HPS&ST Newsletter
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Introduction

The HPS&ST Newsletter is sent monthly to about 10,300 emails of 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 40+ years.

The Newsletter, along with RESOURCES, OBITUARIES, OPINION PIECES and more, are lodged at the website: HERE

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 (publications, conferences, Opinion Piece, etc.) are welcome and should be sent direct to the editor: Michael R. Matthews, UNSW, **m.matthews@unsw.edu.au** .

Teaching about Pseudoscience in the NSW School Programme

The Australian state of New South Wales has in the past two years revised its high school science curriculum. Pseudoscience is now an explicit topic in the senior years.

The Aims of the Yrs.11-12, Investigating Science a subject alongside Physics, Chemistry, Biology, state:

> *The study of Investigating Science in Stage 6* (Yrs. 11-12) *enables students to develop an appreciation and understanding of science as a body of knowledge and a set of valuable processes that provide humans with an ability to understand themselves and the world in which they live. Through applying Working Scientifically skills processes, the course aims to enhance students' analytical and problem-solving skills, in order to make evidence-based decisions and engage with and positively participate in an ever-changing, interconnected technological world.*

The contrast of science with pseudoscience is explicitly made. Teachers are asked to cover:

- *The definition of, and problems associated with, pseudoscience.*
- *Historic and contemporary pseudoscience claims.*
- *Using social media to investigate examples of pseudoscience.*
- *How distorting a graph can be used to manipulate data in support of a specific viewpoint.*
- *A set of criteria to identify pseudosciences.*
- *The impact of pseudoscience on the public's trust in science and science-based decision making.*

The curriculum goes on:

> *using examples, analyse a pseudo-scientific claim and how scientific language and processes can be manipulated to sway public opinion, including but not limited to: astrology, numerology, and iridology.*

Clearly, teaching this topic requires teachers to have an appreciation of both HPS and of philosophy of education. Two disciplines that are in short, and diminishing, supply in teacher education programmes.

In July conference of Heads of Science in NSW schools was held. Michael Matthews made a presentation on the new topic. This was distributed in advance as a file to participants and is available **HERE**.

Philosophy of Science Journal - 90th Anniversary Open Access Articles

In celebration of this milestone, the Editors invite you to enjoy six months' free access to a specially curated collection, which includes articles such as:

On the Method of Theoretical Physics -
Albert Einstein

Methodological Individualisms: Definition and Reduction
May Brodbeck

On Relativity Theory and Openness of the Future
Howard Stein

The Communication Structure of Epistemic Communities
Kevin J. S. Zollman

Follow this link for complete access to the anniversary collection!

PhilSci Archive - Top 5 Downloads

PhilSci-Archive is the official preprint repository for the PSA and the best place to host your philosophy of science preprints. It offers a free, stable, and openly accessible archive for scholarly articles and monographs. With PhilSci-Archive, researchers can search the open-access repository and get curated alerts about new work delivered to their inboxes.

Many journals encourage authors to post preprints on archives like the PhilSci-Archive in order to increase readership, and historical data suggests that posting to the archive increases a published paper's citation rates (see HERE. Visit HERE to create a free account and post your preprints. Conference organisers can utilise the site to pre- or post-circulate conference papers.

The most downloaded preprints for the last 6 months from include:

Avigad, Jeremy (2022) - What we talk about when we talk about mathematics

Villavicencio, Marcos (2020) - Four Examples of Pseudoscience

Zinkernagel, Henrik (2008) - Did time have a beginning?

Vickers, Peter John (2008) - Bohr's Theory of the Atom: Content, Closure and Consistency

Griffiths, Paul E. (2021) - What are biological sexes?

NARST Strand 13, History, Philosophy, Sociology, and Nature of Science

The strand addresses Historical, philosophical and social issues of science as related to science education.

Conference proposals are due **August 15th** for the 2024 NARST conference being held 17-20 March in Denver. The Call for Proposal is **HERE**

Strand coordinators: Jacob Pleasants and Allison Antink-Meyer

2023 IUHPST Essay Prizes

The 2023 winner of the IUHPST Essay Prize in History and Philosophy of Science is **Ahmad Elabbar** from Cambridge University for his essay "The curatorial view of assessment and the ethics of scientific advice: Beyond decisional autonomy towards distributive epistemic justice".

The runner-up prize has gone to **Karoliina Pulkkinen** of the University of Helsinki for her essay "Beyond democratic legitimacy of value-judgments in science: a closer look at science in the early Soviet Union".

The full prize announcement, along with links to files of each essay, is available HERE.

Opinion Page. Is a Grand Theory of Everything Finally within Reach?

JAMES WELLS, Physics, University of Michigan

James Wells is a theoretical physicist who graduated B.S. and M.S. from Brigham Young University and Ph.D. from University of Michigan. His research explores ideas designed to solve outstanding "origins" problems in fundamental physics: the origin of gauge symmetries, dark matter, flavor violations, CP violation, and mass. is a Fellow of the American Physical Society, a recipient of an Outstanding Junior Investigator (OJI) Award from the U.S. Department of Energy, and a Sloan Fellowship from the Alfred P. Sloan Foundation.

He is the author of *Effective Theories in Physics: From Planetary Orbits to Elementary Particle Masses* (Springer 2012, Open Access) and *Discovery Beyond the Standard Model of Elementary Particle Physics* (Springer 2020).

When trying to explain what motivates me as a physicist, the film *A Passage to India* (1984) comes to mind. Based on the play by Santha Rama Rau, adapted from the novel by E M Forster, it describes the fallout from a rape case in the fictional city of Chandrapore, during the

British Raj in India in the 1920s. What keeps the viewer's attention is the subtlety of the relationships between the characters – particularly the fragile friendship between the man accused of the rape, Dr Aziz, and an Englishman, Mr Fielding. Data about identity alone, such as race, class, gender or educational status, can never reveal these dynamics nor capture why they fascinate us. When the case arrives in court, ostensibly similar people behave very differently in relation to the defendant. The dynamics of individual behaviour trump any immutable labels we might apply; yet these static labels also impose constraints on just how far any individual can go. We watch, we theorise, and we update our knowledge of the characters and the forces at work. By the end, we find that Fielding and Aziz are more alike than we'd thought, having created a new bond on the basis of a more complete understanding of one another.

