HPS&ST Note

December 2018

Introduction

This HPS&ST monthly note is sent direct to about 7,450 individuals who directly or indirectly have expressed 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 and more engaging and effective teaching of the history and philosophy of science. The note 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 20+ years.

The note 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 note (publications, conferences, opinion pieces, etc.) are welcome and should be sent direct to the editor:

Michael R. Matthews, UNSW, m.matthews@unsw.edu.au.

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

http://www.hpsst.com/

16th Congress of Logic, Methodology and Philosophy of Science and Technology (DLMPST), Czech Technical University, Prague, August 5-10

Czech Technical University, Prague, Czechia, 5–10 August 2019 The International Congress of Logic, Methodology and Philosophy of Science and Technology (CLMPST) is organized every four years under the auspices of the Division for Logic, Methodology and Philosophy of Science and Technology of the International Union for History and Philosophy of Science and Technology (DLMPST/IUHPST).

http://clmpst2019.flu.cas.cz/

The Institute of Philosophy of the Czech Academy of Sciences is proud to host the 16th CLMPST in the summer of 2019.

Submission deadline: 15 December 2018 CLMPST 2019 will host three plenary lectures, delivered by Heather Douglas, Joel D. Hamkins, and Sandra D. Mitchell, and over twenty invited lecturers including: Anna Alexandrova, Atocha Aliseda Llera, Christina Brech, Anna Brożek, Alex Broadbent, Valentin Goranko, Gerhard Heinzmann,

Gürol Irzık, Tarja Knuuttila, Jan Krajíček, Sabina Leonelli, Maryanthe Malliaris, Michael Matthews, Jonathan Okeke Chimakonam, Dunja Šešelja, Heinrich Wansing, and Sang Wook Yi. CLMPST 2019 calls for contributed papers and contributed symposia in 20 thematic sections grouped within fields:

- Logic
- General Philosophy of Science
- Philosophical Issues of Particular Disciplines

Contributed papers

Please submit, in EasyChair here an abstract of 500 words (including the references) prepared for anonymous review. Indicate to which section you submit the paper (tick the appropriate box).

The allocated time for each contributed paper is 30 minutes (including discussion).

All questions about submissions should be directed to the congress secretary, Mr. Martin Zach, at clmpst2019@flu.cas.cz.

The members of the programme committee are listed here.

Responsible Officials

Hanne Andersen (Chair of the Programme Committee)

Benedikt Löwe (Secretary General of the DLMPST/IUHPST)

Tomáš Marvan (Head of the Local Organizing Committee)

Mario Bunge Symposium at DLMPST: Contributors Invited

There is an opportunity to contribute to a proposed DLMPST congress symposium Appraising the Philosophical Contributions of Mario Bunge.

A 500-word abstract will be required to be submitted to the symposium organizer by December 1, and intention to do so, should be communicated in advance. Contributors cannot be making another presentation at the congress, and they must register for the congress.

Further information from Michael R. Matthews (m.matthews@unsw.edu.au)

International Congress on the History of Science in Education, May 30 – June 1, 2019, Vila Real, Portugal

The International Congress on the History of Science in Education is a joint organization of the University of Trás-os-Montes and Alto Douro (UTAD), University of Porto (UP), University of Coimbra (UC) and University of S. Paulo (USP), and it will take place on May 30, 31 and June 1, 2019, at Polo 1 of the School of Human and Social Sciences of UTAD, Portugal.

The 1ICHSE rises following the 1st Meeting of History of Science in Teaching and 2nd Meeting of History of Science in Teaching held at UTAD and UC, in 2015 and 2017, respectively, and it will take place every two years alternating between the universities involved.

The 1ICHSE aims to bring together researchers, professors and students, interested in the history and teaching of Biology, Geology, Chemistry, Physics and Mathematics, as well as Educational Sciences, Engineering, Medicine, Pharmacy, Biochemistry, Anthropology, Astronomy, Psychology, Economics, Sociology, Ecology, Molecular Biology and Nanosciences, among others, in a multi-centered and multidisciplinary debate.

