HPS&ST NEWSLETTER

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DECEMBER 2020

The HPS&ST NEWSLETTER is emailed monthly to about 8,500 individuals who directly or indirectly have an interest in the contribution of history and philosophy of science to theoretical, curricular and pedagogical issues in science teaching, and/or interests in the promotion of innovative, engaging and effective teaching of the history and philosophy of science. The NEWSLETTER is sent on to different international and national HPS lists and international and national science teaching lists. In print or electronic form, it has been published for 25+ years.

The NEWSLETTER seeks to serve the diverse international community of HPS&ST scholars and teachers by disseminating information about events and publications that connect to concerns of the HPS&ST community.

Contributions to the NEWSLETTER (publications, conferences, opinion pieces, &.) are welcome and should be sent direct to the editor: Michael R. Matthews, UNSW (m.matthews@unsw.edu.au).

The NEWSLETTER, along with RESOURCES, OBITUARIES, OPINION PIECES and more, are available at the website: http://www.hpsst.com/

HPS&ST NEWSLETTER STAFF

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Genetics Education and Social Identity special issue of *Science & Education*

The focus of the Special Issue is the interplay between genetics education and conceptions of social identity (i.e., beliefs about race, gender, sexuality, disability).

The link to the Special Issue is below, along with links to each of the papers published within it.

Link to the Special Issue here.

Introduction to the Special Issue *by Brian Donovan and Ross Nehm*

The Confounding of Race in High School Biology Textbooks, 2014–2019 *by John Willinsky*

From Basic to Humane Genomics Literacy *by Brian Donovan, Monica Weindling and Dennis Lee*

Does Social Constructionist Curricula Both Decrease Essentialist and Increase Nominalist Beliefs About Race? *by John Tawa*

Using Anthropological Principles to Transform the Teaching of Human "Difference" and Genetic Variation in College Classrooms *by Amelia Hubbard and Laura Monnig*

Investigating Conflation of Sex and Gender Language in Student Writing About Genetics *by Molly Stuhlsatz, Zoë Buck Bracey, and Brian Donovan*

Behavioral Genetics, Population Genetics, and Genetic Essentialism *by Alexandre Morin-Chassé*)

Measuring Belief in Genetic Determinism: A Psychometric Evaluation of the PUGGS Instrument *by Robyn Tornabene, Gena Sbeglia, and Ross Nehm*

Teaching the History of Science: *Isis* Vol. 111 No. 3, September 2020

The September 2020 issue of *Isis* (the journal of the U.S. History of Science Society) contains a 62-page, 8-article section on 'Teaching the History of Science'. Each of the articles is available for free download as a pdf file.

Introduction: The Changing Pedagogical Landscapes of History of Science and the "Two Cultures", *Karen Rader*

The History of Chemistry in Chemical Education, *John C. Powers*

In Praise of a Historical Storytelling Approach in Science Education, *Daniel Gamito-Marques*

Crash Course History of Science: Popular Science for General Education? *Allison Marsh & Bethany Johnson*

Bringing History into the Lab: A New Approach to Scientific Learning in General Education, *David Brandon Dennis, R.A. Lawson & Jessica M. Pisano*

Reconstructing Early Modern Artisanal Epistemologies and an "Undisciplined" Mode of Inquiry, *Tianna Helena Uchacz*

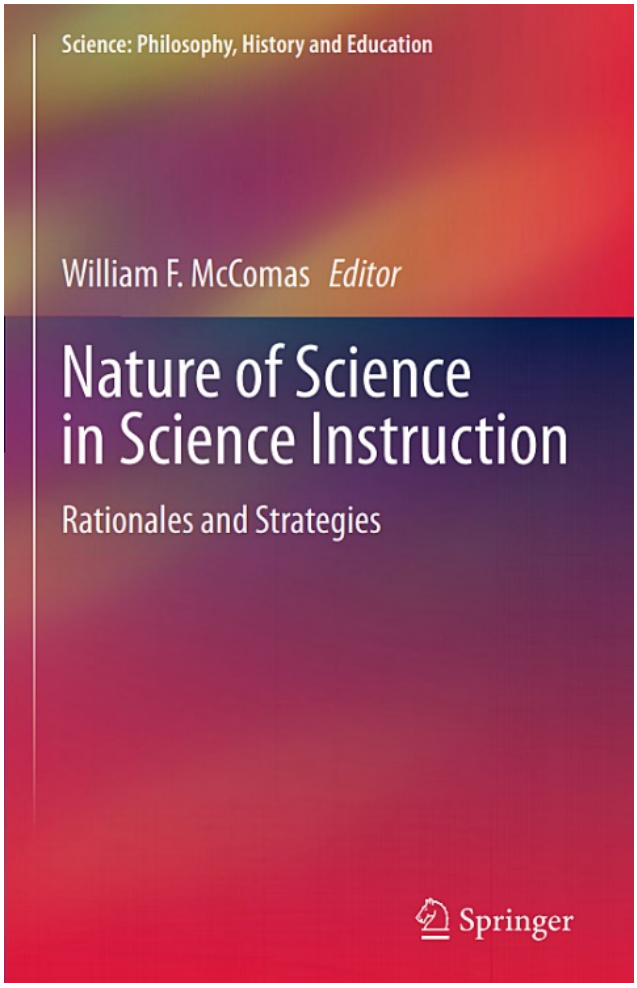
Co-teaching Botany and History: An Interdisciplinary Model for a More Inclusive Curriculum, *Frederica Bowcutt & Tamara Caulkins*

History in the Education of Scientists: Encouraging Judgment and Social Action, *Vivien Hamilton & Daniel M. Stoebel*

Teaching the Nature of Science (NOS) Book

William F. McComas (ed.) *Nature of Science in Science Instruction Rationales and Strategies*, Springer, 2020.

The book has 39 chapters, 735 pages, and 65 contributors from 12 countries (USA, Lebanon, Netherlands, Greece, Sweden, Canada, Israel, Germany, Taiwan, Chile, Turkey, Australia, UK).



