HPS&ST NEWSLETTER

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The HPS&ST NEWSLETTER is emailed monthly to about 9,000 individuals who directly or indirectly have an interest in the contribution of history and philosophy of science to theoretical, curricular and pedagogical issues in science teaching, and/or interests in the promotion of innovative, engaging and effective teaching of the history and philosophy of science. The NEWSLETTER is sent on to different international and national HPS lists and international and national science teaching lists. In print or electronic form, it has been published for 25+ years.

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

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

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

HPS&ST NEWSLETTER STAFF

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Why Trust Science and Science Education? Call for Papers *Science & Education* Journal

Public debates around issues such as climate change and vaccination have put into question the public trust in science (Oreskes, 2019). Some science education researchers have adopted positions that science is fundamentally shaped by ideology (Mackenzie, Good, & Brown, 2014). The emerging lines of research in science and science education have been based on claims that science suffers from a systematic bias through sexism, racism, capitalism, colonialism and other ideological interests. The methodological approaches such as ethnomethodology, deconstructionism and critical theory have mediated the propagation of such lines of research along with showcasing of historical case studies of misuse of and abuse by science in society.

In the broad context of social justice causes including efforts to combat structural racism and sexism, such framing of science as an oppressive endeavour would appear to garner support. Yet, the explanatory and predictive power of scientific knowledge as well as contributions of science to society, are undeniable, as evidenced by the current anticipation of an effective vaccine to tackle the Covid-19 pandemic.

Science has a history of not only contributing to society, for instance, through medical and technological innovations but also through rational and evidence-based debate on social issues. In the post-truth era where the legitimacy of expertise and evidence-based claims are increasingly eroded, the consequences of science denial can be fatal. For example, climate change denial is likely to lead to a planetary emergency where the natural world and the environment will suffer an irreversible destruction.

The complex interaction between science and society points to some key tensions: tensions between uncertainty in scientific knowledge versus the capacity to build powerful explanatory and predictive models; tensions between democratic values versus undemocratic decision-making given priority of evidence; tensions between science as an economics-driven enterprise versus a knowledge-driven enterprise.

At a time when science education needs to instil in future citizens robust evidence-based reasoning skills for the sake of social and planetary justice, how can such tensions be reconciled? The Editors of *Science & Education* invite papers that address this fundamental question through theoretical and empirical studies in a special issue with the theme of "Why Trust Science and Science Education?". Some example themes that papers can explore are the following:

- Why should science be trusted? How is trust established in scientific communities? How can science education foster trust in science? For example, what examples of curricula are available that support trust in science and what impact do they have on science teaching and learning?
- How can science learning environments be shaped to acknowledge the power and the limitations of science? What evidence is there that such learning environments improves students' understanding of and engagement with science?
- Can approaches based on critiques of science help students appreciate evidence-based discussions, contribute to their understanding of

policy-debates, and the need for scientifically informed regulatory practices? If so, how?

- If science is inherently oppressive (ie. sexist, racist, imperial), how can it be salvaged from its exploitative nature and legacy? How can learning environments be designed to foster understanding of how science should work?
- What role can informal and non-formal learning environments play in educating the public about why and when trust in science is warranted?
- How do the political landscapes of different nations and communities foster public trust or mistrust in science? What are some examples from history of science as well as contemporary science? What implications do they present for education?

Submission deadline: **April 30th, 2021**

Science & Education publishes research using historical, philosophical, and sociological approaches in order to improve teaching, learning, and curricula in science and mathematics. In addition, the journal disseminates accounts of lessons, units of work, and programs at all levels of science and mathematics that have successfully utilised history and philosophy. The journal promotes the inclusion of history and philosophy of science and mathematics courses in science and mathematics teacher education programs. Moreover, it promotes the discussion of the philosophy and purpose of science and mathematics education and their place in and contribution to the intellectual and ethical development of individuals and cultures.

Instructions for the preparation and submission of manuscripts can be accessed here.

References

Mackenzie J., Good R., & Brown J.R. (2014). Postmodernism and Science Education: An Appraisal. In, M. Matthews (Eds), *International Handbook of Research in History, Philosophy and Science Teaching*. Dordrecht: Springer.

Oreskes, N. (2019). *Why Trust Science?* Princeton, NJ: Princeton University Press.

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

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

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

Link to the Special Issue here.

Introduction to the Special Issue (by Brian Donovan and Ross Nehm) here.

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

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

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

Using Anthropological Principles to Transform the Teaching of Human "Difference" and Genetic

Variation in College Classrooms (by Amelia Hubbard and Laura Monnig)

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

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

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

New *Metascience* Journal

To support its research program, the Society for the Progress of Metasciences (Sopromet) publishes a journal entitled *Mɛtascience*. It ensures the dissemination of metascientific research about the major problems of analysis and synthesis of scientific production in order to develop a *scientific general discourse* about the world as well as about science, which allows us to know it.

Mɛtascience is distinct from the established same-named review journal. The new *Mɛtascience* publishes texts online in preprint form as soon as they are accepted. As soon as there is enough articles, an issue is then put together. *Mɛtascience* will also publish thematic issues, which will be edited by a member of Sopromet. Mɛtascience is also available in `pdf` and in paper version at Éditions Matériologiques.

While *Mɛtascience* is mainly aimed at academics, it may also present the work of researchers from the public sector, international bodies, independent research institutes, private consultancy offices and non-governmental organisations (NGOs), and the work of independent researchers.

