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Introduction: Ways of Integrating History and Philosophy of Science

Theodore Arabatzis
University of Athens, Greece

Jutta Schickore
Indiana University

This special issue presents selected contributions to the conference "Integrated History and Philosophy of Science" (&HPS3) held at Indiana University in September 2010. The introduction revisits a previous special issue on History and Philosophy of Science, published in Perspectives on Science (2002), and reflects on the recent development of HPS as a field. Ten years ago, scholars expressed concern about the growing distance between mainstream history of science and mainstream philosophy of science. Today, we have good reason to be optimistic. The papers assembled in this special issue demonstrate that we now have a whole spectrum of combinations of historical, philosophical, and other perspectives to study science, ranging from augmenting historical studies by philosophical perspectives and vice versa to historicist reflection on methodological, epistemological, or scientific concepts and practices. This plurality of approaches to combining the historical and the philosophical perspectives on science is a hopeful sign that integrated HPS is here to stay.

The articles in this special issue are revised contributions to the third conference "Integrated History and Philosophy of Science" (&HPS3) held at Indiana University in September 2010. Incidentally, in 2002, *Perspectives on Science* published another special issue addressing the relation between history and philosophy of science. It comprised papers presented at a session on this topic at the 2001 meeting of the History of Science Society (Gal 2002; Janssen 2002; Schickore 2002; Steinle 2002). In the introduction and commentary to the contributions, the editors, Friedrich Steinle

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and Richard Burian, expressed concern about the growing distance between mainstream history of science and mainstream philosophy of science (Steinle and Burian 2002, pp. 391–2). For the two editors, the drifting apart of the two fields of history and philosophy of science was the major obstacle for interdisciplinary scholarship. The special issue was meant to achieve two goals: to encourage debates about the appropriate form and value of the interaction between history of science and philosophy of science and to provide examples of how the perceived gap between the two fields might be bridged.

Ten years have passed, so it is a good time to revisit Steinle's and Burian's texts, reflect on the recent development of HPS as a field, and consider if there is still reason for concern. It is noteworthy that Steinle's and Burian's worry is different from earlier concerns about the relation between the two fields.[1] Rather than blaming Logical Empiricism for excluding history from the purview of philosophy of science, they point to growing differences in focus and methodology between late 20th-century history and philosophy of science. They diagnose in history of science a preoccupation with either broader cultural or narrow local contexts and a corresponding lack of interest in epistemic content. They find in philosophy of science a focus on structures of argumentation and evaluation and a corresponding lack of interest in the cultural embeddedness of scientific knowledge. Because of these differences, history and philosophy of science do not have much to say to one another.

Burian and Steinle were not the first to make this point. In 1989, Larry Laudan lamented the ever-widening gap between the fields of history of science and philosophy of science (Laudan 1989; see also Pinnick and Gale 2000). Mid-20th-century history of science and philosophy of science shared the focus on scientific theories and their dynamics. Long-term histories of ideas lend themselves rather well to "tests" of philosophical theories of fundamental concepts and theory change, so scholars in both fields could contribute to the project of accounting for the dynamics of theory change. But in the late 1970s and 1980s, historians of science gradually turned away from the history of ideas and moved on to other issues—social histories, cultural histories, and histories of objects and materials. It thus became harder and harder for philosophers to find in the works of historians of science historical case studies that were relevant to their concerns, and in turn, philosophical reflections on science seemed increasingly irrelevant for historical inquiry.

