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Introduction: Integrated history and philosophy of science in practice

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This special issue of *Studies in History and Philosophy of Science* presents a selection of nine papers from the &HPS4—Integrated History and Philosophy of Science—conference, which was held in Athens, Greece, March 15–18, 2012, under the sponsorship of the Department of Philosophy and History of Science of the University of Athens.

The original idea for &HPS grew out of a meeting of interested historians and philosophers of science at the November 2002, co-located meetings of the History of Science Society and the Philosophy of Science Association in Milwaukee. Concern about centrifugal forces within the larger HPS community found expression in the desire to create a new professional space within which intentionally integrated HPS scholarship could flourish. There was talk of a new professional association, perhaps a new journal. Discussion continued after the Milwaukee gathering, and eventually it was decided to keep structure to a minimum, testing the community's need for a new space with just a conference or two.

The &HPS conference series was launched in October 2007 with a gathering at the University of Pittsburgh, under the sponsorship of Pitt's Center for Philosophy of Science, and &HPS2 at the University of Notre Dame in 2009, under the sponsorship of Notre Dame's Graduate Program in History and Philosophy of Science. Special thanks are owed to the National Science Foundation for its generous support of the &HPS1 and &HPS2 meetings. Those two conferences were big successes, and there followed a meeting at Indiana University (2010) and the meeting reflected here, in Athens, in 2012. The series, now seemingly well entrenched and drawing more participation with every iteration, continued with &HPS5 at the University of Vienna in June 2014.[1]

Many people ask what, exactly, is intended by the designation, "Integrated History and Philosophy of Science." That question is best answered by the series manifesto:

> A Manifesto
>
> &HPS is distinctive in that it is both historical and philosophical at the same time.
>
> Good history and philosophy of science is not just history of science into which some philosophy of science may enter, or philosophy of science into which some history of science may enter. It is work that is both historical and philosophical at the same time. The founding insight of the modern discipline of HPS is that history and philosophy have a special affinity and one can effectively advance both simultaneously.
>
> What gives HPS its distinctive character is the conviction that the common goal of understanding of science can be pursued by dual, interdependent means. This duality may be localized in a single work. Or it may be distributed across many works and many scholars, with parts locally devoted just to historical or philosophical analysis. Intellectual history, for example, serves this purpose. What unifies this local scholarship into an HPS community is the broader expectation that all the work will ultimately contribute to the common goal.

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[1] Details on its make-up and further information about all of the conferences in the series can be found at the &HPS archive at Pitt's Center for Philosophy of Science: http://www.pitt.edu/~pittcntr/Events/All/Conferences/others/other_conf_2007-08/andHPS/andHPS.htm.

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> There is no distinct methodology that is HPS. Doing HPS does not confer a free pass to suspend the standards of one field to advance the other. It must be good history of science and philosophy, in that its claims are based on a solid grounding in appropriate sources and are located in the relevant context. And it must be good philosophy of science, in that it is cognizant of the literature in modern philosophy of science and its claims are, without compromise, articulated simply and clearly and supported by cogent argumentation.

As this manifesto indicates, there is a plurality of approaches to integrating history and philosophy of science, blending philosophical analysis and historical interpretation in different ways.[2] Some of these possibilities are exemplified by the papers in this special issue. Regardless of how they integrate HPS, however, we believe that all of the papers meet the standards of good HPS scholarship. They are solidly grounded on pertinent historical sources and address (and are informed by) widely discussed issues in contemporary philosophy of science.

The first two papers, by Tom Ryckman and Katherine Brading, bring the history of physics to bear on the philosophy of physics. Ryckman's paper is a plea for a historical reorientation of philosophy of physics, which so far has focused exclusively on foundational issues in contemporary physics, "regarding our best physical theories as *unhintergehbar*, behind which interpretation or understanding is no longer needed or even possible." Ryckman stresses the historical contingency of physical theories, which suggests that their ontological implications should be taken with caution. The task facing philosophers of physics, according to Ryckman, is less to use the theories of modern physics as an unproblematic guide to ontology and more to understand historically and philosophically how these theories emerged and were established in the first place. Ryckman finds inspiration for his project in Hilbert's struggle to understand the "pre-established harmony" between mathematics and physics, which Hilbert did not consider as a given but tried to account for in terms of his "finite stance".

Brading also engages with the history of physics for philosophical purposes. She addresses a metaphysical issue in the philosophy of space and time, presentism, by developing Newton's philosophical ideas on ontological unity. She considers Newton's work from the perspective of the history of philosophy, integrating the history of science and the history of philosophy. Historians of philosophy, in contrast to historians of science or intellectual historians, are accustomed to treat past philosophers as contemporaries. This interpretive strategy has the advantage of making the history of philosophy relevant to contemporary issues and concerns. Sometimes, however, it may generate readings that are anachronistic and insensitive to historical context. This not the case with Brading's paper, which pays attention to the historical context of Newton's philosophical ideas, develops their implications, and in the process breathes new life into presentism.

The next three papers, by Teru Miyake, Alisa Bokulich, and Sally Riordan, investigate seminal philosophical issues through particular episodes in the history of science. The focus of Miyake's paper is the underdetermination of theory by observation. Miyake thinks through this problem by reconstructing Kepler's arguments for the Copernican system and against the Ptolemaic and the Tychonic ones. He examines two contemporary philosophical reconstructions of Kepler's work and finds them wanting. He then suggests his own philosophical tools for dealing with underdetermination: "decomposition" and "identification". These tools, according to Miyake, capture Kepler's own reasoning and make it possible to understand the rationale behind Kepler's choice of the Copernican system. In Miyake's project there is two-way traffic between history and philosophy of science: an adequate conceptualization of a philosophical problem enables the historical understanding of the epistemic situation faced by past scientists and, conversely, the examination of past scientific practice suggests how the philosophical problem in question can be resolved.

