Special Issue Introduction: Emerging Prospects for History of the Physical Sciences

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ABBREVIATED TITLE: Emerging Prospects

This special issue of *HSNS* represents the fruits of a series of a conferences hosted by the Center for History of Physics at the American Institute of Physics (AIP).[1] These meetings have brought together early-career scholars, and senior commentators, from fourteen countries and four continents interested in the history of the physical sciences. Convened to address current historiographical and professional issues, these conferences promote dialogue between junior and senior scholars and across topical specialties. More specifically, at a roundtable discussion following the first meeting in July 2011, participants expressed a desire for more conversations across subject matter, methodologies, time periods, and national boundaries in the history of the physical sciences. The goal of this issue is to highlight the possibilities of such dialogue. In

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[1] The first of these convened in July 2011 and was organized around the theme of continuity and discontinuity in the physical sciences. The second, on "Global Science, Global Technology, Global Impacts," met in March and April of 2014. A third conference is planned for summer 2016. For information on these and other Center for History of Physics programs, see: https://www.aip.org/history-programs/physics-history.

particular, we want to emphasize how historians of the physical sciences have begun to respond to escalating concerns about insularity and hyperspecialization. The papers that follow are richly detailed, but each is self-consciously directed towards themes that resonate beyond the specialties they investigate. They demonstrate how historians of the physical sciences are rising to the challenges of a diversifying field by developing strategies to engage broader audiences.

The perceived need to communicate across topical boundaries has motivated these AIP conferences in part because it is a matter of wider historiographical urgency. Considerable attention has been and continues to be directed towards confronting growth, both quantitative and qualitative, and the difficulties that come with it. Concerns include, but are not limited to: fewer permanent faculty positions for recent PhD recipients, increasing specialization, and dwindling readership for more narrowly focused research projects. Questions of dialogue, audience, and broader historiographical relevance headlined the focus section of a 2005 issue of *Isis* and motivated the 2012 *Osiris* volume. The conversation breaks down into a descriptive and a normative component. First, how did the field get this way? Second, what, if anything, should we do about it?

The discussion in *Isis* provides an apt microcosm of the larger conversation. In David Kaiser's words, "balkanization seems more and more the rule of the day."[2] Kaiser identifies changes in the infrastructure and educational mandates of graduate programs across the United

[2] David Kaiser, "Training and the Generalist's Vision in the History of Science," *Isis* 96, no. 2 (2005): 244–51, on 244. Kaiser has continued to emphasize this theme, most recently in David Kaiser, "Booms, Busts, and the World of Ideas: Enrollment Pressures and the Challenge of Specialization," *Osiris* 27 (2012): 276–302.

States that have contributed to the field's fragmentation. The most dramatic of these changes is a population boom—the number of PhDs granted in history of science having ballooned in recent decades.[3] Rapid growth has promoted localized studies within established research areas. Concurrently, deemphasizing "great works" in favor of unpublished archival materials has encouraged microhistorical analyses. A simultaneous shift towards social, cultural, and postmodernist approaches has displaced overarching narrative frameworks. Although subdividing existing research areas, emphasizing small-scale history, and focusing on social and cultural contingencies have enriched our understanding of science, these trends have encouraged highly specialized historical studies. As a consequence, the field has fractured and new scholars have been discouraged from developing general, or even widely applicable, conclusions.[4]

[3] Kaiser, "Generalist's Vision" (ref. 2), on 247–48. Kaiser shows that PhD production in the history of science doubled in each of the two decades preceding 2003. Numbers collected in November 2015, obtained via Kaiser's method of tabulating English language history of science dissertations from the United States and Canada using ProQuest's Dissertations & Theses database (ProQuest uses the subject heading "science history"), show that PhD production in the history of science has plateaued, with output fluctuating around an approximate average of 149 dissertations per year between 2001 and 2014, inclusive. In the short term, however, stabilized PhD production does little to blunt population concerns given the lingering impact of recent growth, a scanty supply of tenure-track positions, and the upward creep of average retirement age.

[4] Ibid.