Curiosity

The curiosity that drives many particle physicists isn't so different from what keeps us watching *A Passage to India*. The obvious and immutable data about the identity of elementary particles include their spins, their electric charges and their masses. From muons to charms, we can learn such information pretty quickly. But it takes years, even lifetimes, to reveal both the nature and degree of their relationships.

The neutrino, for example, was introduced in 1930 by Wolfgang Pauli, who needed to account for the fact that energy was conserved when a nucleus broke apart. But he would never have guessed how deep the relationship is between a left-handed spinning electron and the neutrino. It took more than 40 years of careful observations and ingenious theoretical work to reveal the deeper unified relationship they have together: via the fundamental force we now know as the 'weak force'. That's where the deepest and most satisfying learning in particle physics is to be found: through painstaking observations and the sifting of evidence comes a creative willingness to allow for multiple possibilities.

With the discovery of the Higgs boson in 2012, every elementary particle predicted by the Standard Model of physics has now been found. Yet the field is far from 'done'. Among the continuing work, physicists are still looking for a grand unified theory that explains the forces that operate at the subatomic level – a common understanding that accounts for the disparate phenomena we observe among the particles we have in hand. Not everyone agrees that this is worthwhile or even possible; some think we finished learning new things about elementary particles in 2012, and we must accept the cacophony of unrelated details in our physics tables. But I believe that to understand nature at its foundations, it's necessary to push further, to unearth more subtle and surprising relationships beneath the surface of what we see.

Unification of Subatomic Forces

Our observations to date support the idea that a unified theory of subatomic forces can be achieved. If true, it would revolutionise our understanding of nature far beyond any discovery of particle physics in the past half century – akin to theological transitions from polytheistic religion (many deities, many fundamental forces) to a monotheistic religion (one unified God, one unified force).

Unification revelations – 'they are more like each other than we thought' – have been remarkably productive throughout science. We now know that nature is often simpler and more cohesive than it seems. For most of human history, our theories for why planets move was disconnected from beliefs about why boulders tumble down mountains and apples fall off trees. But in 1687, Isaac Newton revealed that gravity offered a single, unifying explanation. All the explanations that had one 'force' for planets wandering in the sky, and another for apples being pulled to the ground, were brought together in one economical framework.

Other odd forces revealed themselves to us, but good explanations were slow to arrive. Between his duties attending to the medical needs of Queen Elizabeth I and her court, the physician and physicist William Gilbert wrote his magnum opus *De Magnete* at the start of the 17th century on the forces and attractions of electric charges that explained the workings of a compass. But the challenge of how to reconcile electrical charges with magnetic attraction and repulsion fascinated and confused natural philosophers for centuries

thereafter. The crowning achievement came in 1861, when James Clerk Maxwell unveiled a set of equations that put electricity and magnetism on equal footing. The theory of electromagnetism showed that they were 'more alike than you think'.

Newton's Gravitational Conundrum

However, a conundrum remained in Newton's theory of gravity and his laws of motion. The mass of a particle that's used in equations to predict the particle's acceleration when subject to *any* force (electromagnetic force, gravitational force, force due to a spring, etc) is mysteriously exactly the same mass that's used in different equations to determine what gravitational force exists between the particle and some other body. The first kind of mass is called the 'inertial mass' and the second kind 'gravitational mass'. Newton had to arbitrarily assume their exact equivalence to get the correct answers, even though there was no compelling reason why it had to be so.

However, Albert Einstein's general theory of relativity solved this mystery by theorising that there's a single unified origin for both types of masses. Einstein recognised that the feeling of total weightlessness when you're in freefall, even in the presence of gravity, is because of the equivalence of your inertial and gravitational masses. He elevated this observation to the *principle of equivalence*. In an acclaimed review article on relativity in 1907, he concluded that any new gravitational theory that included his new concepts had to conform with the principle of equivalence. It was this idea that ultimately helped him complete the formulation of the general theory of relativity in 1915.

What's so interesting about the principle of equivalence, from our point of view, is that it could just as easily be called the *principle of mass unification*. What led Einstein to general relativity were thoughts of unifying disparate objects (these masses are 'more alike than you think'), which in the old theory had no reason to be connected to each other. Newton unified planetary orbits and apple falls; Maxwell unified electricity and magnetism; and Einstein unified inertial mass and gravitational mass.

What new frontier can we identify in nature that calls out for deeper understanding of the relationships between particles – a new principle in the tradition of unifying planetary orbits with falling apples, electricity with magnetism, and inertial mass with gravitation? A good answer is a tighter relationship between elementary particles through the unification of certain forces that determine their interactions, known as the *gauge forces*. These three forces are electromagnetism, the weak force, and the strong force.

Gauge Bosons

With these three forces come many *gauge bosons* – a fancy way of describing the particles that are exchanged in order to activate the forces. There are a total of 12 such gauge bosons, or force carriers, in the Standard Model. There is one electromagnetic gauge boson (the photon) associated with the electromagnetic gauge force, three weak gauge bosons (W+, W-, Z) associated with the weak gauge force, and eight strong-force gauge bosons (the gluons) associated with the strong gauge force.

The electromagnetic force is mediated by photons, which get exchanged between particles that feel electric attractions and repulsions. The weak gauge force is what causes many particles to decay into others. For example, a neutron will spontaneously fall apart into three new particles: a proton, an electron and an antineutrino. We didn't understand exactly how this decay could happen. After all, neither the neutron nor the neutrino have an electric charge, so they can't talk to each other via photon exchange of the electromagnetic force.

Now, what if all three of the gauge forces were to be unified into a grand unified force – a single Ur-force? What would the observational consequences of such a reality be? For one, the relative charges of each particle under all three gauge-forces would have to follow a very particular pattern consistent with what a grand unified force would require. Secondly, the strength of each of the three forces would need to converge to a unified strength as we go to higher energies. Third, there would be new particles beyond those we have already seen. And finally, there would be decays and interactions among known particles that are forced on us, even at low energies, by the grand unified theory. Our

observations to date push us in the direction of entertaining the existence of an Ur-theory of nature.