The book reflects the most recent thinking in nature of science and features the work of both well-established scholars and those new to the field.

The primary aim of the book is to provide curriculum examples that will move the conversation about nature of science (NOS) instruction from a focus on why we should teach this content and what elements we should include in the science curriculum to the more pressing question of how to teach this interesting but complex topic.

The book provides a complete introduction to the history and purpose of NOS and offers tested strategies for teaching its elements in a variety of instructional settings.

The first section is designed for those new to the topic and examines the why and what of nature of science. The second section focuses on extending that knowledge to include questions of scientific method, theory-laden observation, the role of experiments and observations and distinctions between science, engineering, and technology. The remainder of the book focuses on teaching aspects of NOS in a wide variety of instructional environments.

Full details available here.

Gratis Book Downloads from Springer

Knowledge from a Human Point of View
Ana-Maria Crețu, Michela Massimi in Synthese Library (2020)

Teaching for Excellence and Equity: Analyzing Teacher Characteristics, Behaviors and Student Outcomes with TIMSS
Prof. Nathan Burroughs *et al.* in IEA Research for Education (2019)

Understanding Statistics and Experimental Design: How to Not Lie with Statistics
Prof. Dr. Michael H. Herzog *et al.* in Learning

Materials in Biosciences (2019)

Socioeconomic Inequality and Educational Outcomes: Evidence from Twenty Years of TIMSS Dr. Markus Broer, Yifan Bai *et al.* in IEA Research for Education (2019)

University Education: From Knowledge to Wisdom

Nicholas Maxwell is editing a special issue of the journal *Philosophies* devoted to the theme: "From the Acquisition of Knowledge to the Promotion of Wisdom".

The deadline for submissions is **15 May 2021**. "*Philosophies* has no restrictions on the length of manuscripts, provided that the text is concise and comprehensive." See here for more information.

For specific information, and elaboration of the issue's theme, contact the guest editor:

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Website: www.ucl.ac.uk/from-knowledge-to-wisdom
Publications online: http://philpapers.org/profile/17092

Opinion Piece: *Theories in History and in Practice*, Stephen French

Steven French is Professor of Philosophy of Science at the University of Leeds. He has taught in Brazil and the USA and is the author or co-author of several books and numerous papers, including most recently *The Aesthetics of Science* with Milena Ivanova (Routledge 2020).

Introduction

What is a scientific theory? We can certainly point (figuratively and literally) to any number: the Boveri-Sutton chromosome theory, Ragnar Nurske's balanced growth theory of economics, the molecular orbital theory of molecular structure and of course those old favourites, Newtonian mechanics, Maxwell's Theory of Electromagnetism, the Special Theory of Relativity, quantum theory …the list goes on. But can we characterise or otherwise pin down what a theory *is* in terms that go beyond simply listing examples? One way of answering this question might be to look to the history of science and the practices of scientists themselves. Let's consider the last example in my list, quantum theory.

A Little History of Quantum Physics

As is very well-known, during the mid- to end-1920s there were various alternative theoretical constructions in play, including not only Schrödinger's wave mechanics and Heisenberg's matrix mechanics, of course, but also Dirac's 'general science of non-commuting quantities' and Weyl's group-theoretic approach (see Bueno and French 2018). However, as it turned out, despite Dirac's aversion to the latter, his 'transformational' framework is mathematically the same as Weyl's. And as Schrödinger indicated and von Neumann subsequently demonstrated, the former's mechanics and Heisenberg's are also equivalent (Muller 1997). Now, for many commentators, including physicists as well as philosophers of physics, it is the von Neumann formulation, with its representation of states as vectors (or more generally, rays) in Hilbert space, and observables as operators, that provides *the* theoretical framework 'of' quantum mechanics – question begging alert! – although many, especially physicists themselves, would agree that Dirac's approach, with its 'bra' and 'ket' formalism, offers certain pragmatic advantages.

von Neumann himself was dismissive of Dirac's framework, incorporating as it did the infamous 'delta function' which von Neumann regarded as mathematically self-contradictory (see Bueno and French 2018 Ch. 7). But then he also became dissatisfied with his own Hilbert space formulation, and attempted to delineate an entirely new framework based on a mathematical structure known as continuous geometry. And just as von Neumann criticised Dirac for his lack of rigour, so Weyl admonished advocates of Heisenberg's matrix mechanics as introducing treatments of variables that were 'mathematically unsatisfactory and physically unfeasible' (Scholz 2007), offering his group theoretic approach as a way of yielding 'deeper insight into the true state of affairs' (ibid.).

So, although these different mathematical frameworks can be shown to be interrelated – wave and matrix mechanics are just different representations on Hilbert space; Dirac's transformational account was equivalent to the group-theoretic; the latter yields the Hilbert space formulation via its representations – they embodied different motivations and offered different advantages. In particular, we all know (don't we?!), that Schrödinger was a 'naïve' realist, defending (hopelessly, or so it is typically claimed) a wave-based conception, whereas Heisenberg was – to put it crudely –an equally naïve positivist, focussing on the representation of observable quantities.

Of course, their attitudes and those of Dirac's were more complex than that (Kragh 1990) but even if one felt that such attitudes have more to do with the stance one should take with regard to 'the' theory, rather than how one delineates the latter, the crucial point remains that *the quantum 'revolutionaries' differed with regard to what they took 'the' theory to be and what principles they felt sat at the heart of it*. Thus, for Heisenberg it was wave-particle duality, understood, at least early on, in the context of Bohrian complementarity. Yet, this did not feature at all in Dirac's book, *The Principles of Quantum Mechanics*; rather he emphasised the analogy with classical mechanics afforded by the relationship between Heisenberg's non-commuting products and the Poisson brackets of classical dynamics (Kragh 1990). And as we have noted, von Neumann, who in his *Mathematische Grundlagen der Quantenmechanik* of 1932 undertook to provide quantum mechanics with a secure mathematical foundation, rejected Dirac's framework as insufficiently rigorous.

