HPS&ST NEWSLETTER

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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, &c.) 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/

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CONTENTS

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

Teaching the Nature of Science (NOS) Book 3

IUHPST Essay Prize in History and Philosophy of Science 4

University Education: From Knowledge to Wisdom 5

Opinion Piece: Time to heed the alarm raised 35 years ago over a continuing failure in science learning, Ibrahim A. Halloun 5

Recent HPS&ST Research Articles . . 11

Recent HPS&ST Related Books . . . 12

Coming HPS&ST Related Conferences 18

HPS&ST Related Organisations and Websites 19

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*

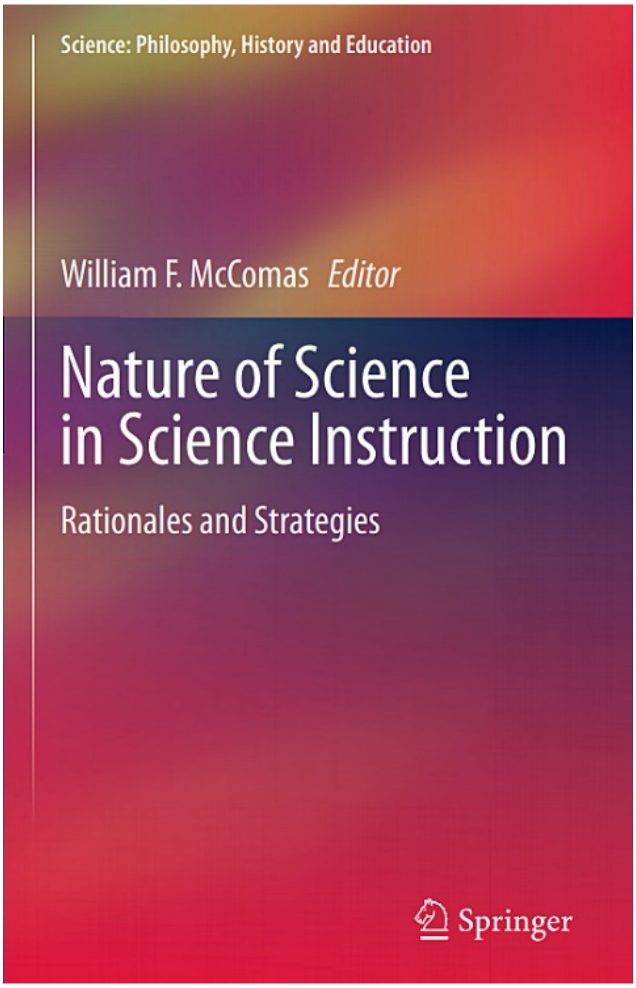
Co-teaching Botany and History: An Interdisciplinary Model for a More Inclusive Curriculum, *Frederica Bowcutt & Tamara Caulkins*

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.

IUHPST Essay Prize in History and Philosophy of Science

The International Union of History and Philosophy of Science and Technology (IUHPST) invites submissions for the 2021 IUHPST Essay Prize in History and Philosophy of Science. This biennial prize competition seeks to encourage fresh methodological thinking on the history and philosophy of science and related areas.

Entries in the form of an essay of 5,000–10,000 words in English are invited, addressing this year's prize question:

What can history and philosophy of science, technology and medicine contribute to our current global challenges?

What constitutes a current global challenge is left to the judgment of the authors, but examples include the coronavirus pandemic, climate change, socioeconomic inequality, racism, the refugee crisis, and science denialism.

All entries should consist of original work that has not previously been published. Entries written originally in another language should be submitted in English translation, along with the name and contact details of the translator. Entries will be judged on the following criteria, in addition to general academic quality: direct engagement with the prize question, effective integration of historical and philosophical perspectives, and potential to provide methodological guidance for other researchers in the field.

The author of the winning entry will be invited to present the work at the 26th International Congress of History of Science and Technology (ICHST) to be held in Prague, Czechia, 25–31 July 2021. Presenting at the Congress will be a condition of the award.

The award will carry a cash prize of $1,000 and a waiver of the Congress registration fee.

Other strong entries will also be considered for presentation at the Congress. In order to ensure this consideration, entrants should submit the entry also as a standalone paper abstract for the Congress by the deadline for that, following the standard instructions indicated on the Congress website here.

Entries are invited from anyone, without restriction of age, nationality or academic status. Co-authored work will be considered; if the winning entry is a co-authored work the cash prize will be shared out among the authors.

This prize is administered by the Joint Commission of the IUHPST, whose remit is to make links between the work of the two Divisions of the IUHPST: the DHST (Division of History of Science and Technology) and the DLMPST (Division of Logic, Methodology and Philosophy of Science and Technology). For further information about IUHPST, see: http://iuhps.net

Entries for the prize competition should be submitted in pdf format by e-mail to the Chair of the Joint Commission, Prof. Hasok Chang, Department of History and Philosophy of Science, University of Cambridge (hc372@cam.ac.uk). Any queries should also be directed to him.