Likewise, we can analyse more particles in the Standard Model, such as right-handed electrons, right-handed up quarks and left-handed up and down quarks. After many measurements, we find another set of willy-nilly values for the charges they display under all three gauge-forces. But upon closer inspection using group theory mathematics, we find that those numbers also magically fit exactly into a single grand unified particle: W= (right-handed electron, left-handed down quark, right-handed and left-handed up quarks). It's as though 10 very raggedy puzzle pieces scattered on the floor were pieced together to make a perfect circle.

Unification as Nature's Choice

It didn't have to be this way. The charges of the elementary particles in our Universe could have been such that there was no way to unify any two or more of them into a single unified particle. It's the combination of observational data and mathematics that offers us strong hints that the charges for elementary particles in the standard model aren't arbitrary, but rather arise by virtue of being embedded into a grand unified theory framework.

There's a second set of observational data hinting that the unification of the gauge forces is nature's choice. This comes from measuring the strengths of the forces. When we measure the strength of the electromagnetic interaction and compare it with, say, the strong interaction, we get a very different answer.

Again, it didn't have to be like this. One of the force strengths could have moved away from the pack as we moved up the energy scale. This would have immediately made the project of grand unification look impossible or highly suspect. Furthermore, the scale of putative unification adds to the positive view of this picture. Its value is neither too low to run up against the problem of proton decay (to be discussed below), nor is it too high (10^{17} or higher) to collude with the inscrutable dynamics of strong gravity that spoils all calculations and interpretations. We see again that observational data (force strength measurements) and theoretical work (group theory and renormalisation group techniques) have led us toward grand unification.

Is there any way to obtain direct proof of unification? What I've described so far count as strong hints, but by no means are they proof. They could be cruel coincidences of nature that have led us astray. To obtain 'proof for all practical purposes' would require us to do experiments at the unification scale and observe the production of new particles and new interactions directly through collisions.

For example, many grand unified theory ideas require the existence of an additional grand unified gauge boson that could be directly produced in collisions, seen, and measured. Unfortunately, it's out of the question to build a high-energy collider that could reach the energies where we think the grand unified theory resides. It took us many decades to reach energies of only a few thousand times the proton mass – and it might never be the case that experiments could reach energies of 15 orders of magnitude higher, which is what it would take to convince the most ardent sceptics.

Proton Decay

The search for a grand theory isn't over, though. One of the most sought-after hints is the data connected to the search for proton decay. Along with the neutron, the proton makes up the nuclei within our bodies. If the proton were to decay quickly, it would disrupt our cells and give us cancer and we could never have reliable life. Fortunately, the proton lives a very long time: as far as we know, it lives for at least 10^{34} years. That's about 24 orders of magnitude longer than the lifetime of the Universe. The prediction of grand unified theories for the lifetime of the proton generally falls in the range of 10^{30} to 10^{36} years. Any theories that predict a proton lifetime of less than 10^{34} years can be ruled out.

It's vital for us to find and catalogue the particles that serve as nature's raw material. But if we stop there, we're like impatient school children who merely read the Wikipedia synopsis of *A Passage to India* and then get on with writing their term papers. There's so much more to learn and to synthesise about this complex narrative than the

basic facts reveal. The story of nature is all the more woven with an infinite number of patterns, most as yet unseen. The subtle relationships between particles – the interactions between themselves in many different environments – is what lends our understanding its richness. The revelations of unification in science in general, and especially in physics, have been incredibly fruitful in the deepening of our knowledge and in lighting the way to future discoveries.

Among the many possibilities for unification, nature seems to have dropped us irresistible hints that our particles and our gauge forces are indeed unified into a grand unified theory of some kind. These hints are based on observational data along with the advanced theoretical tools of relativistic quantum field theory and group theory mathematics. However, the limitations of our technology have also made it extremely hard for us to get more direct proof. Seeing a proton decay is one of our few hopes for more direct corroboration – and that's why so much effort is going into watching protons with an eagle eye to see if one disintegrates. Data will determine whether unified theories will continue to pay off as they have for so many centuries. If history is our guide, we have every reason to believe they will.*

From *Aeon* 21 May 2021

Invitation to Submit Opinion Piece

In order to make better educational use of the wide geographical and disciplinary reach of this *HPS&ST Note*, 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 editor. 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 Note.

They will be archived, and downloadable, in the OPINION folder at the HPS&ST web site **HERE**:

HPS&ST in Latin America

On August 9-11, 2023, the IHPST-LA regional conference will be held in Porto Alegre, Brazil. Details available **HERE.**

A report will be given in the September newsletter.

If you have any information about events, publications, research groups, books about HPS&ST in Latin American and want to submit a brief note to be published in the HPS&ST Newsletter, please contact first Nathan Lima here or secondly Michael Matthews here.

HPS&ST in Asia

Correction. In the June newsletter, reference was made to a South Korean Ministry of Education seminar that was held at Lihua Women's University. The prestigious university should have been referred to by its widely known Anglicized name: Ewha Women's University.

If you have any information about events, publications, research groups or books about HPS&ST in Asia and want to submit a brief note to be published in the HPS&ST Newsletter, please contact first Xiao Huang (Zehjiang Normal University) **HERE** or Michael Matthews **HERE.**

Varia

- HPS&ST books, downloadable files **HERE**
- *Science & Education* Open Access articles (122) **HERE**
- 'Cultural Studies in Science Education: A philosophical Appraisal' (Michael R. Matthews) has been published in *Cultures of Science* journal (Vol.6 No.2, June 2023). Available **HERE**
- A 70-page article 'Thomas Kuhn and Science Education' (Michael R. Matthews) has been published in *Science & Education* (DOI 10.1007/s11191-022-00408-1). Available **HERE**.
- Jerry Coyne on the widening debate about Mātauranga Māori (Māori Science) in New Zealand schools and universities **HERE**.

  Previous HPSST Newsletter contributions to the debate can be read HERE and HERE.