In order to better understand Sopromet's mission and learn more about metascience, we invite you to read the presentation of the journal published in the first issue of *Mɛtascience* as well as the introduction to this issue.

Presentation. Mɛtascience and the Bunge alternative

Opinion Piece: *Huygens, senior and junior: How a father's mere curiosity about nature evolved during the Dutch Golden Age into the son's focused scientific enquiry* Hugh Aldersey-Williams

Aldersey-Williams studied natural sciences at the University of Cambridge. He is the author of

several books, the latest of which is *Dutch Light: Christiaan Huygens and the Making of Science in Europe* (2020).

During the 1650s, the admired Dutch diplomat Constantijn Huygens often found himself with time on his hands. He was the loyal secretary to successive princes in the House of Orange, the ruling dynasty in the northern Netherlands during the Eighty Years' War with Spain, and had been knighted by both James I of England and Louis XIII of France. Now that the Dutch were embarking upon an experimental period of republican government, his diplomatic services were no longer required. So he set down his untiring pen, and turned to books.

In September 1653, he happened to read *Poems and Fancies*, a newly published collection by the English exile Margaret Cavendish, Duchess of Newcastle, a staunch royalist who had sought to escape the persecutions of Oliver Cromwell's Commonwealth by making her home in the city of Antwerp. Among its verses and dialogues, Cavendish's book featured a range of her untested scientific ideas, including a 50-page verse exposition of her atomic theory. Her 'extravagant atoms kept me from sleeping a great part of last night,' Huygens wrote to a mutual friend.

A few years later, in March 1657, the 60-year-old Huygens initiated a correspondence with Cavendish, wondering if she might have an explanation for an odd phenomenon that had given rise to something of a craze in the salons of Europe. So-called Prince Rupert's drops were comma-shaped beads formed by trickling molten glass into a bucket of cold water. The drops had the apparently paradoxical and highly entertaining property that they were almost indestructible when squeezed in a vice or struck with a hammer, but when the tip of the tail was snapped off the remainder of the drop would instantly explode into powder.

Cavendish was flattered to be asked for her scientific opinion by a man of Huygens's stature. She suggested that 'oily spirits or essences of sulphur' might cause the explosions, incorporated into the glass like the coloured silk in the blown glass orbs of earrings. Huygens then tested her hypothesis by heating one of the drops in a fire to red heat, expecting it to blow up. However, it didn't and, when it had cooled down, he found that it had lost its power to explode at all. Informed of this, Cavendish conjectured that the fire might have evaporated the sulphurous spirit before it could explode, but then also came up with an alternative mechanism: 'pent up air enclosed therein, which, having vent, was the cause of the sound or report which those glasses gave.'

As it happens, both theories were wrong. (Among contemporaries, Robert Hooke came closest to explaining the effect as due to the release of tension built up in the glass as it formed.) What is noteworthy here is the sight of two learned and curious individuals trying to conduct themselves in a scientific way. Both Cavendish and Huygens understood that experiment is the way forward, but neither knew quite what experiments to do or how to assess their results. They wished to infer causes from observed effects, and knew they must refine and modify their hypotheses in the light of results obtained. But they were frustrated that each new approach is informed by little more than guesswork. At the unsatisfactory conclusion of their exchange, Cavendish signed off her last letter: 'Thus, Sir, you may perceive by my argueings, I strive to make my former opinion or sense good, although I doe not binde myselfe to opinions, but truth; and the truth is … I cannot finde out the truth of the glasses.'

It was entirely in keeping with his voracious intellect that Constantijn Huygens should show an interest in natural philosophy – the discipline that would one day become 'science'. In fact, he showed an interest in most fields and was expert in many of them. He spoke or wrote eight languages, perhaps more even than were directly useful in his career as a diplomat, and dabbled in several more. He was one of the foremost poets and composers in the Dutch Republic and he was an artist, one knowledgeable enough to be able to spot the talent of the young Rembrandt and launch him on his career with some early commissions. His interest in nature was wide-ranging. He experimented with mixing his own herbal medicines and perfumes. Obliged to wear spectacles from a young age, he developed an interest in lifelong optics and optical devices of all kinds.

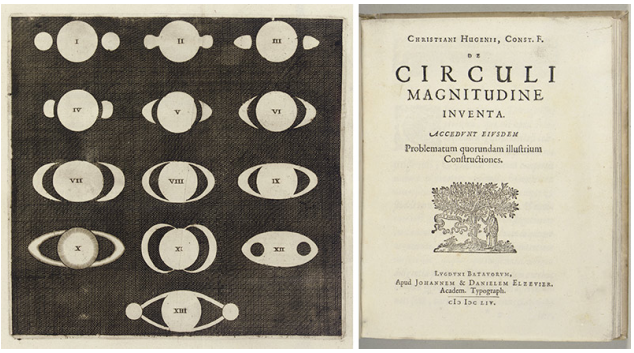
On a diplomatic posting to London in 1621, he met a fellow Dutchman, the inventor Cornelis Drebbel, and acquired from him a camera obscura that, he wrote, projected images of such beauty, it promised to make 'all painting … dead in consequence'. In 1635, he would attempt to assist René Descartes, then living in Holland, in the task of making a hyperbolic lens (a lens of a form that it was thought might overcome the spherical and chromatic aberration that frequently marred the quality of images projected through early telescopes). Despite several attempts to draw the precise curve for the lens grinder to work to, that project was a failure. Shortly after this episode, however, Huygens was able to offer help of a kind that he was more familiar with by arranging for the publication of Descartes's landmark work of philosophy, *Discours de la méthode* (1637), in Holland and France.