In part, this problem is practical, and the solution is obvious: Scholars

1. For a more detailed history of the changing relations between history and philosophy of science, see Schickore 2011.

interested in integrating history and philosophy of science should not wait for nor expect "straightforward" historians or philosophers to do part of their work for them (see Laudan 1989, pp. 12–13).[2] Burian and Steinle did not explicitly say so, but all contributors to the special issue combine their own historical and philosophical research. In his commentary, Burian addressed head-on the question of how one should go about doing so. He framed the question in terms of the relation between the general and the particular, and asked how the tensions between abstract and general philosophical analysis and strictly localized and particular historical study might be overcome. He distinguished a "top down" and a "bottom up" connection between history and philosophy (see also Burian 2001). In the "top-down" approach, the starting point is philosophical. General philosophical theories about science are probed with, illustrated, or exemplified by historical information about particular cases. In the "bottom-up" approach, by contrast, individual case studies produced by historical research are the starting point for generalizations about science or the basis for tests of general theories of science. Conceptual lessons are drawn from historical episodes; general philosophical claims are derived from the historical record. Burian emphasizes that while both the "way up from history" and the "way down from philosophy" are legitimate, both face specific challenges: the danger of misconstruing the historical record in light of philosophical concepts and the danger of grounding general conclusions on scanty supportive evidence.

Are Burian's and Steinle's characterization of the problem of HPS and the solution that Burian outlined still pertinent today? A glance at the programs of recent HSS meetings and publication lists of relevant academic presses suggests that the trend in history of science to practical, material, and cultural contexts of science has not reversed. Many historians of science continue to engage in studies of science museums and popular culture, science and race, technical drawings and iconography, traveling and collecting, spaces and places, among other things.[3] These themes are of course relevant to the understanding of past science, but such focal points make it hard for historically-minded philosophers to find "test cases" for issues of current philosophical interest in today's history of science, such as explanation and reduction, mechanism, realism, and causation.[4] Historians, on the other hand, will not find available philosophical analyses of these issues particularly helpful for their pursuits. Scholars who seek to

2. Laudan gave this advice only to philosophers, but of course, the same holds for philosophically-minded historians.

3. All these themes are culled from the programs of HSS meetings in 2010 and 2011.

4. These themes are drawn from the program of the 2010 PSA meeting.

combine history and philosophy will likely not be able to meet the methodological standards of either discipline.

The divergence of themes and approaches undoubtedly still exists. But we think that scholars who wish to defend the merits of historically informed studies of science face even greater challenges today than they did at the beginning of the new millennium. Philosophy of science has taken a turn to scientific practice; both in the sense that "naturalized" philosophy of science draws on scientific information and in the sense that philosophers of science seek to make their analyses relevant to actual scientific practice. At first glance, this turn to science seems to open up the field of philosophy of science to HPS. But the turn to science does not automatically involve a turn to history. Ronald Giere's recent reflection on HPS illustrates this point quite nicely. In his contribution to a recent collected volume on integrating history and philosophy of science, Giere revisits his oft-quoted review on "HPS—intimate relation or marriage of convenience?" of 1973. In that review, Giere argued from the point of normative philosophy of science that the pursuit of HPS would lead straight into an "is-ought" problem: as norms cannot be derived from facts, history has no role to play for philosophy of science (Giere 1973). Therefore, Giere famously concluded that the union between history of science and philosophy of science was nothing but and could be nothing but a convenience relationship, motivated by each party's desire to leave the parental home: history and philosophy.

Having turned away from normative and towards naturalized philosophy of science, Giere now emphasizes that the "goal of a naturalized philosophy of science is to construct a theory of how science works" and that philosophy is "theoretical in the way most sciences are theoretical." As such, philosophy of science is "fully compatible with the history of science which, by its nature, is a naturalistic study of past science and scientists" (Giere 2011, pp. 7, 4, 4–5). For Giere, however, history of science is just one source of empirical data among others, and since philosophy of science is "quite present-oriented" (p. 7), cognitive science and sociology are at least as important for science studies as history is.

Other philosophers have even suggested that these empirical sciences are much more important than history for the understanding of present science. Already in the mid-1990s, scholars argued that the very question of how history of science and philosophy of science relate to one another was ill conceived because of the implicit assumption that history somehow provided privileged access to science. Panelists at the 1994 *PSA* symposium "Discourse, Practice, Context: From HPS to Interdisciplinary Science Studies" argued that the complexity of the scientific enterprise required that we draw on a multitude of perspectives on science besides

history, including, but not limited to tools and concepts from cognitive science, sociology of science, and cultural studies (see Wylie 1995). Moreover, current issues and pressing problems at the intersection of science and policy, economy, and ethics such as research on global warming, ethical concerns about scientific misconduct and biotechnology, and the fate of science in times of economic crises call for immediate attention, reflection, and evaluation. Because of the interdisciplinary nature of the field, scholars in Science and Technology Studies might seem to be much better equipped to provide relevant information about the intricacies of current science than those trained in the narrower field of HPS, and many STS scholars are tackling the issues just mentioned.[5] The challenge is for HPS to show how historical study might complement and deepen this analysis.