Recent HPS&ST Research Articles

Akerson, V.L., Cesljarev, C., Liu, C. et al. (2023) Third and fourth grade students' conceptions of the nature of scientific inquiry. *International Journal of Science Education.* https://doi.org/10.1080/09500693.2023.2226333

Aydın-Günbatar, S., Roehrig, G.H. (2023). Elaborating Nature of Engineering Through Family Resemblance Approach. *Sci & Educ*, 1-33. https://doi.org/10.1007/s11191-023-00452-5

Bulstrode, J. (2023). Black metallurgists and the making of the industrial revolution. *History and Technology*, *39*(1), 1-41. https://doi.org/10.1080/07341512.2023.2220991

Fricke, K., Reinisch, B. (2023). Evaluation of Nature of Science Representations in Biology School Textbooks Based on a Differentiated Family Resemblance Approach. *Sci & Educ*, 1-29. https://doi.org/10.1007/s11191-023-00444-5

Harris, K.R. (2023). Beyond Belief: On Disinformation and Manipulation. *Erkenntnis*, 1-21. https://doi.org/10.1007/s10670-023-00710-6

Inêz, T. G., Brito, B. P. L. & El-Hani, C. N. (2023). A model for teaching about the Nature of Science in the context of biological education. *Science & Education* 32(1): 231-276.

Kızkapan, O., Nacaroğlu, O. & Kırmızıgül, A.S. (2023). Pre-service Science Teachers' Epistemic Beliefs, Nature of Science Views, and Beliefs in Pseudoscience. *Sci & Educ*, 1-18. https://doi.org/10.1007/s11191-023-00450-7

Montuschi, E., & Bedessem; B (2023). Understanding What in Public Understanding of Science? *Perspectives on Science*; https://doi.org/10.1162/posc_a_00603

Pacaci, C., Ustun, U., & Ozdemir, O. F. (2023). Effectiveness of conceptual change strategies in science education: A meta-analysis. *Journal of Research in Science Teaching,* 1– 63. https://doi.org/10.1002/tea.21887

Rolin, K., Koskinen, I., Kuorikoski, J. et al. (2023). Social and cognitive diversity in science: introduction. *Synthese*, 1-10. https://doi.org/10.1007/s11229-023-04261-9

Rudolph, J. L. (2023). Scientific literacy: Its real origin story and functional role in American education. *Journal of Research in Science Teaching*, 1– 14. https://doi.org/10.1002/tea.21890

Salvi, P. R. (2023). Dalton's Long Journey from Meteorology to the Chemical Atomic Theory. *Substantia*, 1-30. https://doi.org/10.36253/Substantia-2126

Shi, X. (2023). The Value of the Philosophy of Science in Senior High School Science Education from the Perspective of the Nature of Science. *Sci & Educ*, 1-24. https://doi.org/10.1007/s11191-023-00451-6

Verhaegh, S. (2023). The Reception of Relativity in American Philosophy. *Philosophy of Science*, 1-27. https://doi.org/10.1017/psa.2023.85

Wei, L., Gao, B., Wang, J. et al. (2023). Research on the Nature of Science in China's Current High School Physics Textbooks. *Sci & Educ*, 1-17. https://doi.org/10.1007/s11191-023-00443-6

Witteveen, J., Green, S. (2023). Teaching philosophy of science that matters. *Euro Jnl Phil Sci*, 1-10. https://doi.org/10.1007/s13194-023-00529-6

Wylie, A. (2023). Philosophy of the Field, In the Field. *Philosophy of Science*, 1-25. https://doi.org/10.1017/psa.2023.90

Recent HPS&ST Related Books

Belot, Gordon (2023). *Accelerating Expansion: Philosophy and Physics with a Positive Cosmological Constant*. Oxford, UK: Oxford University Press. ISBN: 9780192866462

"*Accelerating Expansion* explores some of the philosophical implications of modern cosmology, focused on the significance that the discovery of the accelerating expansion of the Universe has for our understanding of time, geometry, and physics. The appearance of the cosmological constant in the equations of general relativity allows one to model universes in which space has an inherent tendency towards expansion. This constant, introduced by Einstein but subsequently

abandoned by him, returned to centre stage with the discovery of the accelerating expansion.

This pedagogically-oriented essay begins with a study of the most basic and elegant relativistic world that involves a positive cosmological constant, de Sitter spacetime. It then turns to the relatives of de Sitter spacetime that dominate modern relativistic cosmology. Some of the topics considered include: the nature of time and simultaneity in de Sitter worlds; the sense in which de Sitter spacetime is a powerful dynamical attractor; the limited extent to which observation can give us information about the topology of space in a world undergoing accelerated expansion; and cosmologists' favourite sceptical worry about the reliability of evidence and the possibility of knowledge, the problem of Boltzmann brains." (From the Publisher)

More information HERE

Brading, Katherine & Stan, Marius (2023). *Philosophical Mechanics in the Age of Reason*. Oxford, UK: Oxford University Press. ISBN: 9780197678954

"From pebbles to planets, tigers to tables, pine trees to people; animate and inanimate, natural and artificial; bodies are everywhere. Bodies populate the world, acting and interacting with one another, and they are the subject-matter of Newton's laws of motion. But what is a body? And how can we know how they behave? In *Philosophical Mechanics in the Age of Reason*, Katherine Brading and Marius Stan examine the struggle for a theory of bodies.

"At the beginning of the 18th century, physics was the branch of philosophy that studied bodies in general. Its primary task was to provide a qualitative account of the nature of bodies, including their essential properties, causal powers, and generic behaviors. Pursued by a variety of figures both canonical (from Leibniz to Kant) and less familiar (from Du Châtelet and Euler to d'Alembert and Lagrange), this proved a difficult task. At stake were the appropriate epistemologies and methods for theorizing about the natural world. Solutions demanded the combined resources of philosophy, physics, and mechanics: what Brading and Stan call a "philosophical mechanics."

"Brading and Stan analyze a century of widespread, concerted efforts to solve "the problem of bodies," they examine the consequences of the many failures, both for the problem itself and for philosophy more generally. They reveal relationships among disparate themes of 18th century physics and philosophy, from the nature of matter to the motion of a vibrating string; causation to the principle of least action; and the role of subtle matter in collision theory to analytic mechanics. All of these, Brading and Stan argue, are related to the eventual emergence of physics as an independent discipline, autonomous from philosophy, more than a century after Newton's *Principia*. This book provides a new framing of natural philosophy and its transformations in the Enlightenment; and it proposes an account of how physics and philosophy evolved into distinct fields of inquiry." (From the Publisher)

More information HERE

Broberg, Gunnar (2023). *The Man Who Organized Nature: The Life of Linnaeus*. (A. Paterson, Trans.). Princeton, NJ: Princeton University Press. ISBN: 9780691213422.