Portrait of Constantijn Huygens and his Five Children (1640) by Adriaen Hanneman. Christiaan is depicted top right. *Courtesy of the Mauritshuis, the Hague, Holland*

Huygens happened to be attending another scientific curiosity of the age – a public anatomy demonstration – when he was suddenly called away because his wife Susanna had gone into labour with their second son. Christiaan Huygens was born on 14 April 1629 at the family home in The Hague; he stands now as the greatest scientist in the period between Galileo and Newton, most famous for his discovery of the first satellite of Saturn and the ring (later discerned to be rings) around that planet, as well as for his invention of the pendulum clock, and for devising a substantially correct wave theory of light. There was a world of difference between the father's explorations into natural philosophy and the son's exacting scientific procedure.

In the spring of 1657, while his father was amusing himself with Prince Rupert's drops, the 28-year-old Christiaan Huygens was already famous for

his Saturnian discoveries, and was preparing a full treatise on the planet complete with a prediction for years into the future of the phases of Saturn and the changing appearance of the ring as viewed from Earth, which was to allow later astronomers to deliver a triumphant verification of his scheme, although it was still doubted by some.



An engraving from Christiaan Huygens's *Systema Saturnium* (1659) published by Adriaan Vlacq, the Hague. *Photo courtesy Christie's*

Christiaan had been celebrated for his achievements on a visit to Paris in 1655, when he had met many of the city's leading astronomers and mathematicians, sparring with them over problems of geometry. One challenge of the time was to understand the nature of curves. Curves such as the parabola and the hyperbola belonged to the family of 'conic sections' along with the circle and the ellipse, and could be shown to obey simple mathematical rules. But others, such as the catenary (the curve made by a free-hanging cord such as a washing line) and the cycloid (the line traced by a point on the circumference of a circle rolling along a straight line), were harder to understand. Huygens was not able to completely solve the puzzle of the catenary, but he was at least able to prove that it was not a parabola as many had believed. For now, the cycloid, too, retained its essential mystery – it was known to 17th-century mathematicians as the 'Helen of geometry' for its beauty and its propensity to spark jealous disputes – but it was soon to make a highly surprising reappearance in quite another field of Huygens's enquiries.

While in Paris, Huygens also became aware of the work of Pierre de Fermat and Blaise Pascal, who were beginning to set out the foundations of probability theory by showing that the laws of chance submitted to mathematical logic. On his return to The Hague, Huygens swiftly made his own contribution to the field, summarising the laws of chance in terms of tossing coins and rolling dice in various gaming scenarios, in the first published textbook on probability.

Haagsche Klokje (1657-1659) by Salomon Coster. This is one of the earliest pendulum clocks ever made following Christiaan Huygens's design of 1656. *Photo courtesy the Science Museum, London*

At the same time as this frenzy of observation and calculation, Huygens was also busy on a more practical project, having devised 'a new piece of clockwork that measures time so accurately there is no small hope that it will permit the determin-

ation of longitude with certainty if taken to sea,' as he wrote proudly to his former mathematics tutor. Working with a Hague clockmaker Salomon Coster, Huygens built one clock after another, gradually improving the accuracy of timekeeping by a factor of 100 or so, such that losses were reduced to no more than a few seconds a day.

One of his improvements was to position small buffers made of curved plates of metal against the hanging thread of the pendulum. Although the period of an oscillating pendulum of a given length is theoretically constant, in fact it increases for very large displacements of the pendulum bob. Huygens's metal buffers provided a simple way to regularise the period of the pendulum for all displacements, thereby delivering greater accuracy. Experimenting further, Huygens found that this intervention altered the path of the pendulum bob from a simple arc of a circle to a portion of a more complex curve – which turned out to be none other than the cycloid. Astonished by this revelation, he investigated further and found that the optimum shape of the buffers was also cycloidal.

These apparently diverse achievements arise from a set of investigations initiated by the young Huygens and pursued concurrently and with great intensity and rigour. But as the recurrence of the cycloid demonstrates, they also benefit from some remarkable cross-fertilisation between the theoretical and the practical, and between the disciplines of astronomy, mathematics and mechanics at their core that Huygens was uniquely equipped to exploit. Thus, his innovations in the mechanisms of clocks informed his understanding of fundamental mechanics and geometry, leading him not only to learn more about the cycloid, but also to the concepts of centrifugal force and the conservation of energy. Mechanics also contributed to Huygens's thinking about the catenary, which he proceeded to analyse by imagining the curve that would gradually form if you added hanging weights one by one at different points along a horizontally stretched line.

In astronomy, Huygens built his own increasingly powerful telescopes – including the laborious process of grinding the lenses, which he often shared with his elder brother. He was able to detect Saturn's first moon using a telescope with a 12-foot tube, and then the planet's ring a year later with a 23-foot tube. But it was his knowledge of geometry and mechanics that helped to lead him to the correct interpretation of an orbital ring at a time when other astronomers, working both with poorer telescopes but also with poorer understanding of the physical and mathematical possibilities, were conjecturing all sorts of strange appendages to the planet.