All of these authors were obviously seeking to disseminate what each thought were the basic precepts of the new theory. As Kragh puts it, with regard to Dirac's *Principles*: 'He wanted to shape a theory which had not yet found its final shape.' (ibid) Which raises the obvious question(s): How and when does a theory get its final 'shape'?

As Kaiser has noted:

> [r]ecent scholarship has highlighted the striking heterogeneity—even cacophony—of competing assumptions, approaches, and interpretations during the early years of quantum theory, even among physicists who worked closely together and whose views had earlier been considered synonymous …Indeed, we might well wonder whether any coherent conceptual trajectory connected, say, Planck's publications in 1900 with Heisenberg's, Born's, Jordan's, Schrödinger's, or Dirac's papers in the mid-1920s. (Kaiser 2013)

You might be inclined to dismiss these contrasts as a more or less natural result of the contestation that always follows a major scientific advance, with different parties pushing their different agendas. However, the issue of how we should delineate 'the' theory has continued to resonate. Certainly, these quick remarks do, at least, indicate that what was taken to be the theoretical content of 'the' theory, or even the extent to which it could be taken to 'have' such content, was disputed from the very beginning of the quantum revolution. And of course this point is sharpened further by the well-known divergences between the different 'interpretations' (so-called) of quantum mechanics, from Bohmian mechanics to the Many Worlds View, from the GRW interpretation to wave function realism (see for example French and Saatsi 2020). If part, at least, of the theoretical content of 'the' theory is expected to be cashed out in stating how the world is, or could be, according to that theory, then these interpretations offer alternative contents and the continuing debate demonstrates that this issue is not confined to the quantum revolution itself, nor its immediate aftermath.

The point, then, is that we need to abandon the idea that the history of the field, or the relevant practices of the scientists in general, supports the claim that there is 'a', or 'the' theory of quantum mechanics, as a unitary and well-delineated entity, with definite identity conditions. This was clearly not the case at the time of the so-called quantum revolution, nor in the immediate aftermath, nor subsequently, if we understand a theory, *qua* entity, as incorporating some claim as to how the world is, or could be.

Quantum Physics is Special

Now you might say that quantum mechanics is somehow a special case and that this point cannot be generalised. Well, we can easily go forward from the quantum revolution and ask the question: what is quantum field theory (QFT)? Is it the axiomatised construction beloved by those who are members of the so-called 'Algebraic QFT' camp? Or is it that which physicists themselves actually use? These are significant questions because QFT is widely lauded as yielding some of the most precise predictions ever made in science and therefore as clearly being worthy, and perhaps more so than other theories, of acceptance by the realist and also because these questions bear on concerns that are important for philosophers of physics and realists alike.

Advocates of Algebraic QFT insist that the only way one can avoid the infamous infinities that plague 'the' theory is by reformulating QFT on an axiomatic basis. The problem is that, as typically

formulated, these axioms do not cover or accommodate interactions and hence if Algebraic QFT is taken to be 'the' theory, it is strictly empirically inadequate. In particular, the axioms do not cover the well-known Standard Model of high-energy physics, recently given a further epistemic boost by the discovery of the Higgs boson. Those who urge philosophers to shift their focus to what physicist actually use in their practice(s) have argued that this – termed 'Lagrangian' or 'naïve' QFT – can be rendered perfectly well-defined and kosher, subject to certain caveats, and, furthermore, that it is, in effect, 'the' QFT that underpins the Standard Model (Wallace 2001).

These two options have been presented as opposing horns of a form of underdetermination, with grounds given for favouring one over the other. Again, what we have here is a dispute over what should be 'the' theory of QFT. To what extent those grounds are decisive is dependent on the weight given to such virtues as consistency, for example, or to the promise of a research programme but the point I want to emphasise here is that both options can be seen as constructions or, better perhaps, representations and that we should not blithely accept that there is a real issue as to which one should count as 'the' theory (Fraser forthcoming).

Still, you might continue to be unimpressed, maintaining that even more so than QM, QFT is still in an indeterminate conceptual state and further work is needed before we can delineate the outlines of the theory itself. So, let's shift 'backwards', in a sense, and ask, 'what is *classical* physics?'

Classical Physics: Lifts, Quilts and Facades

This is the question with which Gooday and Mitchell kick off their historical analysis of the distinction between 'classical' and 'modern' physics (Gooday and Mitchell 2013). They argue that this distinction emerged over a long period of time, extending into the 1930s, and depending on the geographical location considered. And they conclude that classical physics only ever existed in the limited sense that the label was developed and attributed by theoreticians in the early twentieth century '…who sought to preserve a restricted role for established theory and techniques whilst setting forth a future research programme based on new forms of theorizing' (ibid., p. 751). Any reference to 'it' prior to 1900 implicitly adopts '…an anachronistic perspective that was created to legitimize the new foundations for physics proposed within relativity and quantum theory.' (ibid.)

As an antidote to such anachronisms, studies of the relevant continuities can be deployed and presented as 'ironic' rejoinders to Kuhn's claim about the rendering invisible of revolutions by the adherents of the new paradigm: rather than committing a form of patricide, physicists constructed a 'classical' identity for their forebears in order to serve their own interests. Thus, '…the apparent unity of 'classical physics' [should be seen] as the *post hoc* creation of twentieth-century theoretical physicists seeking to consolidate new departures within their discipline.' (ibid., p. 722)

But moving to the particular, what about classical mechanics itself? Surely, you might say, there is no doubt about *its* identity – we simply have to recall and write down Newton's laws and we're done! Setting aside for the moment the whole issue of whether Hamilton's 'formulation' counts as such

or should be considered a distinct theory itself, the form in which these laws were given in the Principia is, of course, very different from how we would write them today. Furthermore, they have been subject to different interpretations that in some cases undermine their status as laws, at least laws as standardly conceived: Poincaré, for example, argued that the first law is a convention; the second has often (perhaps erroneously) been taken to provide the definition of 'force' and the status of the third has been described as 'hazy'. Indeed, as Wilson warns us:

> Classical mechanics is frequently characterized as 'billiard ball mechanics' or 'the theory of mechanism' on the grounds that the science treats its materials in the manner of colliding particles or clockwork. The reader should approach such stereotypes with caution because the basic framework of classical mechanics has long been subject to divergent interpretations that unpack the content of Newton's "three laws" in remarkably different ways. These differing interpretations provide incompatible catalogs of the basic objects that are supposed to comprise the 'classical world' – should they be point masses, rigid bodies or truly flexible substances? (Wilson 1996).