In the early 20th century, a tradition of historicist philosophy existed according to which tracing how concepts, ideas, and practices came into being was an integral part of their understanding.[6] During the last decades of the 20th century, this historicist perspective all but vanished from philosophy of science. To advocates of naturalized philosophy as well as to scholars of STS, the privileging of history has become arbitrary, if not altogether questionable. Historical study becomes just one option among many other empirical approaches to science, and given the pressing problems current science is facing, one might think not a particularly relevant one. Given this situation, the main challenge for scholars of HPS is not how to combine "general" philosophical theses and "particular" historical cases. Scholars of HPS are under increased pressure to legitimize the historical perspective. They need to show what, exactly, historical study can contribute to the understanding of current science, and how the historical perspective may aid and augment philosophical reflection.

Notably, there are indications that a community of HPS scholars with its own venues and outlets is forming. New terms such as "integrated HPS" and "historical epistemology" have been coined. Since 2002, there

5. Again, one can turn to recent conferences for evidence. At the 2011 4S meeting, sessions covered themes such as, Understanding the Politics of Expertise in Policy Domains, Reflection on the Impacts of the Great Eastern Japan Earthquake and Severe Nuclear Accident, Neoliberalism, Science and Technology, Designing Sustainable Energy Systems.

6. In his recent essay on historicizing epistemology, Hans-Jörg Rheinberger has identified a strong historicist tradition in 20th-century philosophy with Husserl, Heidegger, Cassirer, Bachelard, and Canguilhem as the main protagonists (Rheinberger 2010). In this context, "historicism" does not mean "radical context-dependence" as an imperative of historical analysis, nor does it mean an acknowledgement of "laws of historical development" (the kind of historicism Popper criticized). Rather, "historicism" refers to the historicist-hermeneutic maxim that "understanding something" means "understanding how it came into being." Historicist philosophy is ultimately concerned with the present. We need to historicize our knowledge in order fully to understand it.

have been a number of conferences and publications on the relation between history and philosophy of science, including, among other things, a collected volume on the history of the distinction between contexts of discovery and justification (Schickore and Steinle (eds.) 2006); Hans-Jörg Rheinberger's book-length history of historical epistemology (Rheinberger [2007] 2010); the conference "What (Good) is Historical Epistemology?" at the Max Planck Institute for the History of Science (2008); an *Isis* Focus section "Changing Directions in History and Philosophy of Science" (December 2008); the conference "Historical Epistemology" at Columbia University, NY (2008); the conference "Historical Epistemology" at Louvain, Belgium (2009); the edited volume *Discourse on a New Method: Reinvigorating the Marriage of History and Philosophy of Science* (Domski and Dickson (eds.) 2010), as well as a collected volume *Integrating History and Philosophy of Science: Problems and Prospects* (Mauskopf and Schmaltz (eds.) 2011), and a special issue of *Erkenntnis* in 2011 with contributions from the 2008 conference at the MPI Berlin. The conference series "Integrated History and Philosophy of Science (&HPS)" that generated the present special issue has been a part of this movement, with conferences in Pittsburgh (2007), Notre Dame (2009), Bloomington (2010), and Athens (2012).

Of course, one might object that the mere fact that there are new venues for HPS and new labels such as "historical epistemology" does not necessarily signal wide agreement about how to integrate the two fields. It does not even imply that integration is in fact attempted. It could simply indicate that there is enough critical mass of scholars who are dissatisfied with their home disciplines and ready to risk a new marriage of convenience. Historians may seek venues for the pursuit of intellectual history or long-term studies of scientific developments. Philosophers may seek venues for the pursuit of studies engaging with actual scientific practice rather than with ideal epistemic situations.