Similar thinking later guided Huygens in the interpretation of comets, which, in common with many other astronomers, he had believed travelled in straight lines outward from the Sun. However, detailed observation of a bright comet that appeared in the sky in 1680 – the first to be detected using a telescope – caused him to change his mind and accept that they in fact moved in elliptical orbits. The occurrence of this comet illustrates once again the fundamental difference in approach between the *curioso* father and the scientific son.

As the historian Simon Schama has shown in *The Embarrassment of Riches* (1987), many Dutch people regarded comets with superstition. Their fear was exploited by ruthless sermonisers, and there was always some disaster to which a cometary appearance could be linked as a harbinger. Constantijn was a little more nuanced than this in his response. He habitually noted the passage

of comets, so that Christiaan thought it worthwhile to ask him how the 1680 comet compared with another bright one that he knew his father had seen as long ago as 1618. Often, Constantijn used the occasion of a comet to produce a poem, but he didn't share the commonplace belief that they were omens – in fact, he played satirically on that idea in his verse. But he couldn't quite believe that they meant nothing, reading them instead as a cryptic message from God that would be revealed in full when its time came.

Christiaan, on the other hand, acknowledged comets as purely physical phenomena, ruling out any merit as portents on the grounds of simple logic. Noting his fellow citizens' divergent readings of the celestial bodies, he reasoned: 'What does it mean if comets signify good and bad events equally, unless they signify nothing?'

Like his father, Christiaan was a more than competent musician. But whereas Constantijn enjoyed concert performances and the social possibilities that they opened up, Christiaan's interest in music was more theoretical. In common with many thinkers of the 17th century, he had his own ideas of how music should sound, and he devised a division of the octave into 31 carefully spaced notes that he calculated would both make for a pleasing sound and facilitate matters important to performing musicians, such as transposition between keys. Unlike most, however, he went further and had built for him a special harpsichord that demonstrated this system.

Perhaps Christiaan's feeling for music helped him to the realisation that, like sound, light too travels in a wavelike fashion. During the final years of his successful career in Paris, he developed this notion into a fully-fledged theory of light. Using his favoured method of geometrical analysis, he was able to explain all commonly observed optical phenomena, including reflection of light from surfaces, as well as its refraction through all kinds of transparent mediums, in an elegant series of diagrams that illustrated what is now often referred to as the Huygens Principle, namely that light can be considered at every point in its journey as a wave emanating from a point. This radical theory, though substantially correct, was soon to be overtaken by Newton's increasingly influential model of light based on 'corpuscles' or particles. It was not until sophisticated experiments in the 19th century that physics finally embraced the notion of light as a wave.

Christiaan Huygens's more mature attitude towards science, and his organised approach to increasing scientific knowledge, marks a profound social and cultural shift from his father's generation. Indeed, if you were ever tempted to imagine that the 'scientific revolution' had a sudden onset, you might place that moment somewhere between these two men's lives. But of course, as recent historiography has shown, science gained ground fairly steadily over several centuries from the High Medieval period onwards.

Whereas Christiaan's conduct as a scientific professional is, if anything, ahead of its time, his father's attitude is very much of his own age. Constantijn might have given more time to examining natural phenomena if he hadn't been so busy with his secretarial duties for the House of Orange, but he still wouldn't have acquired the wherewithal to design an experiment and prosecute it to a successful conclusion. Nor was Constantijn ever in a position to benefit fully from the social structures that grew up around natural philosophers during the course of his son's lifetime. Constantijn and Margaret Cavendish were fully paid-up members of the Republic of Letters, but they didn't

share the protocols that were being developed by the younger generation, which involved an understanding that observations be systematically recorded, experiments be repeatable, results be subject to comparison and independent verification (or falsification if contradictory evidence comes along), and speedily published for the good of all.

Constantijn stands closer to men such as Francis Bacon and the physician and writer Sir Thomas Browne in England. Huygens had in fact met Bacon on his visit to London in 1621 and was disappointed to find the elderly Englishman full of 'arrogant presumption and affectation'. Though famous as the innovator of the so-called 'scientific method', Bacon probably did rather few experiments himself. Browne on the other hand did perform many rudimentary experiments during the course of preparation of his *Pseudodoxia Epidemica* (1646), a vast compendium of popular misconceptions or 'vulgar errors' concerning natural phenomena. The book debunks dozens of these mistaken beliefs, often simply by reference to a notable authority, ancient or modern, but sometimes by resort to a dramatic practical demonstration. For example, to refute the notion that a dead kingfisher can be used as a weathervane (so widespread a belief that it finds its way into Shakespeare's *King Lear*, where Kent speaks of untrustworthy types who 'turn their halcyon beaks/With every gale'), Browne describes how he hung two corpses of the birds from silken threads and noted how they oriented themselves independently in the breeze.

Such figures had largely shed the love of superstition and magic that had beset the previous generation of philosophers such as John Dee at the court of Queen Elizabeth of England and Giambattista della Porta in Naples who, though they might occasionally experiment in a way that we'd now call scientific, nevertheless felt that their investigations were best kept shrouded in an aura of mystery. They had correctly concluded that it was fruitless to spend time on astrology and prophecies and were instead clearsighted enough to recognise the virtue in disabusing people of erroneous and possibly harmful beliefs, and even to set goals for desirable scientific discoveries to be made in the future, such as cures for diseases or means to control the weather.

