers collected here offer both a (by no means exhaustive) look at the variety of epistemic practices and targets found in the historical sciences and illustrate new directions in the philosophy of historical science.¹ We take 'historical scientists' to be those involved in the scientific investigation of the deep past.

[Maureen O'Malley \(2016\)](#) focuses on how molecular data has revolutionized phylogenetic reconstruction—and the epistemic challenges bred by that very success. [Lindell Bromham \(2016\)](#) uses a series of case studies to demonstrate the comparative method's (see below) power in investigations of macroevolution. Both discuss how our incapacity to experiment directly on past subjects can be mitigated—mitigated in ways highly reminiscent of experimental method. [Adrian Currie \(2016\)](#) identifies a connection between the use of comparative data in biology and archaeology, which underwrites a re-evaluation of evidence in the latter. [Derek Turner \(2016\)](#) revisits inferences about extinct lineages based on fossilized remains, using a mistaken prediction of his own to discuss the difficulty, but necessity, of making predictions about future scientific success or otherwise.

Somewhat serendipitously, each paper explores past targets at different scales. Currie looks at the archaeological challenge of interpreting rock art and the use of the 'comparative method' in paleoanthropology. Such methods involve comparing different cases, and using those comparisons to make empirical inferences. For instance, Currie discusses the use of island dwarfism in elephants and hippopotami to test theories of the same in hominids. He covers the shallow end of the deep past: a few thousand years for archeology, a little over ten thousand for paleoanthropology. Wading deeper, Turner looks at recent efforts to extract information about dinosaur coloration from the fossil record—on a scale

of tens of millions of years. Bromham discusses larger-scale questions, for instance the frequent evolution, but short lifetime, of salt-tolerant plant lineages. Such investigations not only expand our temporal scale to many millions of years, but our scope of concern: as opposed to considering the color of a few lineages, salt-tolerance is examined across the plant kingdom. Finally, O'Malley is interested in the use of molecular data to tackle questions about phylogenetic relationships among the earliest eukaryotes: the deep oceans of time, hundreds of millions of years ago (still barely up to the cosmologist's ankles, of course). Taken as a group, the papers offer a look at historical reconstructions of varying temporal depth and varying scales.

Furthermore, the papers give us a picture of how philosophical reflection on historical science is developing. Three broad themes that stand out are:

- An increasingly nuanced appreciation of the role that underdetermination plays in the practice of historical science.
- A rejection of methodological monism. The historical sciences employ a diversity of methods, inference patterns, and models. One can appreciate methodological pluralism while at the same time noticing important cross-disciplinary patterns.
- A lack of concern—and in some cases, skepticism—about the project of demarcating historical science from other kinds of science. This goes hand in hand with a cautious attitude about making epistemic generalizations about historical science.

A broad consensus on these issues leaves plenty of room for productive disagreements about detail. Philosophers are moving away from earlier comparisons of historical and experimental science to finer-grained investigations of different modes of historical reconstruction. We provide context for the special section by expanding on those three themes.

1. Underdetermination & success

At base, some hypothesis is underdetermined when we lack (perhaps in principle, or perhaps as a matter of contingent fact) sufficient empirical evidence to discriminate between it and a competitor, that is, the evidence we have (or any evidence we could have!) doesn't decide between competing hypotheses. Because historical

¹ They are a subset of the papers presented in the 2014 "Rocks, Bones & Ruins" workshop at the University of Sydney.

science is often marked by degrading signals, and thus incomplete data, it provides excellent source material for enquiring after the nature of underdetermination and how scientists respond to it.² For instance, the fossil record is commonly understood as ‘gappy’: it in no way represents a trustworthy or unbiased sample of the history of life. This is because the conditions required for fossilization are highly specific, and the survival of subsequent fossils (not to mention their eventual discovery by paleontologists!) is highly fragile. Under such conditions, underdetermination is a major concern. Previously, philosophers were concerned with the overall prevalence of underdetermination in historical science, how big a problem it presented, and what it meant for the status of historical science *vis-à-vis* experimental science. This is becoming more focused on practice and more localized.

It is natural to think of “success” in the context of historical science as the overcoming of underdetermination problems.³ New evidence arises which sharpens our picture of the past. Philosophical discussion has turned to the various means by which scientists do succeed in overcoming underdetermination, when they do. What explains that success? What works, what doesn’t? And just as importantly, what are the consequences of epistemic success? Sometimes a bit of epistemic progress can have surprising methodological and theoretical repercussions.

As O’Malley tells it, molecular techniques did not merely provide deeper knowledge of the tree of life’s structure, but challenged some of the assumptions that underlay previous reconstructions. Most strikingly, the idea that evolutionary processes move from simple forms to more complex ones, which played an important role in earlier reconstructions based on morphology, was questioned. Discovering that, say, the assumption that simple forms are not typically, or even often, basal is undoubtedly new knowledge. However, it is knowledge that kicks away the foundations of a large body of previous reconstructions. This tells us something about how science sometimes progresses: *n* steps forwards, *m* steps back.⁴ Success sometimes brings deeper uncertainties in tow.