The deadline for submission is **15 January 2021**.

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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Opinion Piece: Time to heed the alarm raised 35 years ago over a continuing failure in science learning, Ibrahim A. Halloun

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[1] Halloun, I., & Hestenes, D. (1985). The initial knowledge state of college physics students. *American Journal of Physics*, 53 (11), 1043–1055.

Halloun, I., & Hestenes, D. (1985). Common sense concepts about motion. *American Journal of Physics*, 53 (11), 1056–1065.

The two articles became the 1985 *Most Memorable Articles* of the *American Journal of Physics*. *AJP*. (1993). 61 (2), Thirty-five years ago, we published two complementary articles[1] in the *American Journal of Physics* about the *Mechanics Diagnostic Test* (MDT) originally developed as part of my PhD dissertation at Arizona State University (ASU) on model-based instruction of Newtonian theory:

Four major results came out of administering MDT to high school and college students:

1. Students come to their physics courses with common sense (CS) beliefs about the motion of physical objects that are at odds with Newtonian theory.

2. These beliefs, often labelled as naive, lay, or folk beliefs or conceptions, misconceptions, or alternative conceptions, are deeply rooted in students' minds as part of their overall CS paradigms, and common modes of science instruction do very little to subdue these beliefs and paradigms.

3. CS paradigms govern students' cognitive processes and prevent them from meaningful learning of scientific theory and thus from correct interpretation of real world systems and phenomena.

4. Students may successfully pass course exams by reproducing course materials they learned by rote and retained by heart in their short-term memory. The same students often fail drastically on the same exams given awhile later, indicating that assimilated science materials either did not make their way to student long-term memory (LTM) or, if they did, these materials are being inhibited from activation by CS paradigms that are tenaciously sustained in student LTM.

103–105.

Other diagnostic tests and inventories were developed before and after MDT in physics and other scientific fields all coming, until the present day, to results similar to the ones indicated above in the respective fields. In fact, student beliefs about physical systems and phenomena that are at odds with scientific theory have plagued science education for ages almost like a terminal cognitive pandemic. These beliefs can, and must, be understood within the framework of ordinary people common sense (CS) paradigms. According to such naturally predominant paradigms, and among other things, the reality of physical systems and phenomena is exposed directly to our senses, and thus most ordinary people believe that the Sun turns around the Earth because this is the way it appears to us.

About four centuries ago, Galileo Galilei, the father of modern science, taught us that this is far from being true and that direct human perception is often deceiving. Thus, in order to understand the universe, we have to transcend our perceptions and imagine how the world could actually exist in a way that is not exposed directly to our senses. As such, we can then realise that the Earth turns around the Sun and not the other way around. In this and many other respects, scientific paradigms are counterintuitive, which makes it hard to let them prevail over CS paradigms in students' minds without resolute and purposeful efforts in this direction in formal education beginning at an early age.

Traditional science curricula that work primarily on conveying specific aspects of scientific theory – often haphazardly selected – cannot help students achieve such prevalence, not to mention a Galilean paradigm shift. That is why calls have reverberated, and efforts been deployed within the educational community for decades now to change course, but unfortunately often to no avail. Changes brought about in the desired direction by a given group or individual have been hardly sustained, if any, and rarely reproduced at the same level of success by concerned others. Looking at the broad spectrum of high school and college students, researchers keep getting results similar to the ones we published 35 years ago, with no systemic reform producing desired large scale changes. Our experience suggests that, no matter how gloomy the situation may actually look, there are effective ways to turn things around and bring the so far obstinate cognitive pandemic of CS paradigms under control.

MDT was originally developed not for its own sake, but as part of a battery of instruments designed to ascertain the efficiency of a modelling pedagogical framework that I first conceived at ASU for my PhD dissertation[2], and continued developing afterwards in collaboration with colleagues at ASU and elsewhere. From start, development of the modelling framework went along two complementary directions that any pedagogical framework needs to address and that we will hereafter refer to as academic and cognitive dimensions addressing respectively "what" and "how" to teach and learn, first in physics and then in science3.

The academic dimension needs to reveal in every possible detail what a given discipline like physics (or field like science) is about, how its episteme is organised, and how professionals in that discipline go about setting and achieving their goals. In this respect, we defined scientific models and modelling processes and transformed them from conceptual tools and research methodology for scientists to describe and explain patterns in the structure and/or behaviour of physical realities (real world systems and phenomena) to pedagogical means for students to understand such realities meaningfully and answer questions and solve problems about them successfully and creatively. Under the modelling pedagogical framework3, we thus hold that:

1. science is primarily about the description and explanation of patterns in the structure and behaviour of physical systems;
2. scientific episteme consists of scientific theories, with each theory organised around a limited number of conceptual models representing in specific respects particular real world patterns;
3. scientists construct, corroborate, and deploy conceptual models systemically and systematically to reliably interpret physical realities (describe and explain respective patterns) and deal with them creatively and innovatively (infer their past and predict their future, control and change their states, and invent related artefacts); scientific models and modelling allow for a coherent big picture and efficient knowledge transfer within and among different scientific disciplines, and for efficient and practical convergence between these and non-scientific disciplines;
4. any science curriculum should thus be primarily about scientific models and modelling, and any science course should be organised explicitly around a small set of models that show well enough how the respective scientific theory serves its function at a level that matches students' cognitive potentials.