What they still lacked, however, was a developed social network in which they could pursue this work. Like Dee and della Porta, astronomers such as Johannes Kepler and Tycho Brahe had been dependent on court patronage and worked in varying degrees of isolation. The kings and emperors who employed them privileged astronomy over other sciences for the historical reason that astronomy was an essential support to the important predictive business of astrology. Other disciplines of physics that we'd recognise today, such as mechanics, hydraulics and ballistics, were supported as applied sciences, and were the province of the engineers of fortifications, drainage schemes and weaponry. Mathematics, too, was regarded as a lowly technical discipline, merely the handmaiden of these more useful arts.

This was all to change in the space of a few years around 1660. On his first visit to Paris, already famous for his work on Saturn, Christiaan Huygens had found himself fêted in the intellectual salons for which the city was famous. Even when he returned to The Hague, his French friends continued to spread news of his scientific breakthroughs at these meetings, and when he reappeared in the city, briefly in 1660, and then to settle there in 1663, Christiaan immersed himself in these circles. But although the salon that he principally attended had resolved to steer its discussions towards things that could be established

as fact and of practical benefit, he still found himself obliged 'to listen to the prattle of pedants for hours on end on subjects of nullity'.

Fortunately, the influential contacts Huygens made in these intellectual circles brought him to the attention of Jean-Baptiste Colbert, the all-powerful minister of Louis XIV, who was setting up new royal academies as a means of bringing greater glory to the French state. An academy of dance was founded in 1661, followed by others in architecture, painting and sculpture, and music. He wished also to see an academy of sciences that would support his larger project of building a state whose policies would be informed by hard data. As a man to lead the academy of sciences, Huygens was almost the ideal candidate. Colbert required a versatile and diligent experimenter who could set out a programme of research across all the sciences, and who would not be averse to directing that research towards the service of his state-building project. Colbert saw Dutch nationality as no obstacle, and he might even have reckoned it an advantage, as Huygens, unlike some of the airier Parisian *salonistes*, would be unlikely to object to projects of a practical nature, being familiar from his homeland with the role of science in managing the relation between land and water (even though these talents would be largely diverted into fripperies such as the creation of fountains on the royal estates).

Huygens's central role in the formation of such an institution (the Royal Society of London was founded around the same time, and Huygens became its first foreign fellow) is the final achievement of his career that shows how far science had developed since his father's day. With the supporting network of fellow academicians, it was now possible to practise science with single-minded devotion. For all his own powerful court connections, Constantijn could never have found himself in the same position. It required the nexus of a large city as well as the patronage of a powerful king to make it work – things that the provincial Netherlands could never offer. Christiaan Huygens prospered scientifically in Paris in a way that wouldn't have been conceivable in The Hague, and French science gained greatly from his early leadership role in the Academy of Sciences.

Perhaps the study of the mathematics of probability that he'd undertaken from his earliest days in Paris also coloured his conception of what all of science should be. The sense of science as certain knowledge, rooted in old ideas of scholastic theology, had been overtaken by a new meaning as natural philosophers concerned themselves no longer with scientism but learned to settle for the most likely interpretation of the evidence before them. This humble realisation, as much as any cascade of sudden revelations striking men of genius, provided the kick for the 'scientific revolution'. For Huygens, even physical principles might never be established with absolute certainty. In his last treatise, a speculation on life on other planets, published only after his death, he wrote: 'It is a glory to arrive at probability … But there are many degrees of probable, some nearer truth than others, in the determining of which lies the chief exercise of our judgment.' Christiaan Huygens had defined the task of the modern scientist.

Originally published at *Aeon* on 8 January 2021.

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

Dai, P., Williams, C.T., Witucki, A.M. et al. (2021). Rosalind Franklin and the Discovery of the Structure of DNA. *Science & Education*, 1-34. doi:10.1007/s11191-020-00188-6 online first

de Berg, K.C. (2021) An analysis of the difficulties associated with determining that a reaction in chemical equilibrium is incomplete. *Foundations of Chemistry*, 1-23. doi:10.1007/s10698-020-09393-1 online first

Hopkins, K. (2021). Neuroscience as a Contemporary Science Domain to Contextualize Nature of Science Instruction. *Science & Education*, 1-38. doi:10.1007/s11191-020-00187-7 online first

Jardim, W.T., Guerra, A. & Schiffer, H. (2021). History of Science in Physics Teaching. *Science & Education*, 1-30. doi:10.1007/s11191-020-00191-x online first

Lee, JK., Aini, R.Q., Sya'bandari, Y. et al. (2021). Biological Conceptualization of Race. *Science & Education*, 1-24. doi:10.1007/s11191-020-00178-8 online first

Rivera, S., Oliveira, A. (2021). "Why would Benjamin Franklin want to know if lightning was electricity?" Elementary teachers and students making sense of the nature of science during interactive read-alouds. *Cult Stud of Sci Educ*, 1-23. doi:10.1007/s11422-020-09988-2 online first

Samon, S., Levy, S.T. (2021). The Role of Physical and Computer-Based Experiences in Learning Science Using a Complex Systems Approach. *Science & Education*, 1-37. doi:10.1007/s11191-020-00184-w online first

Yacoubian, H.A. (2021) Students' Views of Nature of Science. *Science & Education*, 1-28

doi:10.1007/s11191-020-00179-7 online first

Recent HPS&ST Related Books

Durand, Pierre M. (2021) *The Evolutionary Origins of Life and Death*. Chicago IL: Chicago University Press. ISBN: 978-0-226-74762-0

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

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

More information available here.