"Carl Linnaeus (1707–1778), known as the father of modern biological taxonomy, formalized and popularized the system of binomial nomenclature used to classify plants and animals. Linnaeus himself classified thousands of species; the simple and immediately recognizable abbreviation "L" is used to mark classifications originally made by Linnaeus. This biography, by the leading authority on Linnaeus, offers a vivid portrait of Linnaeus's life and work. Drawing on a wide range of previously unpublished sources—including diaries and personal correspondence—as well as new research, it presents revealing and original accounts of his family life, the political context in which he pursued his work, and his eccentric views on sexuality.

"*The Man Who Organized Nature* describes Linnaeus's childhood in a landscape of striking natural beauty and how this influenced his later work. Linnaeus's Lutheran pastor father, knowledgeable about plants and an enthusiastic gardener, helped foster an early interest in botany. The book examines the political connections that helped Linnaeus secure patronage for his work, and untangles his ideas about sexuality. These were not, as often assumed, an attempt to naturalize gender categories but more likely reflected the laissez-faire attitudes of the era. Linnaeus, like many other brilliant scientists, could be moody and egotistical; the book describes his human failings as well as his medical and scientific achievements. Written in an engaging and accessible style, *The Man Who Organized Nature*—one of the only biographies of Linnaeus to appear in English—provides new and fascinating insights into the life of one of history's most consequential and enigmatic scientists." (From the Publisher)

More information HERE

Brown, Brandon R. (2023). *Sharing Our Science: How to Write and Speak STEM*. Cambridge, MA: The MIT Press. ISBN: 9780262546959

"In *Sharing Our Science*, scientist-turned-writing teacher Brandon Brown offers an eminently useful guidebook for STEM practitioners looking to communicate their technical work to either a technical or a broader audience. Professionals are increasingly required to communicate their work through blogs, podcasts, and newsletters and to submit to traditional media. After seeing his colleagues struggle to find a writing guide that tackled the unique challenges of writing and speaking about scientific topics, Brown set out to write the definitive handbook to assist STEM students, scientists, engineers, and tech workers alike.

"In this practical and relevant book, Brown uses his experience as a proven science communicator to cover three levels of writing: fundamental craft considerations, such as narrative tension, structure, sentences, and audience; unique scientific considerations, such as conveying numbers and utilizing metaphors; and finally, social considerations, such as public speaking and writing inside and outside of silos. In place of a reference manual, Brown's engaging narrative guide clarifies the fundamental principles that impact all scientific communication tasks, from white papers and slide decks to Zoom meetings and emails. Sharing Our Science represents the culmination of a lifetime of writing, research, and teaching that will enrich scientists' careers and illuminate the ways in which science is done and conveyed to the world." (From the Publisher)

More information HERE

Carter, J. Adam (2023). *Digital Knowledge: A Philosophical Investigation*. Milton Park, Abingdon: Routledge. ISBN: 9780367566913

"Information we use to structure our lives is increasingly stored digitally, rather than in biomemory. (Just think: if your online calendar went down, would you know where you are supposed be and at what time next week?) Likewise, with breakthroughs such as those from Google DeepMind and OpenAI, discoveries at the frontiers of knowledge are increasingly due to machine learning (often, applied to massive datasets, extracted from a fast-growing datasphere) rather than to brainbound cognition. It's hard to deny that knowledge retention and production is becoming increasingly – in various ways – digitised.

"*Digital Knowledge: A Philosophical Investigation* is the first book to squarely and rigorously investigate digital knowledge: what it is, how to make sense of it in connection with received theories of knowledge, and where it is going. Key questions J Adam Carter examines along the way are the following:

"How is mere digital information converted into reliable digital knowledge?
To what extent can digital knowledge be vindicated against sceptical challenges, and in what ways might digital knowledge stand distinctively subject to defeat?
What is the epistemically optimal way for us to decide which tasks to outsource entirely to intelligent machines, and to what extent is

further outsourcing appropriate (or not) to verify the results of that same outsourced cognition?
Are there any ways in which the expansion of the datasphere threatens to make knowledge more, rather than easy, to come by? If so, are there any promising ways to safeguard, epistemically, against such threats?"

Using fascinating examples throughout, such as the recent chess match between Stockfish and Google's AlphaZero, smartphones and personalisation, *Digital Knowledge: A Philosophical Investigation* is an ideal for researchers investigating this fascinating area of research at the intersection of traditional mainstream epistemology, the philosophy of cognitive science, the philosophy of technology, and computer science." (From the Publisher)

More information HERE

Chakrabarty, Prosanta (2023). *Explaining Life through Evolution.* Cambridge, MA: The MIT Press. ISBN: 9780262546256

"*Explaining Life through Evolution* tells the origin story of life on this planet and how we arrived at the tremendous diversity among organisms that we see around us today. Prosanta Chakrabarty explains evolution in a concise, accessible, and engaging way, emphasizing the importance of understanding evolution in everyday contemporary life. Weaving his own lived experience among discussions of Darwin and the origins of evolutionary thought, Chakrabarty also covers key concepts to our understanding of our current condition, including mutation; the spectrum of race, sex, gender, and sexuality; the limitations of ancestry tests; and the evolution of viruses like SARS-CoV-2, the virus at the heart of the COVID-19 pandemic.