The cognitive dimension needs to prescribe, based on reliable research in cognitive science and neuroscience, how students may achieve meaningful

[2] Halloun, I., & Hestenes, D. (1987). Modeling instruction in mechanics. *American Journal of Physics*, 55 (5), 455–462.

understanding of the academic perspective above and develop their paradigms and profiles to reasonable levels. In this respect, we devised the modelling cycle as a comprehensive methodology of experiential learning for model construction and deployment and insightful regulation of student common sense conceptions and practices. More specifically, under the modelling pedagogical framework[3]:

1. students are engaged, individually and in groups, in experiential learning cycles for model construction and deployment (modelling cycles);

2. students rely on a systemic schema, a generic template for constructing any conception (concepts and relations among concepts) in any field, to construct any scientific model and spell out, under a specific framework (scientific theory), and in accordance with a well-defined taxonomy of learning outcomes, (i) the scope of the model (what pattern it represents and what it describes and/or explains about this pattern and model referents, i.e., physical realities manifesting the pattern), (ii) its constitution (what entities make up the model and its environment and how these entities interact and affect the model structure), and (iii) its performance (how and why the model works, or its referents behave, and what are the outcomes);

3. students deploy a generic, systemic scheme for model construction and deployment, including all sorts of problem solving;

4. students are constantly engaged in insightful dialectics for revealing and resolving any issue within their own paradigms, in correspondence to the real world and in commensurability with scientific paradigms;

5. teachers plan efficient modelling cycles, with each cycle dedicated to student construction and deployment of one particular scientific model under teacher mediation involving Socratic dialogues and timely intervention tailored to students' individual needs.

Colleagues and student teachers have been implementing the modelling pedagogical framework for over thirty years at the college and pre-college levels. Through systematic comparative evaluation of these teachers' and their students' performance, we have been able to identify a number of factors that are critical for any pedagogical framework, and not only the modelling framework, to succeed making scientific paradigms prevail over CS paradigms in students' long-term memory (LTM).

The success in question is primarily determined by the nature of, and relative adherence to, the pedagogical framework under which a curriculum and related courses are designed and implemented. Any curriculum, and thus any course at any educational level, must be designed and implemented under a well-defined pedagogical framework that addresses evenly and explicitly both academic and cognitive dimensions. Missing or playing down any dimension in any respect in course design or implementation prevent students from developing meaningful and sustainable scientific knowledge that prevails over CS beliefs and paradigms in their LTM.

Epistemic and methodological idiosyncrasy and fragmentation are major persistent flaws in stu-

[3] Halloun, I. (2001). *Apprentissage par Modélisation: La Physique Intelligible*. Beyrouth, Liban : Phoenix series/ Librairie du Liban.
Halloun, I. (2004/2006). *Modeling Theory in Science Education*. Dordrecht, NL: Kluwer/ Springer.

dent knowledge before and after science instruction. Students fail to develop a coherent conceptual picture of science and fail to deploy scientific knowledge consistently and systematically across similar and different contexts. They are thus incapable to transfer what they assimilate in class within and across courses. Scientific models and modelling processes readily allow for convergence within all scientific fields and disciplines. As conceptual systems representing real world patterns in the structure and/or behaviour of physical systems, scientific models also allow for convergence with non-scientific fields and disciplines. This would especially be the case when curricula outside science are conceived under systemic pedagogical frameworks that emphasise the importance of physical and conceptual systems of all nature in developing a meaningful and productive picture of the real world and the conceptual realm of professionals in all fields.

To succeed meeting their ends, any pedagogical framework and any curriculum should have reasonable expectations about both students and teachers so that both groups may willingly, constructively, and efficiently achieve what is expected of them. Curriculum developers and teachers should be well aware of what students can actually achieve, and how they can feasibly do so, at specific points of instruction, given their natural cognitive state and their educational background. They should especially know how neuro-cognitive maturity determines learning, somewhat in the Piagetian sense, and how learning can determine neuro-cognitive growth, somewhat in the Vygotskian sense. Cognitive science and especially neuroscience are indispensable in this respect.

Meanwhile, curriculum developers, teacher education institutions, and education authorities and administrators should all have reasonable expectations of what teachers can achieve with their students given, among others, their professional background and the state of the entire ecology in which they are working, including the state of their students, available resources, and workload and compensation.