There has been another shift: away from thinking of underdetermination primarily as a philosophical problem, a localized version of a skeptical puzzle, and towards it being an aspect of the practice of historical science. Turner’s paper, in particular, moves in this direction by highlighting some of the ways in which scientific research involves betting on future evidence. Historical scientists *qua* scientists, Turner argues, must consider underdetermination issues.

One lesson is clear: explaining how historical scientists succeed in overcoming underdetermination is going to be messy and complicated. Previous accounts—those appealing to “smoking guns” (Cleland, 2002), or to consilience (Forber & Griffiths, 2011)—capture part of the truth, but there is no one-size-fits-all solution. The key to philosophical understanding of science is to identify patterns while also attending to localized detail. In some cases, applying new technologies or evidential sources will be the decisive step—see O’Malley’s discussion of the importance of molecular evidence, or Turner on recent research on the microstructure of

fossils. In other cases, success has more to do with finding creative ways of reasoning around an underdetermination problem—see Currie and Bromham on the comparative method. Although underdetermination is a more or less constant challenge, epistemic success is a messy, rarely unmixed, multifarious phenomenon.

2. Pluralism about method

In this section we discuss the method of historical science, that is, how should we characterize knowledge-generating practices targeting the deep past?

Let’s start with some historical context. Historical science played a role in mid-20th Century philosophy of explanation. Most well-known was Hempel’s (1942) problematization of historiographical explanation. For Hempel, scientific explanation essentially involves the logical deduction of our target from a set of initial conditions and—importantly—general laws of nature. The narrative quality of historical explanation never seemed to conform well to his model. Historical (or “genetic”) explanations appear to invoke particular—perhaps unique—events, and do not *prima facie* appeal to laws. Hempel’s response was to take historical explanations as merely partial—explanation *sketches*—as opposed to the real deal. Others, such as William Dray (1957) and W.B. Gallie (1959), disagreed, arguing that there is a different mode of explanation, and thus a different way of doing science, represented by historiography. Although this debate was construed narrowly around styles of explanation, the relative status of historical science—the legitimacy or otherwise of their method—was very much in dispute. In short, Hempel held historical science to standards that were not its own, and it did not fare well.

This rich debate revealed (or perhaps contributed to!) a tension between the historical sciences, with their apparent focus on particular events, and the law-seeking (or “nomothetic”) experimental sciences. The distinction itself seems to raise questions about the epistemic status of historical science. This basic tension has been revisited (and questioned) more recently (see, for instance, Jeffares, 2008; Turner, 2005, 2007; Tucker, 1998, 2004). It also lies in the background of efforts to clarify the nature of narrative explanation (e.g. Currie, 2014; Hull, 1975). Most strikingly, Carol Cleland (2002, 2011) has staunchly occupied the anti-Hempel camp, arguing that (1) historical scientists have a distinct method, that is, a distinct way of generating knowledge, and (2) that method and more familiar ‘experimental’ science are equally valid. Cleland, then, is a pluralist about scientific method: there is more than one way to be a successful, legitimate scientist. She uses a relatively stark distinction between paradigmatic historical and experimental methods. Cleland treats these as ideal types, allowing that real, on-the-ground scientific work often involves some blending of the two. Nevertheless, she is committed to the idea that there is a paradigmatic way of doing historical science, and moreover, that distinctively historical science is, epistemically speaking, just as good as experimental science. That is, the results of historical investigations are as plentiful and as well confirmed as those of experimental investigations.

The relationship between different modes of scientific enquiry—experimental vs. historical for instance—still matters and is still worthy of philosophical exploration. Both O’Malley and Bromham press on distinctions like Cleland’s, emphasizing how experiment-like the historical sciences can be. For instance, while allowing that historical scientists are often restricted in their capacity to conduct traditional manipulative experiments, Bromham sketches and illustrates a variety of techniques which show that experiment-like functions can be played by the historical record. Strikingly, Bromham’s reflections do not point to any single way of doing this, but rather highlight their plurality. Although comparing

² Underdetermination is typically a problem for science in ‘hypothesis-testing’ mode, and we don’t mean to suggest that trying to discriminate between explicit hypotheses is all scientists do—far from it! We do suspect however that because historical scientists often face, and are very overtly concerned with, degraded and incomplete data, much of their thinking is perhaps more geared towards hypothesis testing.

³ Success in historical science could mean more than that, including occasional predictive success—think of geologists predicting the occurrence of fossil fuel deposits—but overcoming underdetermination is nonetheless a central aim.

⁴ Maureen O’Malley points out to us the inaptness of this metaphor: scientific progress is a complex, multi-dimensional beast, rather than a well-behaved, linear march.

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