"Offering a contemporary update to classic popular evolution books by Stephen Jay Gould, Jerry Coyne, and others, *Explaining Life through Evolution* is not only an illuminating read, but also an essential guide to the kind of scientific literacy that we need in order to face the challenges of our collective future." (From the Publisher)

More information HERE

Daston, Lorraine (2023). *Classical Probability in the Enlightenment* [New Edition]. Princeton, NJ: Princeton University Press. ISBN: 9780691248509

"What did it mean to be reasonable in the Age of Reason? Enlightenment mathematicians such as Blaise Pascal, Jakob Bernoulli, and Pierre Simon Laplace sought to answer this question, laboring over a theory of rational decision, action, and belief under conditions of uncertainty. Lorraine Daston brings to life their debates and philosophical arguments, charting the development and application of probability theory by some of the greatest thinkers of the age. Now with an incisive new preface, *Classical Probability in the Enlightenment* traces the emergence of new kind of mathematics designed to turn good sense into a reasonable calculus." (From the Publisher)

More information HERE

Emery, Nina (2023). *Naturalism Beyond the Limits of Science: How Scientific Methodology Can and Should Shape Philosophical Theorizing*. Oxford, UK: Oxford University Press. ISBN: 9780197654101

"Philosophers and scientists both ask questions about what the world is like. How do these fields interact with one another? How should they? *Naturalism Beyond the Limits of Science* investigates an approach to these questions called methodological naturalism. According to methodological naturalism, when coming up with theories about what the world is like, philosophers should, whenever possible, make use of the same methodology that is deployed by scientists. Although many contemporary philosophers have implicit commitments that lead straightforwardly to methodological naturalism, few have a clear understanding of how widespread and disruptive methodological naturalism promises to be for the field.

By way of a series of case studies involving laws of nature, composition, time and modality, and drawing on historical and contemporary scientific developments including the discovery

of the neutrino, the introduction of dark energy, and the advent of relativity theory, this book demonstrates the ways in which scientists rely on extra-empirical reasoning and how that very same extra-empirical reasoning can yield surprising results when applied to philosophical debates.

Along the way, Nina Emery's investigation illuminates the complex relationship between philosophy and the sciences, and makes the case that philosophers and scientists alike would benefit from a greater understanding of the connections between the two fields." (From the Publisher)

More information HERE

Gauvin, J. (2023). *Instruments of Knowledge.* Leiden, The Netherlands: Brill. ISBN: 978-90-04-50461-5

"In a bid to claim 'scientific objects' as requiring a significant amount of conceptual labor, this book looks sequentially at instruments, habits, and museums. The goal is to uncover how, together, these material and immaterial activities, rules, and commitments form one meaningful and credible blueprint revealing the building blocks of knowledge production. They serve to conceptualize and examine the entire life of an instrument: from its ideation and craft to its use, reuse, circulation, recycling, and (if not obliterated) its final entry into a museum. It is such an epistemological triptych that guides this investigation." (From the publisher)

More information HERE

Hård, Mikael (2023). *Microhistories of Technology: Making the World*. London, UK: Palgrave Macmillan. ISBN: 978-3-031-22815-5 [Open Access]

"In this open access book, Mikael Hård tells a story of how people around the world challenged the production techniques and products brought by globalization. Retaining their autonomy and freedom, creative individuals selectively adopted or rejected modern gadgets, tools, and machines. In standard historical narratives, globalization is portrayed as an unstoppable force that flattens all obstacles in its path. Modern technology is also seen as inexorable: in the nineteenth century, steamships, telegraph lines, and Gatling guns are said to have paved the way for colonialism and other forms of dominating people and societies. Later, shipping containers and computer networks purportedly pulled the planet deeper into a maelstrom of capitalism.

Hård discusses instances that push back against these narratives. For example, in Soviet times, inhabitants of Samarkand, Uzbekistan, preferred to remain in—and expand—their own mud-brick houses rather than move into prefabricated, concrete residential buildings. Similarly, nineteenth-century Sumatran carpenters ignored the saws brought to them by missionaries—and chose to chop down trees with their arch-bladed adzes. And people in colonial India successfully competed with capitalist-run Caribbean sugar plantations, continuing to produce their own muscovado and sell it to local consumers.

This book invites readers to view the history of technology and material culture through the lens of diversity. Based on research funded by the European Research Council and conducted in the Global South, *Microhistories of Technology: Making the World* shows that the spread of modern technologies did not erase artisanal production methods and traditional tools." (From the Publisher)

More information HERE

Jackson, Catherine M. (2023). *Molecular World: Making Modern Chemistry*. Cambridge, MA: The MIT Press. ISBN: 9780262545549

"According to existing histories, theory drove chemistry's remarkable nineteenth-century development. In *Molecular World*, Catherine M. Jackson shows instead how novel experimental approaches combined with what she calls "laboratory reasoning" enabled chemists to bridge wet chemistry and abstract concepts and, in so doing, create the molecular world. Jackson introduces a series of practice-based breakthroughs that include chemistry's move into lampworked glassware, the field's turn to synthesis and subsequent struggles to

characterize and differentiate the products of synthesis, and the gradual development of institutional chemical laboratories, an advance accelerated by synthesis and the dangers it introduced.

"Jackson's historical reassessment emerges from the investigation of alkaloids by German chemists Justus Liebig, August Wilhelm Hofmann, and Albert Ladenburg. Stymied in his own research, Liebig steered his student Hofmann into pioneering synthesis as a new investigative method. Hofmann's practice-based laboratory reasoning produced a major theoretical advance, but he failed to make alkaloids. That landmark fell to Ladenburg, who turned to cutting-edge theory only after his successful synthesis.

"In telling the story of these scientists and their peers, Jackson reveals organic synthesis as the ground chemists stood upon to forge a new relationship between experiment and theory—with far-reaching consequences for chemistry as a discipline." (From the Publisher)

More information HERE

Ilya Kasavin (2023) *A Social Philosophy of Science. An Introduction*

NOMOS Verlag, Baden-Baden, ISBN 978-3-8487-8424-0. Details: **HERE**

The **author** is a Fellow of the Russian Academy of Sciences, Editor in Chief of *Epistemology & Philosophy of Science*, Head of Dept. for Social Epistemology of the Institute of Philosophy, Russian Academy of Sciences, Philosophy chair, Lobachevsky State University, Nizhnij Novgorod, President of Russian Society for History and Philosophy of Science. Kasavin welcomes dialogue or reviews about the book's argument from interested scholars.