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Robert Kohler suggests that specialization itself is not so much the problem as the fact that "specialized work seems no longer informed by general themes that other specialists could share."[5] A disproportionate focus on localized problems encourages works that are less accessible at best and irrelevant at worst to the wider history of science community. Kohler observes that curtailing balkanization does not mean discouraging specialist work, which constructively nuances our field.[6] Rather, it involves creating mechanisms that make detailed case studies both tractable and applicable to scholars in other areas. Kohler advocates reframing our narratives in terms of common themes—credibility, trust, expertise, identity, practice, etc.—that can speak to diverse academic audiences across topics and time periods. Many other scholars join Kohler and Kaiser in promoting analyses with wider relevance.[7] They emphasize

[5] Robert Kohler, "A Generalist's Vision," *Isis* 96, no. 2 (2005): 224–29, on 224.

[6] Ibid., 225.

[7] See: Paula Findlen, "The Two Cultures of Scholarship?" *Isis* 96, no. 2 (2005): 230–37; Steven Shapin, "Hyperprofessionalism and the Crisis of Readership in the History of Science," *Isis* 96, no. 2 (2005): 238–243; Jed Z. Buchwald and Allan Franklin, "Introduction: Beyond Disunity and Historicism," in *Wrong for the Right Reasons*, ed. Jed Buchwald and Allan Franklin (Dordrecht: Springer, 2005), 1–16; Babak Ashrafi, "Big History?," in *Positioning the History of Science*, ed. Kostas Gavroglu and Jürgen Renn (Dordrecht: Springer, 2007), 7–11; Josep Simon and Néstor Herran, "Introduction," in Beyond Borders: Fresh Perspectives in History of Science, ed. Simon and Herran (Newcastle, 2008), 1–26; Lorraine Daston, "Science Studies and the History of Science," *Critical Inquiry* 35 (2009): 798–813; Peter Dear and Sheila Jasanoff, "Dismantling Boundaries in Science and Technology Studies," *Isis* 101, no. 4 (2010): 759–74; Peter Dear,

different themes and methods; however, they all urge historians of science to take the audience question seriously and to consciously craft scholarship that resonates beyond narrow sub-specialties.

The question of readership affects historians of the physical sciences with particular acuteness. Physics, for example, once at the center of public discourse about science, no longer occupies an appreciable portion of the popular consciousness.[8] The lack of cultural currency commanded by physics, which it once enjoyed in spades, makes it correspondingly difficult for historians of physics to articulate the relevance of their work, whether to public or professional audiences. It is no accident that the heyday of the history of physics—in terms of the influence it wielded within the history of science community—corresponded with the height of Cold War-powered public approbation of physical research. Analogously, the history of biology, medicine, and technology are exhibiting vigorous growth in an era when the most visible interfaces

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"Science Is Dead; Long Live Science," *Osiris* 27 (2012): 37–55; Robert E. Kohler and Kathryn M. Olesko, "Introduction: Clio Meets Science," *Osiris* 27 (2012): 1–16.

[8] For further discussion of this issue, see John S. Rigden and Roger H. Stuewer, "Has the Media Forgotten Physics?" *Physics in Perspective* 12, no. 3 (2010): 245–47. In addition Richard Staley has provided a detailed, wide-angle discussion of how the historiography of physics has evolved across this shift. Richard Staley, "Trajectories in the History and Historiography of Physics in the Twentieth Century," *History of Science* 51 (2013): 151–77. Staley emphasizes that for historians of physics to articulate their relevance in the current climate, they need to break away from a focus on singular research trajectories and engage with less thoroughly studied elements of the physical sciences.

between science and the public are on issues such as stem cell research, vaccinations, and electronic media. The decreased visibility of physics and its history, however, should not be mistaken for a decline in either's relevance. Rather, historians of physics now have the challenge and the opportunity to fit their work into a much more varied public and professional milieu.[9]

With these considerations in mind, who is our audience? Should we be trying to reach historians of science, scientists, historians, philosophers, other scholars, the public? Historians of physics, especially those who are technically inclined, may find this question uncommonly vexing. Dieter Hoffmann and Christian Joas advocate for a "professional history of physics that studies and contextualizes historical developments in physics—at a technical level attractive to physicists, while also reflecting the state-of-the-art in the history of science and satisfying its