Finally, teachers have to be trained and treated as professionals, and they have to carry out their mission as such. Once in-service, teachers cannot, and should not, be left on their own. Appropriate systems, platforms, and mechanisms should be in place to continuously monitor students and teachers, provide timely support for teachers in need, and ensure efficient sharing of best practices (through some sort of "communities of practice" like professional learning communities) and continuous professional development for all teachers. Moreover, teachers and all other stakeholders must constantly be supported to heed and meet any challenge that may arise, including unprecedented qualifications and needs that could eventually emerge in the job market and various aspects of life and that education must prepare students for.

The modelling pedagogical framework is not a traditional didactic framework for lecture and demonstration about scientific bits and pieces. It is about teacher-mediated student development of meaningful and productive model-based scientific theory and paradigm, including generic means and methods for insightful and regulatory knowledge development, and thus for helping students (and teachers!) transcend their CS paradigms. Teachers need intense clinical training to master and efficiently deploy such a framework, including continuous workshops and support while in service. Our experience suggests that teachers can do significantly better and be more at ease if: (a) the framework is part of their pre-service education at the undergraduate and graduate levels, and (b) curricula they implement are conceived in this framework or another framework that can accommodate, or be adapted to, modelling tenets and principles in both academic and cognitive respects.

Common sense beliefs revealed by MDT and similar inventories are not held by students about specific physical systems and phenomena in isolation of other thoughts and practices. These beliefs stem from overall CS paradigms that govern everything students and other ordinary people think about, and do with, physical realities. Counterpart, scientific paradigms are largely counterintuitive and hard to consider and develop without formal education under appropriate pedagogical frameworks that take into consideration the state of mind of both students and scientists. The modelling pedagogical framework is such a framework, and it has proven viable in over thirty years of practice and continuous development at the college and pre-college levels. With proper training and support, understanding and appreciation of concerned authorities (!), and under appropriate frameworks like the modelling framework, teachers can heed resolutely the alarm we raised 35 years ago and tame down students' CS paradigms to the extent of having scientific paradigms prevail meaningfully in their long-term memory.

These matters and more are elaborated in the expanded version of this paper available here and here.

Invitation to Submit Opinion Piece

In order to make better educational use of the wide geographical and disciplinary reach of this HPS&ST NEWSLETTER, invitations are extended for readers to contribute opinion or position pieces or suggestions about any aspect of the past, present or future of HPS&ST studies.

Contributions can be sent direct to Michael Matthews or Nathan Oseroff-Spicer.

Ideally, they might be pieces that are already on the web, in which case a few paragraphs introduction, with link to web site can be sent, or else the pieces will be put on the web with a link given in the NEWSLETTER.

They will be archived in the OPINION folder at the HPS&ST web site: `http://www.hpsst.com/`.

PhD Theses in HPS&ST Domain

The HPS&ST NEWSLETTER is the ideal medium for publicising and making known submitted and awarded doctoral theses in the HPS&ST domain.

The following details should be submitted to the editor at m.matthews@unsw.edu.au:

- Candidate's name and email
- Institution
- Supervisor
- Thesis title
- Abstract of 100-300 words
- Web link when theses are required to be submitted for open search on web.

Recent HPS&ST Research Articles

Amery, F. (2020). An attempt to trace illusions to their physical causes: Atmospheric mirages and the performance of their demystification in the 1820s and 1830s. *The British Journal for the History of Science*, 1-25. doi:10.1017/S0007087420000369

Dong, H. (2020). Hobbes's model of refraction and derivation of the sine law. *Arch. Hist. Exact Sci.* doi:10.1007/s00407-020-00265-w online first

Donovan, B. M. et.al. (2020.) Genomics literacy matters: Supporting the development of genomics literacy through genetics education could reduce the prevalence of genetic essentialism. *Journal of Research in Science Teaching*. doi:10.1002/tea.21670 online first

Forgione, F. (2020). Evolution as a Solution: Franco Andrea Bonelli, Lamarck, and the Origin of Man in Early-Nineteenth-Century Italy. *Journal of the History of Biology*, 1-28. doi:10.1007/s10739-020-09617-2 online first

Gandolfi, H. E. (2020). "It's a lot of people in different places working on many ideas": Possibilities from global history of science to Learning about nature of science. *Journal of Research in Science Teaching*, 1-38. doi:10.1002/tea.21671 online first

Hubbard, A.R., Monnig, L.A. (2020). Using Anthropological Principles to Transform the Teaching of Human "Difference" and Genetic Variation in College Classrooms. *Science & Education*, 1-25. doi:10.1007/s11191-020-00164-0 online first

Li, X., Wang, W. (2020). Exploring Spatial Cognitive Process Among STEM Students and Its Role in STEM Education: A Cognitive Neuroscience Perspective. *Science & Education*, 1-25. doi:10.1007/s11191-020-00167-x online first

Ma, Xi (2020) Mineral and mineralogy in late Qing China: translations and conceptualizations, 1860s–1910s. *Annals of Science*. doi:10.1080/00033790.2020.1833082

Meiring, H-J. (2020) Thomas Robert Malthus, naturalist of the mind. *Annals of Science*. doi:10.1080/00033790.2020.1823479 online first