Taking up that last question, as originally stated these laws could not be applied to rigid or deformable bodies, and it was Euler (again) who generalised them, although Euler's laws can also be taken as a distinct set of axioms for the behaviour of such bodies. But the basis of this generalisation is not conceptually straightforward because thinking of rigid bodies or continua as merely 'swarms' of point masses held together by short-scale cohesive bonding cannot serve to underpin the empirical success involved, nor will it help illuminate the various conceptual issues in play (Wilson 2014). In particular, what might be seen as the 'triumphant hegemony' (ibid. p. 103) of classical mechanics owes a great deal to the often hidden contribution of what Wilson terms 'lifts', which are basically devices and manoeuvres that take one between different levels of description, demarcated by different characteristic scale lengths and typically different ontologies.

So consider the example of a steel beam and the shifts involved as we move from the level of the 'bulk' steel, to that of the crystalline grain, and then to that of the molecular lattice and finally to that of point mass atoms bound together. And these lifts may be infected with various dubious presuppositions, such as, and typically, that certain rules and principles applicable at one scale can be exported unproblematically to another.

Thus, the very notion of 'force' alters its significance via such lifts: consider friction, for example, regarded at one level as a straightforward Newtonian force opposing forward motion, but from the perspective of another, this 'force' incorporates the stretching effects that the mass of the object has upon the material, causing it to travel further than is apparent. Another classic example is that of the viscosity of a fluid, typically analysed in terms of the shear 'forces' on units or blocks of fluid that from a foundational perspective are, at best, ontologically ephemeral but essential for the relevant description at the level of fluid mechanics.

Contentiously, perhaps, Wilson claims that axiomatic presentations simply do not accommodate these shifts in ontological perspective and we are left with 'doctrinal holes', the filling in of which raises deep conceptual issues. But more significantly perhaps, these lifts and strategies, devices and moves of various kinds, form a crucial part of the practice of modelling, generating a 'compendium of descriptive lore' in terms of which

classical mechanics is best viewed as a series of descriptive patches, linked together by these very manoeuvres (Wilson 2014, p. 19).

As a result, Wilson urges us to abandon the attempt to impose 'internal conceptual closure' in such cases and instead replace 'theories', as our unit of philosophical interest and as standardly conceived, with 'theory facades', which are quilt-like assemblages that 'look kinda like theories if you don't look at them too closely' (2014; p. 20; 2006). From this perspective, one can better appreciate and understand the kinds of moves we find in textbooks of classical mechanics, for example, as we move up (or down) from one descriptive level to another and also the kinds of conceptual shifts associated with such moves.

Conclusion

What should we make of all this? If we just take classical mechanics, Wilson's description of the relevant practices in terms of Frankensteinian 'theory façades', consisting of patches and lifts, holes and ladders, moves and manoeuvres of various kinds, all cobbled and bolted together, undermines any account that takes these practices to be 'about' the theory regarded as a clearly delineated thing with well-defined identity conditions. The similarly brief reflection on the history of quantum physics likewise raises concerns for such accounts. Certainly those who take theories to be 'things', in some sense, perhaps 'living' in some abstract realm or 'World 3', as Popper famously thought, face apparently insuperable obstacles in squaring such a view with these histories and the practices of scientists themselves.

These vignettes thus cast doubt on the idea that scientific practices, as represented in the history of science, or, I also argue, textbooks and the like, or scientists' reminiscences …demonstrate or indicate in some way that there *really* are theories 'out there' and as a result, following this train of thought, that philosophers of science should, indeed, come up with an ontology of theories that reflects these practices.

As I've tried to suggest, these practices are complex, overlapping and, in some cases, entangled. It is simply not clear how we should delineate classical physics from quantum physics, for example, or what counts as the relevant theory in either case. We can shift our terminology to 'theory façades' or 'frameworks' but those terms obscure the diversity and the complexity of what scientists do and come up with. Best, I would suggest, to drop the idea that they come up with something, that then lives in some Popperian realm, say, and accept that what we are presented with in the histories and the textbooks and the reminiscences is no more than a kind of construction for which certain features of the relevant practices have been emphasised and highlighted for all sorts of different purposes. In other words, we should accept that *there are no such things as theories* (French 2020).

Now, we can still make claims such as 'quantum mechanics is empirically supported' but what makes that claim true is not some feature of an abstract thing, 'the' theory of quantum mechanics; rather it is the set of relevant practices, both theoretical and empirical. Perhaps even more interestingly, shifting to these practices as the 'truth makers' of such claims also affords a new understanding of statements such as 'quantum mechanics is beautiful', for example. Taking this to attribute a quality to the theory conceived as a thing then takes us into the whole morass of issues regarding whether such aesthetic qualities are epi-

stemically significant or not. If instead we take it to be made true by certain practices, that morass can be neatly sidestepped.