Katzir, Shaul (2023). *Sonar to Quartz Clock: Technology and Physics in War, Academy, and Industry*. Oxford, UK: Oxford University Press. ISBN: 9780198878735

"*Sonar to Quartz Clock* examines how the unapplied phenomenon of piezoelectricity became applied for technologies such as sonar, crystal frequency control, the quartz clock, and how its research has consequently changed during WWI and the interwar period. It aims at reconstructing, for the first time, the fascinating history of the inventions and the development of these highly important technologies, which are still in extensive use, and which were crucial for the electronic revolution, arguably the most important technological developments of the twentieth century.

"On this basis, this book suggests a better and more nuanced understanding of the relationships between modern science and technology and the process of development and innovation of science-based technologies. It examines in particular the mutual transfer and transformation of knowledge between them including the way physics becomes practically applicable, the way applications and societal interests shape technology and science, and the differences and similarities between scientific and technological research. The book presents an in-depth analysis of the scientific and technological research and development in the field, and of the evolution of their experimental, theoretical, and technical aspects within their social military and commercial contexts. It offers an integrative history of science and technology, needed to better comprehend their interactions and evolution but rare in current historiography.

"This book will appeal to historians of science and technology, sociologists of science and generally scientists and engineers studying or working with piezoelectricity, ultrasound devices, and crystal frequency control." (From the Publisher)

More information HERE

Kuchinskaya, Olga (2023). *The Politics of Invisibility: Public Knowledge about Radiation Health Effects after Chernobyl*. Cambridge, MA: The MIT Press. ISBN: 9780262548861

"Before Fukushima, the most notorious large-scale nuclear accident the world had seen was Chernobyl in 1986. The fallout from Chernobyl covered vast areas in the Northern Hemisphere, especially in Europe. Belarus, at the time a Soviet republic, suffered heavily: nearly a

quarter of its territory was covered with long-lasting radionuclides. Yet the damage from the massive fallout was largely imperceptible; contaminated communities looked exactly like noncontaminated ones. It could be known only through constructed representations of it.

In *The Politics of Invisibility*, Olga Kuchinskaya explores how we know what we know about Chernobyl, describing how the consequences of a nuclear accident were made invisible. Her analysis sheds valuable light on how we deal with other modern hazards—toxins or global warming—that are largely imperceptible to the human senses.

"Kuchinskaya describes the production of invisibility of Chernobyl's consequences in Belarus—practices that limit public attention to radiation and make its health effects impossible to observe. Just as mitigating radiological contamination requires infrastructural solutions, she argues, the production and propagation of invisibility also involves infrastructural efforts, from redefining the scope and nature of the accident's consequences to reshaping research and protection practices.

"Kuchinskaya finds vast fluctuations in recognition, tracing varyingly successful efforts to conceal or reveal Chernobyl's consequences at different levels—among affected populations, scientists, government, media, and international organizations. The production of invisibility, she argues, is a function of power relations." (From the Publisher)

More information HERE

May, Joshua (2023). *Neuroethics: Agency in the Age of Brain Science*. Oxford, UK: Oxford University Press. ISBN: 9780197648094

"Is free will an illusion? Is addiction a brain disease? Should we enhance our brains beyond normal? *Neuroethics* blends philosophical analysis with modern brain science to address these and other critical questions through captivating cases. The result is a nuanced view of human agency as surprisingly diverse and flexible. With a lively and accessible writing style, *Neuroethics* is an indispensable resource for students and scholars in both the sciences and humanities." (From the Publisher)

More information HERE

Morange, Michel (2023). *A History of Biology* (T. L. Fagan & J. Muise, Trans.). Princeton, NJ: Princeton University Press. ISBN: 9780691253923

"This book presents a global history of the biological sciences from ancient times to today, providing needed perspective on the development of biological thought while shedding light on the field's upheavals and key breakthroughs through the ages. Michel Morange brings to life the dynamic interplay of science, society, and biology's many subdisciplines, enabling readers to better appreciate the interdisciplinary exchanges that have shaped the field over the centuries.

"Each chapter of this incisive book focuses on a specific period in the history of biology, describing the major transformations that occurred, the enduring scientific concerns behind these changes, and the implications of yesterday's science for today's. Morange covers everything from the first cell theory to the origins of the concept of ecosystems, and offers perspectives on areas that are often neglected by historians of biology, such as ecology, ethology, and plant biology. Along the way, he highlights the contributions of technology, the important role of hypothesis and experimentation, and the cultural contexts in which some of the most breathtaking discoveries in biology were made.

"Unrivaled in scope and written by a world-renowned historian of science, *A History of Biology* is an ideal introduction for students and experts alike, and essential reading for anyone seeking to understand the present state of biological knowledge." (From the Publisher)

More information HERE

Penn, W. (2023). *Process Realism in Physics: How Experiment and History Necessitate a Process Ontology*. Berlin: De Gruyter. ISBN: ISBN: 9783110782516

"Science should tell us what the world is like. However, realist interpretations of physics face many problems, chief among them the pessimistic meta induction. This book seeks to develop a realist position based on process ontology that avoids the traditional problems of realism. Primarily, the core claim is that in order for a scientific model to be minimally empirically adequate, that model must describe real experimental processes and dynamics. Any additional inferences from processes to things, substances or objects are not warranted, and so these inferences are shown to represent the locus of the problems of realism.

The book then examines the history of physics to show that the progress of physical research is one of successive eliminations of thing interpretations of models in favor of more explanatory and experimentally verified process interpretations. This culminates in collections of models that cannot coherently allow for thing interpretations, but still successfully describe processes." (From the Publisher)

More information HERE

Slezak, P. (2023). *Spectator in the Cartesian Theater: Where Theories of Mind Went Wrong since Descartes* (Roman & Littlefield). ISBN: 978-1-66692-375-9

The "Cartesian Theater" is Dennett's famous metaphor for the idea that a homunculus or "little man" watches the screen on which our thoughts appear. However, contrary to much academic teaching and scholarship, *Spectator in the Cartesian Theater: Where Theories of Mind Went Wrong since Descartes* shows that Descartes was not guilty of this fallacy for which he has been blamed. In his physiological writings neglected by philosophers, Descartes explained that the pseudo-explanation arises not from what is included in our theory of consciousness, but rather from what is missing. We fail to notice that the theory is incomplete because we are intuitively doing part of the explanatory work. That is, we are the spectators in the Cartesian Theater.