Bokulich focuses on the semantics of the mathematical terms that are employed in physical theories. Her starting point is a well-known philosophical puzzle about the "unreasonable effectiveness of mathematics" in natural science. She comes to terms with this puzzle by offering a rich historical account of Maxwell's ruminations on (and uses of) "the method of physical analogy". Maxwell's methodological musings illuminate how mathematics is interpreted and applied in scientific practice and indicate how analogy can be used as a tool for providing a physical interpretation of mathematical symbols. Bokulich's paper, not unlike Brading's, suggests that the analysis of a contemporary philosophical problem can profit from the historical study of scientists' philosophical reflections on their own practices.

Riordan's paper takes off from philosophical questions about the "natural", "fundamental", or "objective" character of scientific measures. These questions are explored in a historical fashion via two cases: the late 18th century debates about the kilogram and the early 21st century debates about the fundamentality of physical constants. Riordan's historical approach unsettles our philosophical intuitions about what it means for a measure to be natural or for a constant to be fundamental. She shows how the meaning of "natural" and "conventional" has changed over time. In late 18th century France "natural" meant "invulnerable to change". Whereas today we are used to considering the kilogram as a conventional unit, in the late 18th century the kilogram qualified as a natural unit. Furthermore, Riordan discusses a puzzling situation in contemporary physics, involving possible criteria for the fundamentality of physical constants. She revisits these criteria, situating them in a historical perspective. The history of measurement is thus brought to bear on a contemporary scientific and philosophical issue.

The aim of the next two papers, by Charles Pence and Arianna Borrelli, is to illuminate particular historical episodes through a philosophical lens. Pence discusses the use of statistical methods and the introduction of the concept of chance in 19th and early 20th century biology. Employing a question from contemporary philosophy of biology, about the relationship between biological processes and statistical theories, he refines and complements the received history of the introduction of chance in biology. According to the received narrative, the original use of statistical methods in biology was not associated with a belief in objective chance. Some of the main actors in the development of evolutionary theory, Charles Darwin, Francis Galton, and Sewall Wright fit well within this narrative. According to Pence, however, other important actors in that story, namely Karl Pearson and W. F. R. Weldon, had views on causality and probability that cannot be captured by the received view. Rather, according to Pence, they should be read through a different interpretive lens: "*the relationship between biological systems and the statistical theories used to describe them*". This contemporary philosophical issue enables a subtle understanding of the philosophies of statistics entertained by Pearson and Weldon, and thus performs fruitful historiographical work.

Borrelli's paper examines early particle physics through the lens of symmetry, a topic widely discussed in contemporary philosophy of science. She challenges how physicists and philosophers of physics think about the role of symmetries in the practice of physics. The early history of particle physics, according to Borrelli,

[2] The history and contemporary state of HPS are discussed in Howard (2011), Schickore (2011), and Arabatzis and Schickore (2012).

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suggests that symmetry considerations were intertwined with conservation principles and selection rules. The heuristic role of this "triangle" is evident in key contributions to particle physics before and shortly after the Second World War. Thus, Borrelli's paper accomplishes simultaneously two things. First, it fills a lacuna in the historical literature on the role of symmetry in modern physics, which had hitherto been dominated by the retrospective accounts of physicists. Second, it indicates that philosophical accounts of symmetry need to be reconsidered within a broader framework, encompassing conservation principles and selection rules.

The final two papers, by Klodian Coko and Michela Massimi, engage with two towering figures of integrated HPS, Pierre Duhem and Thomas Kuhn. Coko discusses the interplay of history and philosophy of science in Duhem's work and argues that his tenacious opposition to atomism well into his later years had a historical basis. Earlier interpretations of Duhem's anti-atomism portray him either as a dogmatic instrumentalist who rejected the atomic theory for a priori philosophical reasons or as a moderate realist who doubted the existence of atoms because of the severe difficulties faced by atomic theory in the late 19th century. Coko accepts neither of these interpretations. He rejects the former, stressing the historical grounding of Duhem's philosophy of physics. He also challenges the latter, pointing out that by the early 1910s, before Duhem's death, the difficulties of the atomic theory had been overcome without compelling Duhem to accept the existence of atoms. Instead, Coko suggests that Duhem's persistent skepticism towards atoms derived from (and was supported by) his historical studies.

Massimi's paper takes off from Kuhn's (in)famous thesis that the world changes during a scientific revolution. She illustrates Kuhn's thesis by examining the transition from the Aristotelean to the Galilean theory of falling bodies and challenges Kuhn's reading of that episode as involving an abrupt and discontinuous gestalt switch. Drawing upon well-established scholarship on medieval science that had been available to Kuhn, Massimi stresses the elements of continuity that bridge the gap between how medieval scholars and how Galileo saw a falling stone. She then discusses two possible interpretations of Kuhn's thesis: an ontological and a semantic one. She finds the former wanting and defends the latter, articulating it within a Fregean account of meaning and reference. Massimi's interpretation of the world changes thesis neutralizes its prima facie antirealist and constructivist implications. The change of natural kind concepts during a scientific revolution, according to Massimi, does not license a constructivism about facts or entities.

As we look to the future, the papers included in this special issue give us every reason to be optimistic about integrated HPS. As to the &HPS series, it is sustained by a Steering Committee under the leadership of the original co-conveners, Don Howard (Notre Dame) and John Norton (Pittsburgh).

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