Johansson, Lars-Göran (2021) *Empiricism and Philosophy of Physics*. Dordrecht: Springer. ISBN: 978-3-030-64953-1

"This book presents a thoroughly empiricist account of physics. By providing an overview of the development of empiricism from Ockham to van Fraassen the book lays the foundation for its own version of empiricism. Empiricism for the author consists of three ideas: nominalism, i.e. dismissing second order quantification as unnecessary, epistemological naturalism, and viewing classification of things in natural kinds as a human habit not in need for any justification.

"The book offers views on the realism-antirealism debate as well as on the individuation of theories as a thoroughly neglected aspect of underdetermination. The book next discusses a broad range of topics, including the predicates body, spatial distance and time interval, the ontology of electromagnetism, propensities, the measurement problem and other philosophical issues in quantum theory. Discussions about the direction of time and about string theory make up the final part of the book." (From the Publisher))

More information available here.

Fara, Patricia (2021) *Life after Gravity: Isaac Newton's London Career*. Oxford, UK: Oxford University Press. ISBN: 978-0-198-84102-9

"Isaac Newton is celebrated throughout the world as a great scientific genius who conceived the theory of gravity. But in his early fifties, he abandoned his life as a reclusive university scholar to spend three decades in London, a long period of metropolitan activity that is often overlooked. Enmeshed in Enlightenment politics and social affairs, Newton participated in the linked spheres of early science and imperialist capitalism. Instead of the quiet cloisters and dark libraries of Cambridge's all-male world, he now moved in fashionable London society, which was characterised by patronage relationships, sexual intrigues and ruthless ambition.

"Knighted by Queen Anne, and a close ally of influential Whig politicians, Newton occupied a power-

ful position as President of London's Royal Society. He also became Master of the Mint, responsible for the nation's money at a time of financial crisis, and himself making and losing small fortunes on the stock market. A major investor in the East India Company, Newton benefited from the global trading networks that relied on selling African captives to wealthy plantation owners in the Americas, and was responsible for monitoring the import of African gold to be melted down for English guineas.

"Patricia Fara reveals Newton's life as a cosmopolitan gentleman by focussing on a Hogarth painting of an elite Hanoverian drawing room. Gazing down from the mantelpiece, a bust of Newton looms over an aristocratic audience watching their children perform a play about European colonialism and the search for gold. Packed with Newtonian imagery, this conversation piece depicts the privileged, exploitative life in which this eminent Enlightenment figure engaged, an uncomfortable side of Newton's life with which we are much less familiar." (From the Publisher))

More information available here.

Kox, A.J., & Schatz, H. F. (2021) *A Living Work of Art: The Life and Science of Hendrik Antoon Lorentz*. Oxford, UK: Oxford University Press.
ISBN: 978-0-198-87050-0

"Hendrik Antoon Lorentz was one of the greatest physicists and mathematicians the Netherlands has ever known. Einstein called him "a living work of art, a perfect personality". During his funeral in 1928, the entire Dutch nation mourned. The national telegraph service was suspended for three minutes and his passing was national and international front-page news. The cream of international science, an impressive list of dignitaries, including the Prince Consort, and thousands of ordinary people turned out to see Lorentz being carried to his last resting place.

"This biography describes the life of Lorentz, from his early childhood, as the son of a market gardener in the provincial town of Arnhem, to his death, as a towering figure in physics and in international scientific cooperation and as a trailblazer for Einstein's relativity theory. A number of chapters shed light on his unique place in science, the importance of his ideas, his international conciliatory and scientific activities after World War One, his close friendship with Albert Einstein, and his important role as Einstein's teacher and intellectual critic.

By making use of recently discovered family correspondence, the authors were able to show that there lies a true human being behind Lorentz's façade of perfection. One chapter is devoted to Lorentz's wife Aletta, a woman in her own right, whose progressive feminist ideas were of considerable influence on those of her husband. Two separate chapters focus on his most important scientific achievements, in terms accessible to a general audience." (From the Publisher))

More information available here.

Lagerlund, Henrik, Hill, Benjamin, & Psillos, Stathis (Eds.) (2021) *Reconsidering Causal Powers: Historical and Conceptual Perspectives*. Oxford, UK: Oxford University Press.
ISBN: 978-0-198-86952-8

"Causal powers are returning to the forefront of realist philosophy of science. Once central features of philosophical thinking about the natures of substances and causes, they were banished during the early modern era and the Scientific Revolution. In this volume, distinguished scholars revisit the fortunes of causal powers as scientific explanatory principles within the theories of substance and cause across history. Each chapter focuses on the philosophical roles causal powers were thought to play at the time, and the reasons offered in support,

or against, their coherence and ability to perform these roles.

By placing rigorous philosophical analyses of thinking about causal powers within their historical contexts, features of their natures which might remain hidden to contemporary practitioners can be more readily identified and more carefully analysed. The thoughts of such prominent philosophers as Aristotle, Scotus, Ockham, and Buridan are explored, then on through Suarez, Descartes, and Malebranche, to Locke and Hume, and ultimately to contemporary figures like the logical positivists Goodman and Lewis." (From the Publisher))

More information available here.