Murphy, M. A. (2020). Early Industrial Roots of Green Chemistry - II: International "Pollution Prevention" Efforts During the 1970's and 1980's. *Substantia*, 4(2). doi:10.13128/Substantia-894

Raveendran, A. (2020). Invoking the political in socioscientific issues: A study of Indian students' discussions on commercial surrogacy. *Science Education*, 1-37. doi:10.1002/sce.21601 online first

Reith, M., & Nehring, A. (2020) Scientific reasoning and views on the nature of scientific inquiry: testing a new framework to understand and model epistemic cognition in science. *International Journal of Science Education*. doi:10.1080/09500693.2020.1834168 online first

Ren, X., Wang, X., Jin, X. et al. (2020). The Impact of Personal Moral Philosophies on the Safe Practice of Students in Chemistry and Related Majors. *Science & Education*, 1-14. doi:10.1007/s11191-020-00165-z online first

Smithson, R. (2020). Non-Humean Laws

and Scientific Practice. *Erkenntnis*, 1-25. doi:10.1007/s10670-020-00330-4 online first

Soysal, Y. (2020). Talking Science: Argument-Based Inquiry, Teachers' Talk Moves, and Students' Critical Thinking in the Classroom. *Science & Education*, 1-33. doi:10.1007/s11191-020-00163-1 online first

Toma, R.B., Lederman, N.G. (2020). A Comprehensive Review of Instruments Measuring Attitudes Toward Science. *Research in Science Education*, 1-16. doi:10.1007/s11165-020-09967-1 online first

Ward, Z. B. (2020). On value-laden science. *Studies in History and Philosophy of Science Part A*. doi:10.1016/j.shpsa.2020.09.006 online first

Wei, B., Wang, Y. (2020). The Presentation of Science Practice in Twenty Historical Cases: A Content Analysis of a Popular Science Book. *Science & Education*, 1-16. doi:10.1007/s11191-020-00172-0 online first

Recent HPS&ST Related Books

Andrei, Mary Anne (2020). *Nature's Mirror: How Taxidermists Shaped America's Natural History Museums and Saved Endangered Species*. Chicago, IL: The University of Chicago Press.
ISBN: 978-0-226-73045-5

"It may be surprising to us now, but the taxidermists who filled the museums, zoos, and aquaria of the twentieth century were also among the first to become aware of the devastating effects of careless human interaction with the natural world.

"Witnessing firsthand the decimation caused by hide hunters, commercial feather collectors, whalers, big game hunters, and poachers, these museum taxidermists recognised the existential threat to critically endangered species and the urgent need to protect them. The compelling exhibits they created–as well as the scientific field work, popular writing, and lobbying they undertook–established a vital leadership role in the early conservation movement for American museums that persists to this day.

"Through their individual research expeditions and collective efforts to arouse demand for environmental protections, this remarkable cohort–including William T. Hornaday, Carl E. Akeley, and several lesser-known colleagues–created our popular understanding of the animal world and its fragile habitats. For generations of museum visitors, they turned the glass of an exhibition case into a window on nature–and a mirror in which to reflect on our responsibility for its conservation." (From the Publisher)

More information available here.

Bangham, Jenny (2020). *Blood Relations: Transfusion and the Making of Human Genetics*. Chicago, IL: The University of Chicago Press.
ISBN: 978-0-226-74003-4

"Blood is messy, dangerous, and charged with meaning. By following it as it circulates through people and institutions, Jenny Bangham explores the intimate connections between the early infrastructures of blood transfusion and the development of human genetics. Focusing on mid-twentieth-century Britain, Blood Relations connects histories of eugenics to the local politics of giving blood, showing how the exchange of blood carved out networks that made human populations into objects of medical surveillance and scientific research.

Bangham reveals how biology was transformed by two world wars, how scientists have worked to define racial categories, and how the practices and rhetoric of public health made genetics into a human science. Today, genetics is a powerful authority on human health and identity, and *Blood Relations* helps us understand how this authority was achieved." (From the Publisher)

"Bangham tells a stunningly original story: how the science of human blood groups evolved in Britain, from its uses in the transfusion services in World War II through its transformation by the 1960s into a powerful enabler of human population genetics. She exploits a rich trove of archival sources to detail the system of labelling, description, record-keeping, and analysis devised by the leaders of London's blood research centres: R. A. Fisher, Ruth Sanger, and Arthur Mourant. This is, in all, a great feast of a book." – Daniel J. Kevles, professor emeritus of history, Yale University

"In this masterful study, Bangham sheds new light on the history of human genetics. Looking beyond eugenics, she shows how much human genetics owed to the development of blood transfusion in mid-twentieth century Britain. To tell her riveting story, she brings in a fascinating set of characters including donors, nurses, needle sharpeners, and clerks. Bangham argues convincingly that the state infrastructure put in place on the eve of World War II was essential in producing the collections of blood and data on which depended the rise of the new science." – Bruno J. Strasser, author of *Collecting Experiments: Making Big Data Biology*

More information available here.