[9] A number of historians of the physical sciences are already rising to this challenge: Spencer Weart has revised his earlier work on cultural responses to nuclear science to accommodate recent developments, such as the expansion of environmental concerns, in *The Rise of Nuclear Fear* (Cambridge, MA: Harvard University Press, 2012); David Kaiser has made ostensibly arcane developments in quantum mechanics accessible to a wide audience in *How the Hippies Saved Physics* (New York: W. W. Norton & Company, 2012); Eric Conway, in collaboration with Naomi Oreskes, provides a simultaneously rigorous and accessible treatment of the politically-charged history of climate science in *Merchants of Doubt* (New York: Bloomsbury Press, 2010); and Alex Wellerstein's Nuclear Secrecy blog demonstrates the potential for electronic media to disseminate historical sources and analysis to new audiences, http://nuclearsecrecy.com/blog/.

methodological standards."[10] This statement highlights a central challenge: addressing the needs of one audience can render the path to others more difficult. Juggling demanding technical content alongside the social and cultural implications of scientific inquiry complicates the task of framing historical conclusions for a diverse readership. Moreover, the "history of physics" is sometimes perceived as insular by scholars in other subfields. Meeting the methodological standards of history, while necessary, might not be sufficient to cultivate an audience among other historians. We contend, in line with Suman Seth's call for a "new intellectual history," that histories of the physical sciences, technical or not, can and should be made accessible and germane to the themes that drive history of science more generally.[11]

As a historiographical category, the "history of the physical sciences" can address some of these challenges. It might seem odd, while arguing for greater dialogue between specialties, to propose yet another way to demarcate them. Nonetheless, we find that grouping the physical sciences promotes, rather than inhibits, cross-specialty conversation, and the papers herein indicate how this is possible. Our intention is not to reify this category, but to show how highlighting interactions among various aspects of the physical sciences—both historically and historiographically—can serve as a basis for an integrated and intellectually valuable discourse.

Skeptics might worry about the extremes to which this category could be taken. This is not an imperialistic move; we have no designs to subsume other subfields under the history of

[10] Dieter Hoffmann and Christian Joas, "'Then and Now' – A New Section Dedicated to the History of Physics," *Annalen der Physik* 524, no. 2 (2012): A25–A26, on A25.

[11] Suman Seth, "The History of Physics after the Cultural Turn," *Historical Studies in the Natural Sciences* 41, no. 1 (2011): 112–22.

physics. Nor do we aim to subordinate the history of physics, chemistry, geology, etc. to a diffuse synthesis. Rather, we follow the spirit of the AIP conferences and look to the "history of the physical sciences" as an umbrella category with two instrumental advantages. First, it is both inclusive and conducive to the conceptual and methodological space necessary for exploring connections between research projects spanning more than one scientific field. Second, it accentuates commonalities between studies grounded in distinct, but related scientific traditions. The papers presented at the AIP have ranged across the history of quantum mechanics, physical chemistry, geophysical studies of aurorae, the politics of space exploration, and the use of scientific instruments in different national contexts. These presentations revealed an array of opportunities for forging connections both within and between various realms of historical and scientific inquiry.[12]

We also find this category useful for the questions it raises. It need not be tied to the professional and institutional barriers that kept historical actors ensconced in one discipline or

[12] Similar recent efforts have also encouraged a broader professional historical and historiographical discourse. The History of Science Society's Physical Sciences Forum met for the first time at the 2012 San Diego meeting. Attendees advocated promoting historical work on the physical sciences, while also bringing its members into close and regular congress with the Society. By emphasizing the physical sciences, we join this and other attempts to pitch a large topical tent that fosters an open and collaborative spirit. These include a H-Net listserv, H-PhysicalSciences, and a push by the American Physical Society's Forum on the History of Physics to sponsor more historical sessions and to generate contact between historians and scientists.