In addition to works focused on teaching, education, didactics and dissemination of sciences, 1ICHSE seeks to bring together reflections and studies of a more general, disciplinary or interdisciplinary nature, in the history of culture, technology and industry, as well as epistemological, historiographic, biographical or prosopographic. Other topics relevant to the history of science and teaching, such as gender

studies, the teaching of science in a foreign language and, in general, the various aspects of the interactions between science, technology and the humanities are very important welcome to the dialogue space that 1ICHSE seeks to create.

Plenary Speakers:

- Carlos Fiolhais, Physics, Universidade de Coimbra
- Jorge Varanda, Anthropology, University of Coimbra
- Maria Elice Prestes, Biology, Universidade de São Paulo
- Michael Matthews, Education, University of New South Wales

Abstract submission: January 31, 2019

Full text submission; March 31, 2019

Conference Chair:

- Isilda Rodrigues, isilda@utad.pt

Depart. Education and Psychology,

University of Trás-os-Montes e Alto Douro, UTAD, Vila Real, Portugal.

Information available here.

15th International History, Philosophy and Science Teaching Group (IHPST) Biennial Conference, Thessaloniki, July 15-19, 2019

12th Cent. White Tower

School of Education, Aristotle University

The conference will take place at the Aristotle university of Thessaloniki which was founded in 1925 and occupies an area of 33 hectares in the city centre.

The conference will open on Monday afternoon with registration, an opening session and a welcome reception. On Tuesday, Wednesday and Thursday there will be full-day presentations. There will be scheduled opportunity to visit cultural sites and events in Thessaloniki.

Important Dates:

Abstract submission: January 20, 2019

Final paper submission: March 20, 2019

Full conference information available here.

Conference Chair: A/Professor Fanny Seroglou: ihpst2019@eled.auth.gr

Vale: Adolf Grünbaum (1923-2018)

Adolf Grünbaum (1923 – 2018) died November 15. He was a German-American philosopher of science and a critic of psychoanalysis, as well as Karl Popper's philosophy of science. He was the first Andrew Mellon Professor of Philosophy at the University of Pittsburgh from 1960 until his death, and also served as Co-Chairman of its Center for Philosophy of Science (from 1978), Research Professor of Psychiatry (from 1979), and Primary Research Professor in the Department of History and Philosophy of Science (from 2006). His twelve books include *Philosophical Problems of Space and Time* (1963), *The Foundations of Psychoanalysis* (1984), and *Validation in the Clinical Theory of Psychoanalysis* (1993).

He was born in Cologne, Germany, in 1923 and immigrated to the USA, where he built his career. A profile published by *Pitt Magazine* in 2002 described his childhood as a Jew in pre-World War II Germany, as the Nazis consolidated power.

"Grünbaum and his friends weren't allowed to play in the streets, take physical education, or visit public swimming pools," Jason Togyer wrote. "At the synagogue, at lectures, and in the Jewish culture clubs, he exercised his mind instead."

Grünbaum's parents immigrated to Brooklyn in 1938. From there, he attended high school and learned English, before moving on to Wesleyan University and later Yale University, where he received a master's degree in physics and a doctoral degree in philosophy.

It deserves mention that three Jewish refugee teenagers were at the same time welcomed into, and then graduated from Wesleyan, a university of the US Methodist Church: Adolf Grünbaum, Robert S. Cohen and Gerald Holton. They were lifelong friends; with each making significant contributions to history and philosophy of science. While Holton with his work with Harvard Project Physics also made an outstanding contribution to physics education.

Joseph Novak Autobiography: Free and Downloadable

Joseph Novak's Autobiography is available gratis here.

Novak was a leading figure in the thriving constructivist studies of children's thinking about nature their 'proto-scientific' concepts that begun in the 1970s and 1980s and was known as 'Conceptual Change Research' (Driver, Guesne & Tiberghien 1985).