But if nothing else, the current stream of conferences and workshops devoted to HPS provide occasions where new approaches can be presented for consideration to (one hopes) appreciative audiences and opportunities to reflect on possible ways of integrating philosophical and historical perspectives. And the contributions to this special issue show that genuine attempts at integrating elements from history, philosophy, and other areas of science studies do exist. They show that there is a whole spectrum of possibilities. Among other things, they exemplify the merits of *historicist* analysis, the study of how concepts, practices, and methodological and epistemological commitments have developed.

Aaron Cobb enlists history of science in the service of the history of philosophy of science (HOPOS). He does so by demonstrating the importance

of the scientific context for understanding past philosophy of science. In particular, Cobb intervenes in a debate concerning the nature, inductivist or hypothetico-deductivist, of Herschel's philosophy of science. Some scholars have argued, on the basis of certain passages in Herschel's *Preliminary Discourse on the Study of Natural Philosophy,* that Herschel was a proponent of an early version of hypothetico-deductivism (H-D). Other commentators on Herschel's work, however, emphasizing the inductivist passages in *Preliminary Discourse,* have seen him as an inductivist. Both camps have utilized prima facie conflicting passages from the *Preliminary Discourse* to support their respective positions.

Cobb expands the range of evidence that is brought to bear on this interpretive issue. By looking at how Herschel presents his research strategy in his published scientific work, Cobb supports an inductivist interpretation of Herschel's methodology. Cobb focuses on the published report of the electromagnetic experiments that Herschel jointly carried out with Charles Babbage. The way Herschel presents his electromagnetic research shows clearly, according to Cobb, his commitment to inductivism. Cobb then reinterprets some of the passages in the *Preliminary Discourse,* which have been used to support an H-D interpretation of Herschel's methodology. The *Preliminary Discourse* is seen by Cobb as a philosophical articulation of the methodology Herschel followed in his own experimental practice. In a way, Cobb's approach inverts Michael Friedman's well known approach to HOPOS: whereas Friedman draws on the philosophical context of scientific practice to account for scientific development as a rational process (Friedman 2001, 2011), Cobb draws on the scientific context of philosophical reflection to develop a more adequate interpretation of an episode in the history of philosophy of science.

Tom Pashby's paper shows nicely how the realism issue is entangled with the interpretation of the historical record, and it also shows that scholars of HPS cannot expect to find ready-made the historical studies they need in the works of historians of science. As Pashby points out, the two most prominent varieties of realism "make significant claims about the nature of the historical record." By a careful and detailed reconstruction of the development of Dirac's relativistic quantum mechanics and, in particular, of his "hole theory," Pashby makes a significant contribution to the realism debate. On the basis of that episode, which culminated in Dirac's prediction of the positron, he argues against the two main versions of preservative realism: "restrictive" realism and structural realism.

Older attempts to respond to Larry Laudan's pessimistic meta-induction (Laudan 1981) either dismissed his examples as cases of "immature" science or focused on the classic cases of successful theories that turned out to be false, that is, the caloric theory and ether-based electro-

magnetic theory. Pashby brings the debate to the 20th century and makes his case against scientific realism on the basis of a bona fide scientific achievement, Dirac's relativistic quantum mechanics, which could pass all the strident tests that realists have deemed necessary for commitment to the (approximate) truth of a theory: unification of two empirically adequate theories, indispensability of its various parts in calculation and prediction, fertility and, above all, successful novel predictions.

Pashby subjects restrictive realism and structural realism to historical scrutiny and argues that they do not pass muster with what the historical record reveals about the development of Dirac's theory. He examines various possibilities for the restrictive realist and finds all of them wanting. Proceeding to structural realism, he disputes the claim of its proponents that there is always structural continuity across theory change. In the transition from Dirac's hole theory to its successors Pashby points out several structural discontinuities and challenges structural realists to account for them. This is history of science in the service of philosophy of science, but it is not "philosopher's history." Not only does Pashby take into account the considerable solid literature on the reconstructed episode, along the way he also provides novel historical information about Weyl's significance for the development of Dirac's theory and, in particular, for his prediction of antimatter.