Brown, Matthew J. (2020). *Science and Moral Imagination: A New Ideal for Values in Science*. Pittsburgh, PA: University of Pittsburgh Press.
ISBN: 978-0-822-94626-7

"The idea that science is or should be value-free, and that values are or should be formed independently of science, has been under fire by philosophers of science for decades. Science and Moral Imagination directly challenges the idea that science and values cannot and should not influence each other. Matthew J. Brown argues that science and values mutually influence and implicate one another, that the influence of values on science is pervasive and must be responsibly managed, and that science can and should have an influence on our values. This interplay, he explains, must be guided by accounts of scientific inquiry and value judgment that are sensitive to the complexities of their interactions. Brown presents scientific inquiry and value judgment as types of problem-solving practices and provides a new framework for thinking about how we might ethically evaluate episodes and decisions in science, while offering guidance for scientific practitioners and institutions about how they can incorporate value judgments into their work. His framework, dubbed "the ideal of moral imagination," emphasises the role of imagination in value judgment and the positive role that value judgment plays in science." (From the Publisher)

"Finally, a book that grapples in detail with the really hard, central questions concerning values and science–the nature, sources, kinds, and cognitive status of nonepistemic values, how they stack up against epistemic values, how conflicts among these nonepistemic values are to be resolved, and so on. *Science and Moral Imagination* will be a winner among students and professionals alike, from the sciences as well as science studies." – Janet Kourany, University of Notre Dame

"Citing the pervasiveness of choice and contingency throughout the research process, Brown cuts through misunderstandings to offer a welcome new account of values, one that suggests a new type of responsibility that is aimed at avoiding failures of moral imagination in scientific inquiry. *Science and Moral Imagination* provides a refreshingly pragmatic approach to the urgent question of how to manage values in science." – Erik Fisher, Arizona State University

More information available here.

Canales, Jimena (2020). *Bedeviled: A Shadow History of Demons in Science*. Princeton, NJ: Princeton University Press. ISBN: 978-0-691-17532-4

“Science may be known for banishing the demons of superstition from the modern world. Yet just as the demon-haunted world was being exorcized by the enlightening power of reason, a new kind of demon mischievously materialised in the scientific imagination itself. Scientists began to employ hypothetical beings to perform certain roles in thought experiments–experiments that can only be done in the imagination–and these impish assistants helped scientists achieve major breakthroughs that pushed forward the frontiers of science and technology.

“Spanning four centuries of discovery–from René Descartes, whose demon could hijack sensorial reality, to James Clerk Maxwell, whose molecular-sized demon deftly broke the second law of thermodynamics, to Darwin, Einstein, Feynman, and beyond–Jimena Canales tells a shadow history of science and the demons that bedevil it. She reveals how the greatest scientific thinkers used demons to explore problems, test the limits of what is possible, and better understand nature. Their imaginary familiars helped unlock the secrets of entropy, heredity, relativity, quantum mechanics, and other scientific wonders–and continue to inspire breakthroughs in the realms of computer science, artificial intelligence, and economics today.

!The world may no longer be haunted as it once was, but the demons of the scientific imagination are alive and well, continuing to play a vital role in scientists’ efforts to explore the unknown and make the impossible real.” (From the Publisher)

”Hovering between the human and the divine, the thought experiment and whimsy, the demons of science do an impressive amount of conceptual work, as Jimena Canales shows in her wide-ranging, readable book. By hunting down the demons of physics, biology, economics, and other sciences, Canales writes a new history of modern science from a fresh and imaginative viewpoint.” – Lorraine Daston, director emerita, Max Planck Institute for the History of Science in Berlin

”In this terrific book, Jimena Canales shows how demons expose the fault lines of our scientific understanding. Maxwell’s demon, Descartes’s demon, Searle’s demon–for centuries these preternatural thought-guides have stood for the articulated contradictions that provoke radical innovation. In flowing and engaging prose, Canales tackles arenas ranging from thermodynamics and relativity to biology, AI, and economics, bringing us a thoroughly original history of scientific demonology in which science, paradox, and the imagination cross.” – Peter Galison, Harvard University

More information available here.

Friederich, S. (2020). *Multiverse Theories: A Philosophical Perspective*. Cambridge: Cambridge University Press. ISBN: 978-1-108-76594-7

“If the laws of nature are fine-tuned for life, can we infer other universes with different laws? How could we even test such a theory without empirical access to those distant places? Can we believe in the multiverse of the Everett interpretation of quantum theory or in the reality of other possible worlds, as advocated by philosopher David Lewis? At the intersection of physics and philosophy of science, this book outlines the philosophical challenge to theoretical physics in a measured, well-grounded manner. The origin of multiverse theories are explored within the context of the fine-tuning problem and a systematic comparison between the various different multiverse models are included. Cosmologists, high energy physicists, and philosophers including graduate students and researchers will find a systematic exploration of such questions in this important book.” (From the publisher)

More information available here.