In 1983 Novak hosted the first international 'Misconceptions in Science and Mathematics' research conference at Cornell University with 60 presentations (Helm & Novak 1983); the second conference was held in 1987 with 150 presentations (Novak 1987); the third conference was held in 1993 with many more presentations (Novak & Abrams 1993).

Novak guided work at Cornell University where in the decade after 1977 over 100 graduate students were enrolled, and where over his whole career he supervised or contributed to 300+ graduate students and visiting scholars. His distinct contribution was the creation and utilisation of Concept Mapping as a research and pedagogical tool (Novak & Gowin 1984).

Novak and the constructivist tradition rejected the then dominant behaviourist ac-

counts of learning, and also the competing Piagetian cognitive accounts. He maintained:

> Piaget's views on developmental psychology minimize the importance of language and instruction. Ausubel's theory emphasizes concepts as components of cognitive organization and their role in assimilation of new knowledge. (Novak 1977, p.45)

He embraced and co-authored a second edition of David Ausubel's *The Psychology of Meaningful Verbal Learning* (Ausubel, Novak & Hanesian 1978). Typical research questions were: How do children conceptualise and understand the natural world (objects, events and processes) before they enter science classes? How does this 'native' understanding and conceptualisation change in response to instruction? Are there identifiable barriers to scientific understanding? Are there cultural differences in children's science? How do students construct knowledge when they work in groups?' How do students negotiate meaning? And, what is involved in forming consensus?

This research tradition was largely empirical, descriptive, and phenomenological. The most recent version of the authoritative 'constructivism and research' bibliography prepared by Reinders Duit and colleagues at the University of Kiel is available on line and contains 8,400 entries (Duit 2009).

Novak, along with the entire constructivist tradition believed that Kuhn's account of theory change in science illuminated children's learning of science; and further that Kuhn's relativist epistemology and idealist ontology best captured the nature of science. Many have pointed out that this embrace of Thomas Kuhn by science education had detrimental intellectual and pedagogical consequences (Matthews 2004, 2015 sect.10).

Novak's autobiography weaves a rich account of the personal, academic, scholarly and family domains of his life, complete with many photos of family and colleagues. It includes comments about Herbert Feigl's philosophy of science course that he

took as a student at the University of Minnesota. Novak's failure to take the occasion of an autobiography to revisit and re-appraise his Kuhnian enthusiasms of forty years ago will be a disappointment to some readers, but that aside, his story illuminates many pages of the past sixty years of science education research.

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Philosophy of Science with Children

A growing number of science educators are doing philosophy with children as they learn science. Philosophical questions can ignite students' interests in science and expand their perspectives on science, reality and society. The philosopher Matthew Lipman observed that philosophical inquiry stimulates critical and creative thinking among students, and recent research has found a positive impact of doing philosophy on a range of outcomes for children. In the context of science education, philosophical dialogue may contribute to the discussion of big ideas such as substance, classification, the nature of science and ethically or culturally sensitive issues arising in the science class such as the theory of evolution or sexuality.

On 18th - 19th March 2019 the National STEM Learning Centre (UK), will host a 2 day event to explore philosophical dialogue in science education. The aim of the meeting is to share and reflect on approaches to doing philosophy in science education, and research on doing philosophy in science education.

To find out more please click here or contact Lynda Dunlop at York University at lynda.dunlop@york.ac.uk.

To contribute a paper, workshop or philosophical provocation, complete the form here.
(deadline 20th December).

Eddington Conference: Arthur S. Eddington: From Physics to Philosophy and Back Again, 27-29 May 2019, Paris

The centenary of the 29 May 1919 eclipse is a great opportunity for specialists to gather in Paris from 27 to 29 May 2019. This international conference aims to bring together physicists, philosophers and historians, in order to discuss the works and achievements of Arthur S. Eddington.