another. Like any categorization, it lumps together certain things while excluding others, leading us to ask what the included items have in common and what sets them apart from other fields of study. At the same time, well-established research traditions benefit from interpretation within a more diverse intellectual context. It challenges historians of physics to rethink what counts as "physics" and/or "physical science" and how these areas of expertise have changed over time. In short, as a self-consciously artificial category, it is not so jealous of its boundaries. Its flexibility highlights connections between similar activities that may otherwise be distinguished by social, professional, temporal, or political barriers, promoting discussion about how concepts and practices migrate across fields of study, regions, and time periods. We intend this category to be a stepping stone to an integrated discourse that builds on and enriches existing historiography. It prompts historians of physics, or chemistry, or oceanography to explore resonances with related subspecialties, fostering themes that can be relevant to the larger historical community.

No single study can simultaneously target every audience for which it might be useful. Instead, by consciously exploring one or two areas of connection, scholars can begin to overcome insularity in aggregate. In this issue we present to the *HSNS* readership four articles that build on the existing literature and transcend specialization by exposing commonalities in seemingly disparate temporal, regional, and topical corners of the history of the physical sciences. These essays are attentive to the nuanced historical problems that specialization brings to light and also engage themes that bridge the boundaries between audiences. Taken together, they exemplify an approach to the history of the physical sciences that can extract a detailed understanding of particular historical episodes while simultaneously addressing widely relevant concerns.

Physical research, like historical research, must navigate several audiences. We are reminded of this crucial, but often underappreciated point by Anna Carlsson-Hyslop, for whom storm surges—sudden changes in sea level caused by winds and/or barometric pressure changes—offer a window into the complex interplay between practice and patronage in mid-twentieth-century Britain. Building on recent historiography investigating patronage networks,[13] Carlsson-Hyslop describes how shifting patterns of research patronage subtly influenced both the meaning of "accuracy" in oceanographic predictions and the methods used to achieve it. She invokes studies of US oceanography, while remaining sensitive to the ways in which the American story could be misleading in the British context, and shows that the success enjoyed by UK storm surge science was predicated on building intricate and evolving networks of sponsorship, which linked interested individuals, local agencies, and the national government. Each patron played a part in forming and shaping the storm surge science's scope and objectives. Carlsson-Hyslop explores the dynamic relationship between science and its patrons that resulted. Along the way, she connects this detailed case study to general issues of how science and society coevolve.

Marta Jordi Taltavull's contribution examines the interplay between the theoretical frameworks and experimental methods that drove investigations into the relationship between light and matter. The long research tradition on optical dispersion transformed in response to changes in late nineteenth and early twentieth-century physics and chemistry. By following a single phenomenon across the classical-quantum divide—and scrutinizing a longer time period,

[13] See: Casper Anderson, Jakob Ben-Thomsen, and Peter C. Kjærgaard, eds. "Focus: Follow the Money: Networks, Peers, and Patronage in the History of Science," *Isis* 103, no. 2 (2012).

broader range of phenomena, and wider geographic area than traditional studies of dispersion—Jordi Taltavull uncovers previously neglected threads of historical continuity that characterized research into optical dispersion. Such continuity is easily obscured when "revolution" becomes the model by which we represent changes in scientific theory and practice, or when professional boundaries and theoretical transitions are viewed as isolating certain kinds of knowledge rather than mediating its circulation and development. Jordi Taltavull investigates these connections, lending support to recent work that challenges the longstanding, often tacit assumption that the theoretical core of quantum mechanics was largely intact before the new theory was applied to complex systems.[14]

Complementing Jordi Taltavull's study of how a stable structure persisted across theoretical and experimental shifts, Axel Petit asks how the evolution and usage of a shared hypothesis bridged the emerging professional divide between physics and chemistry in the late nineteenth century. He describes how the Williamson-Clausius hypothesis of ionic dissociation developed independently in the context of chemical and physical research programs as the two fields were becoming autonomous. Resurrected by Arrhenius and Thomson some three decades later, the hypothesis catalyzed a new synthesis of diverging research traditions. Petit's treatment of emerging and unstable disciplinary cultures, and their influence on the evolution and adoption of a hypothesis, answers recent calls for more sensitive attention to the complex way in which