Okasha, Samir (2020). *Agents and Goals in Evolution* [Paperback]. Oxford, UK: Oxford University Press. ISBN: 978-0-192-89443-4

"Samir Okasha approaches evolutionary biology from a philosophical perspective in *Agents and Goals in Evolution*, analysing a mode of thinking in biology called agential thinking. He considers how the paradigm case involves treating an evolved organism as if it were an agent pursuing a goal, such as survival or reproduction, and seeing its phenotypic traits as strategies for achieving that goal or furthering its biological interests.

"As agential thinking deliberately transposes a set of concepts–goals, interests, strategies–from rational human agents and to the biological world more generally, Okasha's enquiry firstly looks at the justification for this: is it mere anthropomorphism, or does it play a genuine intellectual role in the science? From this central question, key points are considered such as: how do we identify the 'goal' that evolved organisms will behave as if they are trying to achieve? Can agential thinking ever be applied to groups rather than to individual organisms? And how does agential thinking relate to the controversies over fitness-maximisation in evolutionary biology?

"In addition, Okasha examines the relation between the adaptive and the rational by considering whether organisms can validly be treated as agent-like. Should we expect their evolved behaviour to correspond with that of rational agents as codified in the theory of rational choice? If so, does this mean that the fitness-maximising paradigm of the evolutionary biologist can be mapped directly to the utility-maximising paradigm of the rational choice theorist? All of these important questions are engagingly raised and discussed at length." (From the Publisher)

More information available here.

Oldstone, Michael B. A. (2020). *Viruses, Plagues, and History: Past, Present, and Future* (Second Edition). Oxford, UK: Oxford University Press. ISBN: 978-0-190-05678-0

"More people were killed by smallpox during the twentieth century–over 300 million–than by all of the wars of that period combined. In 1918 and 1919, influenza virus claimed over 50 million lives. A century later, influenza is poised to return, ongoing plagues of HIV/AIDS and hepatitis infect millions, and Ebola, Zika, and West Nile viruses cause new concern and panic.

"The overlapping histories of humans and viruses are ancient. Earliest cities became both the cradle of civilisation and breeding grounds for the first viral epidemics. This overlap is the focus of virologist/immunologist Michael Oldstone in Viruses, Plagues and History. Oldstone explains principles of viruses and epidemics while recounting stories of viruses and their impact on human history. This fully updated second edition includes engrossing new chapters on hepatitis, Zika, and contemporary threats such as the possible return of a catastrophic influenza, and the impact of fear of autism on vaccination efforts. This is a fascinating panorama of humankind's longstanding conflict with unseen viral enemies, both human successes–such as control of poliomyelitis, measles, smallpox and yellow fever, and continued dangers–such as HIV and Ebola. Impeccably researched and accessibly written, Viruses, Plagues and History will fascinate all with an interest in how viral illnesses alter the course of human history." (From the publisher)

More information available here.

Pearce, Trevor (2020). *Pragmatism's Evolution: Organism and Environment in American Philo-*

sophy. Chicago, IL: The University of Chicago Press. ISBN: 978-0-226-71988-7

"In *Pragmatism's Evolution*, Trevor Pearce demonstrates that the philosophical tradition of pragmatism owes an enormous debt to specific biological debates in the late 1800s, especially those concerning the role of the environment in development and evolution. Many are familiar with John Dewey's 1909 assertion that evolutionary ideas overturned two thousand years of philosophy–but what exactly happened in the fifty years prior to Dewey's claim? What form did evolutionary ideas take? When and how were they received by American philosophers?

"Although the various thinkers associated with pragmatism–from Charles Sanders Peirce to Jane Addams and beyond–were towering figures in American intellectual life, few realise the full extent of their engagement with the life sciences. In his analysis, Pearce focuses on a series of debates in biology from 1860 to 1910–from the instincts of honeybees to the inheritance of acquired characteristics–in which the pragmatists were active participants. If we want to understand the pragmatists and their influence, Pearce argues, we need to understand the relationship between pragmatism and biology." (From the Publisher)

"This book is an important contribution to the history of philosophical discussion of biology. I do not know of any other book that covers the material so thoroughly. It will be invaluable to anyone interested in the history of pragmatism and the influence of biology and evolution on pragmatic thinkers." – Richard J. Bernstein, The New School for Social Research

"Pearce's book adds a welcome new dimension to discussion of the history of pragmatism. His treatment of the movement's early years includes an expanded range of characters, some of them fascinating but neglected, others who are recognised as leading figures but not usually linked to pragmatist philosophy. Pearce also shows the influence on pragmatism of an unruly, speculative, and rich collection of ideas about biological evolution and historical change. The book is meticulously researched, very well written, and full of surprises." – Peter Godfrey-Smith, author of *Theory and Reality: An Introduction to the Philosophy of Science*

More information available here.