Finally, and even more broadly, such a move motivates a novel perspective on how we should see our own practices as historians and philosophers of science. Consider the on-going debate within the philosophy of science between the adherents of the so-called 'Syntactic' and 'Semantic' Approaches, about whether theories should be taken to be axiomatised sets of sentences or families of models. Both sides assume that there is something 'out there', *the* theory, that is better represented in formal terms one way or the other. However, from my perspective that assumption should be discarded and instead the debate should be recast in terms of which framework better suits *our* practices as philosophers of science, where these practices and their attendant aims may differ depending on which features of *scientific* practice we are concerned with. Although scientists' reflections on their own practice may lead them to present a certain 'formulation', for want of a better word, as the theory of their given field, we should be wary of falling into the same trap – what we are engaged in is not *representation* so much as *presentation*, in this case of a certain characterisation, whether formal or not, that we claim then enables us to better understand those scientific practices.

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Recent HPS&ST Research Articles

Science & Education (Volume 29, issue 6, December 2020)
Special Issue: Genetics and Identity
Issue editors: Brian Donovan & Ross Nehm
https://link.springer.com/journal/11191/volumes-and-issues/29-6

HOPOS: The Journal of the International Society for the History of Philosophy of Science (Volume 10, Number 1)
Special Issue: Descriptive Psychology and Völkerpsychologie - in the Contexts of Historicism, Relativism, and Naturalism
Editors: Christian Damböck, Uljana Feest, and Martin Kusch

Archila, P.A., Molina, J., Danies, G. et al. (2020). Providing Undergraduates with Opportunit-

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Saribas, D., Çetinkaya, E. (2020). Pre-Service Teachers' Analysis of Claims About COVID-19 in an Online Course. *Science & Education*, 1-32. doi:10.1007/s11191-020-00181-z online first

Shi, X. (2020). Using Explicit Teaching of Philosophy to Promote Understanding of the Nature of Science. *Science & Education*, 1-32. doi:10.1007/s11191-020-00173-z online first

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Recent HPS&ST Related Books

Akerson, Valarie L., Buck, Gayle (Eds.) (2020). *Critical Questions in STEMEducation*. Dordrecht: Springer. ISBN: 978-3-030-57646-2

"This edited volume offers a crosscutting view of STEM and is comprised of work by scholars in science, technology, engineering, and mathematics education. It offers a view of STEM from the disciplines that comprise it, while adhering to the idea that STEM itself is an interdisciplinary treatment of all the associated disciplines in a meaningful way.

This book raises and answers questions regarding the meaning of STEM education and research.

"This volume is divided into three sections: the first one describes the nature of the component disciplines of STEM. The next section presents work from leaders representing all STEM disciplines and deals with aspects such as K-12 and post-secondary education. The last section draws conclusions regarding the natures of the disciplines, challenges and advantages of STEM education in terms of theoretical and practical implications. The two final chapters compile arguments from the research chapters, describing themes in research results, and making recommendations for best STEMeducation practice, and examining areas for future research in STEM education." (From the Publisher)

More information available here.

Anastopoulos, Charis (2020). *Particle or Wave: The Evolution of the Concept of Matter in Modern Physics*. Princeton, NJ: Princeton University Press. ISBN: 978-0-691-22249-3

"*Particle or Wave* is the first popular-level book to explain the origins and development of modern physical concepts about matter and the controversies surrounding them. The dichotomy between particle and wave reflects a dispute — whether the universe's most elementary building blocks are discrete or continuous in nature — originating in antiquity when philosophers first speculated about the makeup of the physical world. Charis Anastopoulos examines two of the earliest known theories about matter — the atomic theory, which attributed all physical phenomena to atoms and their motion in the void, and the theory of the elements, which described matter as consisting of the substances earth, air, fire, and water. He then leads readers up through the ages to the very frontiers of modern physics to reveal how these seemingly contradictory ideas still lie at the heart of today's continuing debates.

"Anastopoulos explores the revolutionary contributions of thinkers like Nicolas Copernicus, Isaac Newton, and Albert Einstein. He shows how Einstein's ideas about relativity unify opposing concepts by identifying matter with energy, and how quantum mechanics goes even further by postulating the coexistence of the particle and the wave descriptions. Anastopoulos surveys the latest advances in physics on the fundamental structure of matter, including the theories of quantum fields and elementary particles, and new cutting-edge ideas about the unification of all forces. This book reveals how the apparent contradictions of particle and wave reflect very different ways of understanding the physical world, and how they are pushing modern science to the threshold of new discoveries." (From the Publisher)

More information available here.

Campbell, John (2020). *Causation in Psychology*. Cambridge, MA: Harvard University Press. ISBN: 978-0-674-96786-1

"I found this book highly engaging. The parts about Karl Jaspers and social robots are packed with insights that will make you nod and smile. Campbell argues that singular causation in the mind cannot be analysed in terms of general causation, but instead is brought to light by human practices that rely on our imaginative understanding of 'the ballistics of people's thoughts and feelings.' These practices include attempts to reach legal verdicts beyond a reasonable doubt about people's motives. The book is accessible, it discusses a range of long-standing philosophical problems about action and interpretation, and no one will drown in technical details. It's simply fantastic." — Susanna Siegel, Harvard University

"There is a simplicity and directness with which John Campbell introduces and pursues material that has become cluttered and blocked in much philosophical discussion that has lost sight of the fundamental problems motivating such discussion in the first place. *Causation in Psychology* offers genuine, true solutions that should change the philosophical landscape for good. A fascinating, deeply original book." — Bill Brewer, King's College London

More information available here.

Chrisomalis, Stephen (2020). *Reckonings: Numerals, Cognition, and History*. Cambridge, MA: The MIT Press. ISBN: 978-0-262-04463-9

"Over the past 5,000 years, more than 100 methods of numerical notation—distinct ways of writing numbers—have been developed and used by specific communities. Most of these are barely known today; where they are known, they are often derided as cognitively cumbersome and outdated. In Reckonings, Stephen Chrisomalis considers how humans past and present have used numerals, reinterpreting historical and archaeological representations of numerical notation and exploring the implications of why we write numbers with figures rather than words.

"Chrisomalis shows that numeration is a social practice. He argues that written numerals are conceptual tools that are transformed to fit the perceived needs of their users, and that the sorts of cognitive processes that affect decision-making around numerical activity are complex and involve social factors. Drawing on the triple meaning of reckon—to think, to calculate, and to judge—as a framing device, Chrisomalis argues that the history of numeral systems is best considered as a cognitive history of language, writing, mathematics, and technology.