"With detailed critiques, Peter Slezak shows that Searle's Chinese Room Argument, Kripke's theory of proper names, Davidson's semantics of natural language and Kosslyn's theory of visual imagery rely on what is intuitively meaningful to us rather than what follows from the theory. Slezak offers a novel solution to the elusive logic of the Cogito argument, showing it to be akin to the Liar Paradox. Since Descartes' perplexity is our own, this shows how the subjective certainty of consciousness and the mind-body problem can arise for a physical system. An intelligent computer would think that it isn't one." (from the publisher)

More details: HERE

Szocik, Konrad (2023). *The Bioethics of Space Exploration*. Oxford, UK: Oxford University Press. ISBN: 9780197628478

"The first book devoted to the bioethics of the space-mission environment, *The Bioethics of Space Exploration* explores the ethical status of possible biomedical challenges in future long-term space missions. Konrad Szocik thoroughly examines arguments favoring and opposing human enhancement, accompanied by somatic and germline gene editing, methodology of space-mission bioethics, and moral bioenhancement. In particular, the three main types of space missions—scientific missions, commercial missions, and space colonization missions—prompt different bioethical discussions and levels of human involvement.

Szocik also considers whether the possibility of saving humanity through space colonization is compatible with ethics of quality of life and the philosophy of antinatalism. Presented from an issue-driven and case-driven perspective, *The Bioethics of Space Exploration* highlights the utility of different normative systems for philosophers, ethicists, and social scientists alike. For any reader interested in the broader humanistic and social approach to space missions, these insightful discussions provide a new perspective into the future of space missions and the potential for radical biomedical technologies." (From the Publisher)

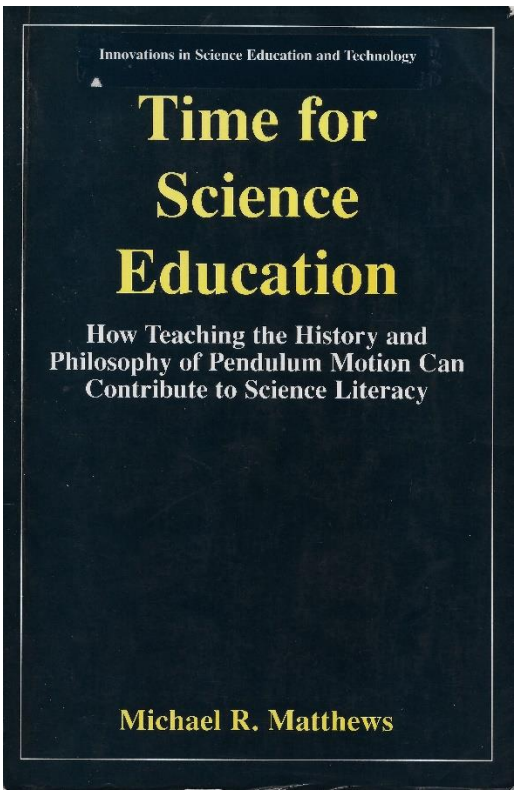
More information HERE

Authors of HPS&ST-related papers and books are invited to bring them to attention of the Newsletter's assistant editor Paulo Maurício (paulo.asterix@gmail.com) for inclusion in these sections.

PhD Award in HPS&ST

We welcome publishing details of all PhDs awarded in the field of HPS&ST. Send details (name, title, abstract, supervisor, web link) to editor: m.matthews@unsw.edu.au

Time for Science Education: How Teaching the History and Philosophy of Pendulum Motion can Contribute to Science Literacy, Kluwer (2000). Book available



This 460-page book has 13 chapters with 1,200 references. They are:

1 Learning About the Pendulum and Improving Science Education
2 Navigation and the Longitude Problem
3 Ancient and Medieval Timekeeping
4 Galileo and the Pendulum Clock
5 Galileo's Analysis of Pendulum Motion
6 Christiaan Huygens and the Pendulum Clock
7 Perfecting Mechanical Timekeeping and Solving the Longitude Problem
8 The Pendulum in Newton's Physics
9 Clocks and Culture: The Clock Analogy in Philosophy and Theology
10 Science and Philosophy: Some Lessons From the History of Pendulum Motion
11 Teaching and Learning about Time and Pendulum Motion: Some Theoretical Considerations
12 Teaching and Learning about Time and Pendulum Motion: Some Pedagogical Considerations
13 Science Education and Culture

A pdf file of the book is available **HERE**.

Coming HPS&ST Related Conferences

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August 9-11, 2023, IHPST-LA regional conference, Porto Alegre, Brazil
Details **HERE**

August 14-18, 2023, International Committee for History of Technology, 50th Conference, Tallinn, Estonia
Details **HERE**

August 28-Sept.3, 2023, ESERA biennial conference, Cappadocia, Turkey
Details **HERE**

August 30-Sept.1, 2023, Consonances Conference, Maynooth University, Ireland
Details: **HERE**

September 4-6, 2023, 3rd International Conference on History of Science and Education, Algrave, Portugal.
Details Isilda Teixeira Rodrigues

September 18-22, 2023, 42nd Scientific Instrument Symposium, Palermo, Italy
Details **HERE**

September 20-23, 2023, European Philosophy of Science Association (EPSA23), Belgrade, Serbia
Details **HERE**

November 9-12, 2023 History of Science Society (HSS), annual meeting, Portland OR.
Details **HERE**

November 29-December 2, 2023, 9th Norwegian Conference on the History of Science, Trondheim, Norway.

Details **HERE**

March 7-11, 2024, Philosophy of Education Society (PES) Annual Conference, Salt Like City, UT
Details **HERE**

March 17-20, 2024, NARST Annual Conference, Denver CO
Details **HERE**

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
FHPP APS - Forum on History and Philosophy of Physics of the American Physical Society
HAD AAS - Historical Astronomy Division of the American Astronomical Society.
ACS HIST – American Chemical Society Division of the History of Chemistry
GWMT - Gesellschaft für Geschichte der Wissenschaften, der Medizin und der Technik
ISHEASTME – International Society for the History of East Asian History of Science Technology and Medicine
EASE - East-Asian Association for Science Education
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
BAHPS - Baltic Association for the History and Philosophy of Science
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 at: **HERE**

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

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