Kent Staley draws on history of science to explore a foundational issue in contemporary cosmology, the "fine-tuning" of the cosmological constant. He does this via examining how physicists in the past have approached fine-tuning problems. His paper crosses paths with Pashby's. They both discuss aspects of the same episode, the early development of quantum electrodynamics, but put history to different philosophical uses. While Pashby draws lessons for the realism debate, Staley's analysis aims at intervening in a philosophical debate in cosmology.

The starting point of Staley's theory is, again, Dirac's hole theory, or rather "idea." Staley departs from an anachronistic historical interpretation of Dirac's problem situation as a "fine-tuning" one. The anachronism is not his own but due to the contemporary physicist Hitoshi Murayama. Staley is sensitive to the historiographical problems created by anachronism, and he offers a contextual and nuanced reconstruction of the development and reception of Dirac's ideas that shows the historical inaccuracy of Murayama's interpretation. However, following Nickles (1992), Staley acknowledges the importance of "bad" history for scientific research and suggests that anachronism can play the same "constructive" role in the resolution of philosophical debates. Thus, he does not hesitate to put Murayama's anachronistic interpretation to philosophical use. Seeing the epistemic situation in contemporary cosmology as relevantly similar to

the epistemic situation in quantum electrodynamics during the 1930s, he is able to draw lessons from the historical case that are applicable to the contemporary cosmological case. In particular, he argues that the success of a theory in solving a fine-tuning problem does not provide sufficient support for all the claims of the theory. The historical analysis of the Dirac case alerts us to the possibility of drawing unwarranted conclusions from the solution of fine-tuning problems.

This suggests another use for integrated HPS: historical episodes may exhibit epistemic features that are similar to those of a contemporary problem situation. With the benefit of hindsight, one could draw "lessons" from those episodes that would be relevant to problems in contemporary science. Echoing Kuhn, we could argue that for the contemporary epistemologist history of science can be seen as a repository of evaluative strategies that retain their relevance for the adjudication of contemporary scientific debates.[7]

Justin Smith's paper exemplifies the value of a historicist analysis of present (organizing) concepts: "One way to go about knowing a thing . . . is by considering how it comes to be." He provides a critique of recent analyses of race, by means of a cognitive-historical analysis of the early modern concept of race. He rejects the widespread idea that the modern concept of race has its roots in the early modern period. The early modern concept of race and its contemporary counterpart are different concepts, which however reflect the same innate disposition to differentiate human groups on the basis of their appearance and behavior.

Smith raises an important question that falls squarely within the purview of integrated HPS: Why do some concepts die out when it is discovered that they are empty (non-referring), whereas others don't? In particular, what distinguishes the concept of race, which persists despite the fact that it does not pick out a real natural kind, from non-referring concepts, such as "phlogiston" and "ether," which have disappeared from the ontology of science? These are philosophical questions that can be addressed only through historical investigation.

From very early on, it was recognized that race is not a natural kind, that it does not capture "species-like or essential divisions within the human species." Nevertheless, it has not faded way. Smith traces the history of racial classification in the early modern period in order to understand the persistence of race in contemporary discourse. He argues that the persistence in question is due to an innate human tendency, which has been

7. Cf. "Canguilhem [who], following his Dutch colleague Eduard Dijksterhuis, . . . [saw] the history of the sciences as itself an 'epistemological laboratory'." (Rheinberger 2010, p. 66)

identified in the cognitive literature, to reify distinctions that are based on superficial characteristics. This tendency is, of course, reinforced by the normative function of the concept of race in contemporary societies. Cognitive science, according to Smith, may discover features of the human mind that function as "a stable background" "against which historical variation can occur." Thus, both the cognitive and the historical components are necessary for understanding the development of concepts.