"Chrisomalis offers seven interlinked essays that are both macro-historical and cross-cultural, with a particular focus, throughout, on Roman numerals. Countering the common narrative that Roman numerals are archaic and clumsy, Chrisomalis presents examples of Roman numeral use in classical, medieval, and early modern contexts. Readers will think more deeply about written numbers as a cognitive technology that each of us uses every single day, and will question the assumption that whatever happened historically was destined to have happened, leading inevitably to the present." (From the Publisher)

More information available here.

Cifarelli, Luisa, Simili, Raffaella (Eds.) (2020). *Laura Bassi–The World's First Woman Professor in Natural Philosophy: An Iconic Physicist in Enlightenment Italy*. Dordrecht: Springer.
ISBN: 978-3-030-53961-0

"This book provides a fascinating insight into the life and scientific work of Laura Bassi, the first female member of the influential Academy of Sciences of the Institute of Bologna and also the first woman to be appointed a university professor in physics, or universal philosophy as it was then termed. The book describes Laura Bassi's research activities and achievements, explaining the influence of Newton, her role in promoting Newtonian experimental physics in Bologna, and her work as an experimentalist, including on electricity. Much attention is paid to the context in which Bassi developed her career. The very considerable difficulties faced by a woman surrounded by male university teachers and members of the Academy are discussed, casting light on the constraints that led Bassi to set up the first experimental physics laboratory in her home, complete with the many instruments required for experimentation and private

teaching. The aim is to provide a rounded and well-documented account of the scientific endeavours and achievements of a too often overlooked scientist who struggled to overcome the prejudices of her age." (From the Publisher)

More information available here.

Dora, Veronica Della (2020). *The Mantle of the Earth: Genealogies of a Geographical Metaphor*. Chicago, IL: The Chicago University Press. ISBN: 978-0-226-74132-1

"The term mantle has inspired philosophers, geographers, and theologians and shaped artists' and mapmakers' visual vocabularies for thousands of years. According to Veronica della Dora, mantle is the "metaphor par excellence, for it unfolds between the seen and the unseen as a threshold and as a point of tension." Featuring numerous illustrations, *The Mantle of the Earth: Genealogies of a Geographical Metaphor* is an intellectual history of the term mantle and its metaphorical representation in art and literature, geography and cartography. Through the history of this metaphor from antiquity to the modern day, we learn about shifting perceptions and representations of global space, about our planetary condition, and about the nature of geography itself." (From the Publisher)

"*The Mantle of the Earth* is an exceptional book. Thoroughly researched, endlessly interesting, and beautifully written, it takes a notion that seems straightforward and explores it in multiple insightful and productive ways. Its breadth is quite extraordinary. Della Dora also wears her learning lightly, until you start looking at the notes, which are staggeringly erudite. Fabulous." – Stuart Elden, University of Warwick, author of *The Birth of Territory*, *Shakespearean Territories*, and *Canguilhem*

More information available here.

Durand, Pierre M. (2020). *The Evolutionary Origins of Life and Death*. Chicago, IL: The Chicago University Press. ISBN: 978-0-226-74762-0

"The question of why an individual would actively kill itself has long been an evolutionary mystery. Pierre M. Durand's ambitious book answers this question through close inspection of life and death in the earliest cellular life. As Durand shows us, cell death is a fascinating lens through which to examine the interconnectedness, in evolutionary terms, of life and death. It is a truism to note that one does not exist without the other, but just how does this play out in evolutionary history?

"These two processes have been studied from philosophical, theoretical, experimental, and genomic angles, but no one has yet integrated the information from these various disciplines. In this work, Durand synthesises cellular studies of life and death looking at the origin of life and the evolutionary significance of programmed cellular death. The exciting and unexpected outcome of Durand's analysis is the realisation that life and death exhibit features of coevolution. The evolution of more complex cellular life depended on the coadaptation between traits that promote life and those that promote death. In an ironic twist, it becomes clear that, in many circumstances, programmed cell death is essential for sustaining life." (From the Publisher)

More information available here.

İhsanoğlu, Ekmeleddin (2020). *Studies on Ottoman Science and Culture*. Abingdon, UK: Routledge. ISBN: 978-0-367-63660-9

"The book addresses multiple issues related to the histories of science and culture during the Ottoman era. Most of the articles contained in this volume were the first contributions to their respective topics, and they continue to provoke discussion

and debate amongst academics to this day. The first volume of the author's collected papers that appeared in the *Variorum Collected Studies* (2004) dispelled the negative opinions towards Ottoman science asserted by scholars of the previous generation. In this new volume, the author continues to explore and develop the paradigm of scientific activities and cultural interactions both within and beyond the Ottoman Empire. One of the topics examined is the attitude of Islamic scholars towards revolutionary notions in Western science, including Copernican heliocentrism and Darwin's theory of evolution.

"This book will appeal to scholars and students of Ottoman history, as well as those interested in the history of science and cultural history." (From the Publisher)

More information available here.

Jewett, Andrew (2020). *Science under Fire: Challenges to Scientific Authority in Modern America*. Cambridge, MA: Harvard University Press.
ISBN: 978-0-674-98791-3

"Erudite and truly original. Jewett explains why so many cultural leaders came to deplore the increasing incursions of science into the realm of values, especially after World War II. A pioneering book." — Ronald L. Numbers, author of *The Creationists*

"Americans today are often skeptical of scientific authority. Many conservatives dismiss climate change and Darwinism as liberal fictions, arguing that "tenured radicals" have coopted the sciences and other disciplines. Some progressives, especially in the universities, worry that science's celebration of objectivity and neutrality masks its attachment to Eurocentric and patriarchal values. As we grapple with the implications of climate change and revolutions in fields from biotechnology to robotics to computing, it is crucial to understand how scientific authority functions—and where it has run up against political and cultural barriers.