[14] Christian Joas and Jeremiah James, "Subsequent and Subsidiary? Rethinking the Role of Applications in Establishing Quantum Mechanics," *Historical Studies in the Natural Sciences* 45, no. 5 (2015): 641–702.

disciplines order scientific practice.[15] This contextual analysis of the Williamson-Clausius hypothesis exposes a protean professional landscape and focuses attention on the ways in which twenty-first century disciplinary orthodoxy can obscure the origins and meanings of historical categories.

Through Josep Simon's contribution, pedagogy joins patronage, knowledge transmission, scientific communication, and discipline formation among the general themes examined in this issue. In particular, Simon investigates the historical and historiographical origins of physics through nineteenth-century pedagogical practices. Studying textbooks, lecture notes, and other instructional materials provides insight into science as it forms, not just after it has been codified and/or institutionalized. Analyzing the evolution of research and education is rapidly becoming a powerful method with which to re-assess long-standing questions in the history of science.[16] Simon, harnessing the potential of pedagogical practice as an evaluative tool, contends that our understanding of the emergence of physics as a discipline in the nineteenth-century is mired in twentieth-century national and scientific traditions. Rather than focusing on a specific location or time period, Simon's transnational study of physics education challenges us to rethink the origins

[15] See, for instance, Gregory A. Good, "The Assembly of Geophysics: Scientific Disciplines as Frameworks of Consensus," *Studies in History and Philosophy of Modern Physics* 31, no. 3 (2000): 259–92.

[16] See, for example, Andrew Warwick and David Kaiser, "Kuhn, Foucault, and the Power of Pedagogy," in *Pedagogy and the Practice of Science*, ed. David Kaiser (Cambridge, MA: MIT Press, 2005), 393–410.

of physics as a discipline, and to reflect on how we approach the history of physics in theory and practice.

Each of these authors approaches the historical record with a fresh perspective that contributes to the existing historiography in novel and constructive ways. They share a facility for navigating the complex, often multidisciplinary tides that marked the eras and fields that they study. Their writings also reflect a range of approaches. Carlsson-Hyslop combines institutional history with an appreciation for how patronage networks guided the conceptual and operational development of storm surge research. By focusing on a specific phenomenon, optical dispersion, over multiple decades, Jordi Taltavull constructs a nuanced narrative that uses insights in experimental practice to explain conceptual developments. Similarly, by analyzing one hypothesis and its transit across various scientific and national contexts, Petit demonstrates the flexibility inherent in late nineteenth-century science as chemists and physicists borrowed from each other's scientific canon to develop a better understanding of electrochemical phenomena. Finally, Simon turns our attention to textbooks and critically re-examines our understanding of how physics emerged as a discipline, developing a powerful counter-narrative built on nineteenth-century pedagogical practices. These papers are sensitive to the social and cultural contexts in which these scientists lived and practiced their craft, as well as to the intellectual development of the scientific concepts and experimental methods they employed.

The history of the physical sciences, as a category, provides conceptual space for discussing subjects that border two or more fields of study, as well as for building upon and synthesizing existing historiographical approaches. By analyzing how concepts and practices were used, transformed, and translated by scientists in different fields of study, these papers

illustrate two layers of utility of the history of the physical sciences. First, they reinforce the benefits of eschewing disciplinary biases: sometimes physicists do talk to chemists, and experimentalists do talk to theorists. By analyzing these conversations, whenever and however they may take place, we can gain valuable insight into general questions of conceptual development, consensus, credibility, authority, epistemological standards, evidence evaluation, professionalization, etc. Second, these articles indicate how a historiographical category of intermediate scale can help to bridge the gap between different, but complementary approaches to the history of science. Most central to our aims, they demonstrate how historians of the physical sciences can continue to advance historically nuanced, methodologically sophisticated arguments of relevance to a diverse set of audiences. These papers suggest that historians of the physical sciences are both willing and able to speak to a broader community of readers.

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