Speakers: Prof. J.D. Barrow (UK), Prof. G.F.R. Ellis (South Africa), Prof. S. French

(UK), Prof. D. Kennefick (USA), Prof. M. Kistler (France), Prof. H. Kragh (Denmark), Lord M. Rees (UK), Prof. J. Renn (Germany), Prof. J.-P. Uzan (France), Prof. D. Valls-Gabaud (France).

Detailed information is available on www.eddingtonstudies.org

It is jointly organised by IPC-Facultés Libres de Philosophie et de Psychologie and Paris Observatory, in partnership with the Institut d'Astrophysique de Paris, the International Astronomical Union, the British Society for the History of Science, and Trinity College (University of Cambridge).

Chair of the Local Organising Committee: Dr Florian Laguens: flaguens@ipc-paris.fr

Dates and deadlines
Deadline for submission : 31 December 2018

Opening of registration : 1 January 2019

Notification of acceptance : 1 February 2019

Deadline for registration : 30 April 2019

BSHS Translation Series Wilhelm Johannsen's *About Darwinism* …

The BSHS is delighted to announce the release of the second in our Translations series. Nils Roll-Hansen's translation of Wilhelm Johannsen's 'About Darwinism', seen from the point of view of the science of heredity' is now freely available on our website: http://www.bshs.org.uk/bshs-translations/

Introduction from the translator:

> "Wilhelm Johannsen is a standard reference in the history of genetics. He clarified the distinction between genotype and phenotype, and introduced the term 'gene'. He also carried out the famous experiment

of selection within pure lines of beans, an experiment that became a paradigmatic demonstration of the stability of genotype. Arguably Johannsen's experimental and theoretical development of the distinction between the phenotype – which depends on variation in environment, – and the genotype – which remains stable through generations, – provided the basis for genetics as an exact science, experimentally and theoretically.

"Johannsen's magisterial treatise *Elemente der exakten Erblichkeitslehre* [Introduction to an exact science of heredity] profoundly influenced the development of genetics in the early decades of the 20th century. The original publication of 1909 was followed by thoroughly revised editions in 1914 and 1926. Johannsen published only a couple of relatively short and specialized genetics papers in English (in particular, Johannsen 1907, 1911, 1923). The popular 1903 article on Darwinism and heredity that is translated below gives an insight into the background and context of his developing theory of genotype. The article was written the same year that he published his classical bean selection experiment (Johannsen 1903), and shows how Johannsen at that point related his ideas about heredity to running debates on evolution, systematics and plant breeding."

Nicola Sugden

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Downloadable and Gratis Book: *Being Modern: The Cultural Impact of Science in the Early Twentieth Century*

University College London Press (UCLP) announces the publication of a new open access book *Being Modern: The Cultural Impact of Science in the Early Twentieth*

Century, edited by Robert Bud, Paul Greenhalgh, Frank James and Morag Shiach.

Download free here.

In the early decades of the twentieth century, engagement with science was commonly used as an emblem of modernity. This phenomenon is now attracting increasing attention in different historical specialities. Being Modern builds on this recent scholarly interest to explore engagement with science across culture from the end of the nineteenth century to approximately 1940.

Addressing the breadth of cultural forms in Britain and the western world from the architecture of Le Corbusier to working class British science fiction, *Being Modern* paints a rich picture. Seventeen distinguished contributors from a range of fields including the cultural study of science and technology, art and architecture, English culture and literature examine the issues involved.

The book will be a valuable resource for students, and a spur to scholars to further examination of culture as an interconnected web of which science was a critical part, and to supersede such tired formulations as 'Science and culture'.

Opinion Page

Teaching research integrity – Using history and philosophy of science to introduce ideas about the ambiguity of research practice

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Statistics in Biology

Using quantitative methods in biology goes back to the experiments of Van Helmont in 1648 when he studied the effects of water and soil on the growth of willow trees. He concluded that willow trees consumed water rather than soil (Pagel 2002). Since then, biologists have had a difficult relationship with analyzing quantitative data. When Mendel used mathematical principles to analyze his data to understand heredity, no biologist at his time appreciated his work. It took decades for biologists to realize Mendel's genius (von Tschermak-Seysenegg 1951; Samuels et al. 2012). Ironically in the 21st century biologists are buried in data; knowing how to analyze them is unavoidable (Marx 2013). Despite this reality, statistics educa-

tion in an introductory biology class has been mediocre at best. Here, we discuss reasons for this disparity and the advantages of using science history – specifically, the history of statistical methods – in an introductory biology course.