"*Science under Fire* reconstructs a century of battles over the cultural implications of science in the United States. Andrew Jewett reveals a persistent current of criticism which maintains that scientists have injected faulty social philosophies into the nation's bloodstream under the cover of neutrality. This charge of corruption has taken many forms and appeared among critics with a wide range of social, political, and theological views, but common to all is the argument that an ideologically compromised science has produced an array of social ills. Jewett shows that this suspicion of science has been a major force in American politics and culture by tracking its development, varied expressions, and potent consequences since the 1920s.

"Looking at today's battles over science, Jewett argues that citizens and leaders must steer a course between, on the one hand, the naïve image of science as a pristine, value-neutral form of knowledge, and, on the other, the assumption that scientists' claims are merely ideologies masquerading as truths." (From the Publisher)

More information available here.

Kojevnikov, Alexei (2020). *The Copenhagen Network: The Birth of Quantum Mechanics from a Postdoctoral Perspective*. Dordrecht: Springer.
ISBN: 978-3-030-59187-8

"This book is a historical analysis of the quantum mechanical revolution and the emergence of a new discipline from the perspective, not of a professor, but of a recent or actual Ph.D. student just embarking on an uncertain academic career in economically hard times. Quantum mechanics exploded on to the intellectual scene between 1925 and 1927, with more than 200 publications across the world, the majority of them authored by young scientists under the age of 30, graduate students or postdoctoral fellows. The resulting theory was a collective product that no single authority could claim, but

it had a major geographical nod – the Copenhagen Institute of Theoretical Physics – where most of the informal, pre-published exchange of ideas occurred and where every participant of the new community aspired to visit. A rare combination of circumstances and resources – political, diplomatic, financial, and intellectual – allowed Niels Bohr to establish this "Mecca" of quantum theory outside of traditional and more powerful centres of science. Transitory international postdoctoral fellows, rather than established professors, developed a culture of research that became the source of major innovations in the field. Temporary assistantships, postdoctoral positions, and their equivalents were the chief mode of existence for young academics during the period of economic crisis and post-WWI international tensions. Insecure career trajectories and unpredictable moves through non-stable temporary positions contributed to their general outlook and interpretations of the emerging theory of quantum mechanics.

"This book is part of a four-volume collection addressing the beginnings of quantum physics research at the major European centres of Göttingen, Copenhagen, Berlin, and Munich; these works emerged from an expansive study on the quantum revolution as a major transformation of physical knowledge undertaken by the Max Planck Institute for the History of Science and the Fritz Haber Institute (2006–2012)." (From the Publisher)

More information available here.

Matlin, Karl S., Maienschein, Jane, & Ankeny, Rachel A. (Eds.) (2020). *Why Study Biology by the Sea?* Chicago, IL: The Chicago University Press. ISBN: 978-0-226-67276-2

"For almost a century and a half, biologists have gone to the seashore to study life. The oceans contain rich biodiversity, and organisms at the intersection of sea and shore provide a plentiful sampling for research into a variety of questions at the laboratory bench: How does life develop and how does it function? How are organisms that look different related, and what role does the environment play?

"From the Stazione Zoologica in Naples to the Marine Biological Laboratory in Woods Hole, the Amoy Station in China, or the Misaki Station in Japan, students and researchers at seaside research stations have long visited the ocean to investigate life at all stages of development and to convene discussions of biological discoveries. Exploring the history and current reasons for study by the sea, this book examines key people, institutions, research projects, organisms selected for study, and competing theories and interpretations of discoveries, and it considers different ways of understanding research, such as through research repertoires. A celebration of coastal marine research, *Why Study Biology by the Sea?* reveals why scientists have moved from the beach to the lab bench and back." (From the Publisher)

"Marine biology and marine science in general are increasingly relevant in an age of global climate change. This book is unique in also dealing with these subjects from a historical and philosophical perspective, which provides new insights and approaches to the various epistemic issues that arise regarding the scientific work itself. The authors are all outstanding and well-recognised scholars, and the volume is not only interesting reading but also an important contribution to preserving the marine environment and the institutions (marine biological stations) devoted to studying it." – Garland E. Allen, Washington University in St. Louis

More information available here.

Miscevic, Nenad (2020). *Curiosity as an Epistemic Virtue*. London, UK: Palgrave Macmillan ISBN: 978-3-030-57103-0

"This book explores curiosity from a normative epi-

stemological viewpoint. Taking into account recent developments in the psychology of curiosity, as well as research on the nature and motivation of scientific inquiry, Miščević identifies curiosity as a positive and vital character trait. Key topics covered include:

- Curiosity as a subject in the history of philosophy
- Curiosity as a possible ethical virtue
- The importance of curiosity about oneself
- Whether curiosity is good in itself or only as a means to an end (e.g. in the pursuit of truth).

"The book begins with a brief historical overview, before turning to the nature of curiosity from both a psychological and philosophical viewpoint. Curiosity is revealed as a crucial instrument in the advancement of science and wisdom, as well as within the wider picture of meaningful human life. Miščević skilfully defends the idea that curiosity motivates and organises our cognitive abilities, playing the central role in our cognitive lives." (From the Publisher)

More information available here.

Prothero, Donald R. (2020). *The Story of Evolution in 25 Discoveries: The Evidence and the People Who Found It*. New York, NY: Columbia University Press. ISBN: 978-0-231-19036-7

"The theory of evolution unites the past, present, and future of living things. It puts humanity's place in the universe into necessary perspective. Despite a history of controversy, the evidence for evolution continues to accumulate as a result of many separate strands of amazing scientific sleuthing.