Piccinini, Gualtiero (2020). *Neurocognitive Mechanisms: Explaining Biological Cognition*. Oxford, UK: Oxford University Press.
ISBN: 978-0-198-86628-2

"In *Neurocognitive Mechanisms* Gualtiero Piccinini presents the most systematic, rigorous, and comprehensive philosophical defence to date of the computational theory of cognition. His view posits that cognition involves neural computation within multilevel neurocognitive mechanisms, and includes novel ideas about ontology, functions, neural representation, neural computation, and consciousness. He begins by defending an ontologically egalitarian account of composition and realisation, according to which all levels are equally real. He then explicates multiple realisability and mechanisms within this ontologically egalitarian framework, defends a goal-contribution account of teleological functions, and defends a mechanistic version of functionalism. This provides the foundation for a mechanistic account of computation, which in turn clarifies the ways in which the computational theory of cognition is a multilevel mechanistic theory supported by contemporary cognitive neuroscience.

"Piccinini argues that cognition is computational at least in a generic sense. He defends the computational theory of cognition from standard objections, yet also rebuts putative a priori arguments. He contends that the typical vehicles of neural computations are representations, and that, contrary to the received view, the representations posited by the computational theory of cognition are observable and manipulatable in the laboratory. He also contends that neural computations are neither digital nor analog; instead, neural computations are *sui generis*. He concludes by investigating the relation between computation and consciousness, suggesting that consciousness may be a functional phenomenon without being computational in nature. This book will be of interest to philosophers of cognitive science as well as neuroscientists." (From the Publisher)

More information available here.

Salmon, Wesley C. (2020). *Scientific Explanation and the Causal Structure of the World*. [eBook]. Princeton, NJ: Princeton University Press.
ISBN: 978-0-691-22148-9

"The philosophical theory of scientific explanation proposed here involves a radically new treatment of causality that accords with the pervasively statistical character of contemporary science. Wesley C. Salmon describes three fundamental conceptions of scientific explanation – the epistemic, modal, and ontic. He argues that the prevailing view (a version of the epistemic conception) is untenable and that the modal conception is scientifically out-dated. Significantly revising aspects of his earlier work, he defends a causal/mechanical theory that is a version of the ontic conception.

"Professor Salmon's theory furnishes a robust argument for scientific realism akin to the argument that convinced twentieth-century physical scientists of the existence of atoms and molecules. To do justice to such notions as irreducibly statistical laws and statistical explanation, he offers a novel account of physical randomness. The transition from the "reviewed view" of scientific explanation (that explanations are arguments) to the causal/mechanical model requires fundamental rethinking of basic explanatory concepts." (From the Publisher)

More information available here.

Vermij, Rienk (2020). *Thinking on Earthquakes in Early Modern Europe: Firm Beliefs on Shaky Ground*. Abingdon, UK: Routledge.
ISBN: 978-0-367-49218-2

"This book is the first extensive study of ideas on earthquakes before the Lisbon earthquake in 1755. The earthquake had a deep impact on European culture, and the reactions to it stood in a long tradition that, before this study, had yet to be explored in detail.

"*Thinking on Earthquakes* investigates both scholarly theories and views that were propagated among the early modern European population. Through a chronological approach, Vermij reveals that in contrast to the Ancient and medieval philosophers who suggested rational explanations for earthquakes, supernatural ideas made a powerful comeback in the sixteenth century. By analysing a variety of sources such as pamphlets, sermons, and treatises, this study shows how changes in the ideas on earthquakes were a result of social and political demands as well as from improvements in the means of communication, rather than from scientific methods. Thus, Vermij presents an illuminating case for the production of knowledge in early modern Europe.

"A range of events are explored, including the Ferrara earthquake in 1570 and the Vienna earthquake in 1590, making this study an invaluable source for students and scholars of the history of science and the history of ideas in early modern Europe." (From the Publisher)

More information available here.

Vertesi, Janet (2020). *Shaping Science: Organizations, Decisions, and Culture on NASA's Teams*. Chicago, IL: The University of Chicago Press.
ISBN: 978-0-226-69108-4

"In *Shaping Science*, Janet Vertesi draws on a decade of immersive ethnography with NASA's robotic spacecraft teams to create a comparative account of two great space missions of the early 2000s. Although these missions featured robotic explorers on the frontiers of the solar system bravely investigating new worlds, their commands were issued from millions of miles away by a very human team. By examining the two teams' formal structures, decision-making techniques, and informal work practices in the day-to-day process of mission planning, Vertesi shows just how deeply entangled a team's local organisational context is with the knowledge they produce about other worlds.

"Using extensive, embedded experiences on two NASA spacecraft teams, this is the first book to apply organisational studies of work to the laboratory environment in order to analyse the production of scientific knowledge itself. Engaging and deeply researched, Shaping Science demonstrates the significant influence that the social organisation of a scientific team can have on the practices of that team and the results they yield." (from the Publisher)

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

December 11-12, 2020, 'History, Philosophy and Sociology of School Biology', on-line and in-person ISHPSSB symposium, Dublin City University
Details available here.

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

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
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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