Mitton, Jacqueline & Mitton, Simon (2021). *Vera Rubin: A Life (Foreword by Jocelyn Bell Burnell)*. Cambridge, MA: Harvard University Press.
ISBN: 978-0-674-91919-8

"One of the great lingering mysteries of the universe is dark matter. Scientists are not sure what it is, but most believe it's out there, and in abundance. The astronomer who finally convinced many of them was Vera Rubin. When Rubin died in 2016, she was regarded as one of the most influential astronomers of her era. Her research on the rotation of spiral galaxies was groundbreaking, and her observations contributed significantly to the confirmation of dark matter, a most notable achievement.

"In Vera Rubin: A Life, prolific science writers Jacqueline Mitton and Simon Mitton provide a detailed, accessible overview of Rubin's work, showing how she leveraged immense curiosity, profound intelligence, and novel technologies to help transform our understanding of the cosmos. But Rubin's impact was not limited to her contributions to scientific knowledge. She also helped to transform scientific practice by promoting the careers of women researchers. Not content to be an inspiration, Rubin was a mentor and a champion. She advocated for hiring women faculty, inviting women speakers to major conferences, and honouring women with awards that were historically the exclusive province of men.

"Rubin's papers and correspondence yield vivid insights into her life and work, as she faced down gender discrimination and met the demands of family and research throughout a long and influential career. Deftly written, with both scientific experts and general readers in mind, Vera Rubin is a portrait of a woman with insatiable curiosity about the universe who never stopped asking questions and encouraging other women to do the same." (From the Publisher)

More information available here.

Myrvold, Wayne C. (2021) *Beyond Chance and Credence: A Theory of Hybrid Probabilities*. Oxford, UK: Oxford University Press.
ISBN: 978-0-198-86509-4

"Concepts related to probability permeate physics. This is most obvious in statistical mechanics, in which probabilities appear explicitly, but even in cases when predictions are made with near-certainty, there are implicit probabilistic assumptions in play. How are we to understand these probabilistic concepts? How do they apply to the physical world? *Beyond Chance and Credence* offers a fresh look at these familiar topics, urging readers to see them in a new light. The book provides an overview of the history of philosophical debates about the nature of probability over the last three centuries, and clear and accessible introductions to conceptual issues in probability theory, thermodynamics, and statistical mechanics.

Myrvold argues that the traditional choice between probabilities as objective chances or else as degrees of belief is too limiting, and introduces a new concept, epistemic chances, that combines physical and epistemic considerations. He goes on to show

that conceiving of probabilities in this way solves some of the puzzles associated with the use of probability and statistical mechanics. The result is an innovative perspective on one of the most central topics in the philosophy of science." (From the Publisher)

More information available here.

Nolan, Jr., James L. (2020). *Atomic Doctors: Conscience and Complicity at the Dawn of the Nuclear Age*. Cambridge, MA: Harvard University Press. ISBN: 978-0-674-24863-2

"After his father died, James L. Nolan, Jr., took possession of a box of private family materials. To his surprise, the small secret archive contained a treasure trove of information about his grandfather's role as a doctor in the Manhattan Project. Dr. Nolan, it turned out, had been a significant figure. A talented ob-gyn radiologist, he cared for the scientists on the project, organised safety and evacuation plans for the Trinity test at Alamogordo, escorted the "Little Boy" bomb from Los Alamos to the Pacific Islands, and was one of the first Americans to enter the irradiated ruins of Hiroshima and Nagasaki.

"Participation on the project challenged Dr. Nolan's instincts as a healer. He and his medical colleagues were often conflicted, torn between their duty and desire to win the war and their oaths to protect life. Atomic Doctors follows these physicians as they sought to maximise the health and safety of those exposed to nuclear radiation, all the while serving leaders determined to minimise delays and maintain secrecy. Called upon both to guard against the harmful effects of radiation and to downplay its hazards, doctors struggled with the ethics of ending the deadliest of all wars using the most lethal of all weapons. Their work became a very human drama of ideals, co-optation, and complicity.

"A vital and vivid account of a largely unknown chapter in atomic history, Atomic Doctors is a profound meditation on the moral dilemmas that ordinary people face in extraordinary times." (From the Publisher)

More information available here.

Reiss, Michael J (2021) *Rethinking Biology: Public Understandings*. London, UK: World Scientific. ISBN: 978-9-811-20826-3

"Biologists always need to grapple with integrating two explanatory approaches. On the one hand, there is necessarily an effort to drill down to the lowest possible level to explain what is happening in whatever is being studied. That involves looking at how higher-level processes arise from lower level ones. On the other hand, there is a need to consider how the broader context influences bottom-up processes; that involves looking at how the whole influences the parts. Neither approach is satisfactory on its own. There is always a need to integrate the consideration of how parts influence wholes with how wholes influence parts.

"This book arises from a concern that in the public dissemination of biology the need to integrate these different perspectives is not coming across well. In popularisations, simplistic micro explanations always seem to arouse most interest and to capture the headlines. That risks distorting and simplifying the complexity of biological processes, and can mislead people. In this book we are urging a concerted attempt to come to grips with the interactive complexity of biology, and to find ways of conveying it to the public accessibly and effectively.

"We are particularly concerned with how biology is communicated to the public. Too often, what comes over to the public is a crude, out-of-date, simplistic, mono-causal, reductionist biology. Why so? Why is biology so misrepresented? Who is responsible? It is partly the media, of course, but we suggest that

biologists themselves are often partly responsible. When it comes to communication with the public, they tend to over-simplify in a way that distorts." (From the Publisher))

More information available here.