"In *The Story of Evolution in 25 Discoveries*, Donald R. Prothero explores the most fascinating breakthroughs in piecing together the evidence for evolution. In twenty-five vignettes, he recounts the dramatic stories of the people who made crucial discoveries, placing each moment in the context of what it represented for the progress of science. He tackles topics like what it means to see evolution in action and what the many transitional fossils show us about evolution, following figures from Darwin to lesser-known researchers as they unlock the mysteries of the fossil record, the earth, and the universe. The book also features the stories of animal species strange and familiar, including humans—and our ties to some of our closest relatives and more distant cousins. Prothero's wide-ranging tales showcase awe-inspiring and bizarre aspects of nature and the powerful insights they give us into the way that life works.

"Brisk and entertaining while firmly grounded in fundamental science, The Story of Evolution in 25 Discoveries is a captivating read for anyone curious about the evidence for evolution and what it means for humanity." (From the Publisher)

More information available here.

Rampling, Jennifer M. (2020). *The Experimental Fire: Inventing English Alchemy, 1300-1700*. Chicago, IL: The Chicago University Press. ISBN: 978-0-226-71070-9

"This book has so many novel elements that it is difficult to know where to begin. Rampling presents one amazing archival discovery after another like a magician pulling rabbits from a hat. Forging vivid and compelling narratives with her materials, while remaining keenly aware of the living history behind the documents, she has been able to sketch the outlines of what has previously been entirely unknown to the history of alchemy. This is a fully achieved piece of research that is destined to become the key work in the field." – Stephen Clucas, Birkbeck, University of London

"Rampling offers a masterful survey of alchemy in England, from its status as the largest scientific genre circa 1400 through the patronage of Henry VIII and Elizabeth I. Building on the legacy of George Ripley, English alchemists developed expert skills in textual interpretation and experimental practice—focused on both medicine and transmutation—in order to portray themselves as philosophers rather than artisans. Rampling writes with admirable lucidity about cryptic manuscripts, colourful figures, and complicated archival evidence." – Ann M. Blair, Carl H. Pforzheimer University Professor, Harvard University

"This is an extraordinary and important piece of scholarship. Rampling carries the reader from the first origins of alchemy in Medieval England, through the Reformation, and down to the end of the seventeenth century—a remarkable temporal sweep. There has not previously been a study of the alchemical tradition that so thoroughly follows a coherently framed national context for so long a period. Rampling presents the material in a remarkably clear and concise fashion that does justice to its complexity yet still guides the reader." – Lawrence M. Principe, author of *The Transmutations of Chymistry: Wilhelm Homberg and the Académie Royale des Sciences*

More information available here.

Yacoubian, Hagop A., Hansson, Lena (Eds.) (2020). *Nature of Science for Social Justice*. Dordrecht: Springer. ISBN: 978-3-030-47260-3

"This edited volume brings closer two contemporary science education research areas: Nature of Science (NOS) and Social Justice (SJ). It starts a dialogue on the characteristics of NOS for SJ with the purpose of advancing the existing discussion and creating new avenues for research. Using a variety of approaches and perspectives, the authors of the different chapters engage in a dialogue on the construct of NOS for SJ, its characteristics, as well as ways of addressing it in science classrooms. Issues addressed are related to why a school science aiming at SJ should address NOS; what NOS-related content, skills and attitudes form the basis when aiming at SJ; and how school science can address NOS for SJ. Through a set of theoretical and empirical chapters, the authors suggest answers, but they also pose new questions on what NOS for SJ can mean, and what issues need to be taken into consideration in future research and practice." (From the Publishers)

More information available here.

Authors of HPS&ST-related papers and books are invited to bring them to attention of Paulo Maurício or Nathan Oseroff-Spicer for inclusion in these sections.

Coming HPS&ST Related Conferences

July 4-8, 2021, IHPST 16th International Conference, University of Calgary, Canada
Details from Glenn Dolphin:
glenn.dolphin@ucalgary.ca.
POSTPONED TO JULY 3-7, 2022

July 11-16, 2021, Biennial meeting of the International Society for the History, Philosophy, and Social Studies of Biology, Milwaukee, WI
Details available here.

July 19-23, 2021 'Objects of Understanding: Historical Perspectives on Material Artefacts in Science Education' will take place at the Europa-Universität Flensburg (Germany)
Details: Roland Wittje, roland.wittje@gmail.com and here.

July 25-31, 2021, 26th International Congress of History of Science and Technology (DHST), Prague. (WEB CONFERENCE)
Information: https://www.ichst2021.org/

September 20-22, 2021, 'Developing Mario Bunge's Scientific-Philosophical Programme', Huaguang Academy of Information Science, Wuhan, China
Details from Zongrong LI 2320129239@qq.com.

July 24-29, 2023, 17th DLMPST Congress, University of Buenos Aires Information: Pablo Lorenzano, pablo@unq.edu.ar.

HPS&ST Related Organisations and Websites

IUHPST – International Union of History, Philosophy, Science, and Technology

DLMPST – Division of Logic, Mathematics, Philosophy, Science, and Technology

DHST – Division of History, Science, and Technology

IHPST – International History, Philosophy, and Science Teaching Group

NARST – National Association for Research in Science Teaching

ESERA – European Science Education Research Association

ASERA – Australasian Science Education Research Association

ICASE – International Council of Associations for Science Education

UNESCO – Education

HSS – History of Science Society

ESHS – European Society for the History of Science

AHA – American History Association

ISHEASTME – International Society for the History of East Asian History of Science Technology and Medicine

BSHS – British Society for History of Science

EPSA – European Philosophy of Science Association

AAHPSSS - The Australasian Association for the History, Philosophy, and Social Studies of Science

HOPOS – International Society for the History of Philosophy of Science

PSA – Philosophy of Science Association

BSPS – The British Society for the Philosophy of Science

SPSP – The Society for Philosophy of Science in Practice

ISHPSB – The International Society for the History, Philosophy, and Social Studies of Biology

PES – The Philosophy of Education Society (USA)

The above list is updated and kept on the HPS&ST website HERE.

HPS&ST-related organisations wishing their web page to be added to the list should contact assistant editor Paulo Maurício (paulo.asterix@gmail.com)

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