Smith's argument is also relevant to the debate on the social construction of scientific knowledge. The concept of race shows that the social construction/natural reality dichotomy is a false one. While that concept is a construct, it may reflect an underlying human disposition that is found across ages and cultures. Thus, he puts forward a novel category, "natural construction," which lies in the middle between *natural* kinds and social *constructions.*

The four contributions to this special issue demonstrate that the recent endeavors to promote HPS amount to more than a new marriage of convenience. They show that HPS has come a long way since the studies of the dynamics of theory change. Taken together, they also indicate that we now have a spectrum of combinations of historical, philosophical, and other perspectives to study science. Pursuing an integrated approach to science can simply mean to acknowledge that historical studies may be enriched by and profit from philosophical perspectives and vice versa. We have seen this happen, for instance, in historical studies of experimental practice, which have been enriched by reflections on issues such as causation and methodological strategies (e.g., Franklin 1986; Schlich 2000, Hudson 2009). Cobb's contribution exemplifies this kind of integration. His interpretation of the Babbage and Herschel electromagnetic experiments is a good illustration of recent work on exploratory experimentation (Burian 1997; Steinle 1997; Waters 2007) because he shows that the purpose of experimentation is much wider than theory-testing, at least if by "theory" we mean high-level explanatory and unifying mathematically formulated constructs. Those experiments did not aim at testing Ampere's then recently formulated electromagnetic theory but rather to explore the characteristics of a particular phenomenon. Furthermore, Cobb's distinction among different levels of theorizing (from the phenomenological to the hidden) echoes distinctions that were made by philosophers of experiment in the 1980s (see, e.g., Hacking 1983, Cartwright 1983; Galison 1987).

In turn, philosophical analyses of science could be (and have been) enriched by attention to intellectual and cultural context and an appreciation for the problem of anachronism. The merits of such work are obvious in recent studies of mechanism, for example (see, e.g., Des Chene 2005).

In the present issue, this kind of analysis is represented by Staley's study of a foundational issue in cosmology.

In more strongly integrated projects, both strands of analysis are indispensable for the argument, and both are given equal weight. Salient problems in philosophy of science, such as the pessimistic meta-induction and its implications for scientific realism, can be adequately addressed only from a (strongly) integrated HPS perspective. Philosophical responses to that problem, such as preservative realism, amount to (or presuppose) interpretations of the historical record. Tom Pashby's philosophical arguments against preservative realism would not be convincing if they were not based on a solid historical analysis.

Another way of integrating strongly is to appreciate that understanding the meaning of a concept, practice, or methodological and epistemological commitment involves understanding how the concept, practice, or commitment came about. Ian Hacking's work on the emergence of the modern concept of probability does this in exemplary fashion (Hacking 1984, 1990). Historicist reflection may enter the picture on two different levels: as the history of methodological, epistemological, or scientific concepts and practices[8] or as part of a reflection on the history of the very concepts we are utilizing in our analyses of science. The latter is a motivation for several of the works that have been produced in the context of HOPOS (see, e.g., Howard 2006). In his contribution to the 2008 *Isis* Focus Section on the relation between history and philosophy of science, Alan Richardson explicitly argues that to understand the contours of philosophy of science today, it is indispensable to understand our own recent past—and to do *that,* we will need to do more than just trace particular concepts through the standard texts of the discipline. We will need to put them in the larger context of 20th-century science and society. It is only then, that we can appreciate that Logical Empiricism was a conscious attempt at reforming philosophy so as to make it more scientific, collaborative, and technical (Richardson 2008). In this issue, Justin Smith's paper is emblematic of this approach. His reconstruction of the genealogy of a concept aims, among other things, at intervening in a contemporary debate about the origins and character of the concept in question.

The plurality of HPS approaches exemplified in this issue suggests that there is not one single best way of integrating historical, philosophical, and other perspectives on science. We do believe, however, that some form of integration is indispensable for understanding contemporary scientific

8. This project has affinities with the early, historicist brand of "historical epistemology," as Rheinberger maps it. The publication of Daston and Galison's book *Objectivity,* which is, after all, a history of an "organizing concept" (Hacking) may help reinvigorate this tradition.

practice and its past development. We hope that this special issue will encourage further efforts in this direction.

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