Rodríguez, Martínez & Laura, María (2021) *Texture in the Work of Ian Hacking: Michel Foucault as the Guiding Thread of Hacking's Thinking*. Dordrecht: Springer. ISBN: 978-3-030-64785-8

"This book offers a systematised overview of Ian Hacking's work. It presents Hacking's oeuvre as a network made up of four interconnected key nodes: styles of scientific thinking & doing, probability, making up people, and experimentation and scientific realism.

"Its central claim is that Michel Foucault's influence is the underlying thread that runs across the Canadian philosopher's oeuvre. Foucault's imprint on Hacking's work is usually mentioned in relation to styles of scientific reasoning and the human sciences. This research shows that Foucault's influence can in fact be extended beyond these fields, insofar the underlying interest to the whole corpus of Hacking's works, namely the analysis of conditions of possibility, is stimulated by the work of the French philosopher.

"Displacing scientific realism as the central focus of Ian Hacking's oeuvre opens up a very different landscape, showing, behind the apparent dispersion of his works, the far-reaching interest that amalgamates them: to reveal the historical and situated conditions of possibility for the emergence of scientific objects and concepts.

"This book shows how Hacking's deployment concepts such as looping effect, making up people, and interactive kinds, can complement Foucauldian analyses, offering an overarching perspective that can provide a better explanation of the objects of the human sciences and their behaviours." (From the Publisher))

More information available here.

Warde, Paul, Robin, Libby & Sörlin, Sverker (2021). *The Environment: A History of the Idea*. Baltimore, MD: Johns Hopkins University Press. ISBN: 978-1-421-44002-6

"What distinguishes this book's approach to intellectual history–in this case, the history of the idea of 'environment'–is the authors' meticulous and unwavering attention to histories of expertise, institutional power, and dominant imaginaries that influence the public career of an influential idea. A must read for those debating the environment today." – Dipesh Chakrabarty, The University of Chicago

"Impressive in the freshness of its argument, the depth of its coverage, and the seamlessness with which its authors, each a distinguished environmental historian, have managed to collaborate in its production. This book will appeal to anyone with a serious intellectual or practical interest in environmental issues. It is hard to imagine that anyone, no matter how extensive their familiarity with the subject, will not learn from this book." – Harriet Ritvo, Massachusetts Institute of Technology, author of *The Dawn of Green: Manchester, Thirlmere, and Modern Environmentalism*

"The Environment is intellectual history of the highest order. Through careful research and extraordinarily wide source material, the authors deftly and expertly unravel the complex and fascinating genealogy of one of the most powerful and influential concepts of the modern era." – Jane Carruthers, University of South Africa, author of *National Park Science: A Century of Research in South Africa*

"The team of Warde, Robin, and Srlin offer a compact, clear, and crisp intellectual history of the

concept of the environment. Ranging across the Anglophone world and sometimes beyond, they bring insight and historical context to their analysis of the crucial thinkers, ideas, and debates in environmental science as it evolved since the 1940s." – J. R. McNeill, Georgetown University, coauthor of *The Great Acceleration: An Environmental History of the Anthropocene since 1945*

"Is it possible for the economy to grow without the environment being destroyed? Will our lifestyles impoverish the planet for our children and grandchildren? Is the world sick? Can it be healed? Less than a lifetime ago, these questions would have made no sense. This was not because our ancestors had no impact on nature–nor because they were unaware of the serious damage they had done. What people lacked was an idea: a way of imagining the web of interconnection and consequence of which the natural world is made. Without this notion, we didn't have a way to describe the scale and scope of human impact upon nature. This idea was 'the environment.'

"In this fascinating book, Paul Warde, Libby Robin, and Sverker Sörlin trace the emergence of the concept of the environment following World War II, a period characterised by both hope for a new global order and fear of humans' capacity for almost limitless destruction. It was at this moment that a new idea and a new narrative about the planet-wide impact of people's behaviour emerged, closely allied to anxieties for the future. Now we had a vocabulary for talking about how we were changing nature: resource exhaustion and energy, biodiversity, pollution, and–eventually–climate change.

"With the rise of 'the environment,' the authors argue, came new expertise, making certain kinds of knowledge crucial to understanding the future of our planet. The untold history of how people came to conceive, to manage, and to dispute environmental crisis, The Environment is essential reading for anyone who wants to help protect the environment from the numerous threats it faces today."

(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

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

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

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

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

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

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

HPS&ST Related Organisations and Websites

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

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

DHST – Division of History, Science, and Technology

IHPST – International History, Philosophy, and Science Teaching Group

NARST – National Association for Research in Science Teaching

ESERA – European Science Education Research Association

ASERA – Australasian Science Education Research Association

ICASE – International Council of Associations for Science Education

UNESCO – Education

HSS – History of Science Society

ESHS – European Society for the History of Science

AHA – American History Association

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

BSHS – British Society for History of Science

EPSA – European Philosophy of Science Association

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

HOPOS – International Society for the History of Philosophy of Science

PSA – Philosophy of Science Association

BSPS – The British Society for the Philosophy of Science

SPSP – The Society for Philosophy of Science in Practice

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

PES – The Philosophy of Education Society (USA)

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

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

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