Statistics is a branch of mathematics that deals with the science of collecting, organizing and interpreting data. After Van Helmont in the 17th century, the next notable usage of quantitative analytical methods in biology was in the 1830s when Adolph Quetelet, a Belgian astronomer, showed that human traits such as height and chest size were distributed in a Gaussian curve (Quetelet 1835).

However, the real surge in the use of statistical methods in biological sciences took place at the beginning of the 20th century. English statisticians Francis Galton, Karl Pearson and Walter F.R. Weldon urged biologists to use statistical methods in their research. In 1901, they founded the first journal for statistical methods, named *Biometrika* (Magnello 2009). Since then statisticians have revolutionized the way biologists analyze data, resulting in scientific achievements that would have never been possible without the use of advanced statistical techniques (Keiding 2005).

For example, the yield of corn in the United States has increased by more than ten times within the last century using advanced statistical methods and breeding techniques (NASS 2016). Public health accomplishments such as successful immunizations for diseases like polio have built on statistical methods such as randomized controlled trials (Meldrum 2000). Jerome Cornfield, a statistician, designed the Framingham heart study in the 1960s that led scientists to narrow down the causes of heart diseases and strokes to dietary factors such as cholesterol, fat and salt (Truett et al. 1967). Since then heart diseases have decreased by 56% and stokes by 70% in the United States (Thom et al. 2006). The use of statistics in biological research has led to other significant achievements, including decreased infant mortality rate, increased motor vehicle safety, and better nutrition.

Despite this widespread use of statistics in biological research, learning statistical methods in an introductory biology classroom has not changed much. The pedagogy for biology and for statistics differ significantly in an introductory biology course. Biology often draws on history, referring to Darwin, Mendel, and Watson

and Crick to explain key ideas. But unlike biology, teaching statistics does not usually draw on the history of a certain concept. Statistics is taught as certain set of rules that students can apply in data analysis of a biological experiment. Unfortunately, this approach means that students don't understand the context for using statistics and often fail to understand how to best use statistics in biology. Here, we discuss the rationale for changing the mode of statistics instruction, showing how science history could play an influential role in improving statistics instruction in biology courses.

Need for Better Statistics Education in Biology

The amount of data generated in biology is at an all-time high. Low cost, high throughput genome sequencing, automation, information technology and robotics in data collection have all contributed to the overabundance of data generated in the biological sciences. For example, public genome repositories such as the National Center for Biotechnology Information (NCBI) already store petabytes of data (Singer 2013). Recently a study compared the amount of data generated in four prolific domains: Astronomy, YouTube, Twitter and Genomics. By 2025, genomic data is projected by the study to need more storage requirements than all the other fields (Stephens et al. 2015). This reality has pushed biological researchers to need more data analytics skills than ever before (Feser et al. 2013). However, most biologists are not trained to have data skills – knowing how to store, integrate, move and analyze large amounts of data (National Research Council 2003).

Even though several statistical packages and software are designed for biologists and are available to perform data analysis, certain steps in biological experiments – like designing an experiment and choosing the tests based on the context of an experiment – require significant knowledge and experience in statistical analysis (Friedman 2001). Performing biological experiments using big data without the best analytical training can lead to spurious results due to biased experimental designs or incorrect interpretation of results (Mertz 2008). Since several high impact factor journals accept only studies with statistically significant results, some biologists are known to selectively publish only data that is statistically significant and this has led to a toxic habit of data falsification or p-hacking. Some suggest that

this is one of the major reasons that biological researchers struggle with reproducibility of results (Head et al. 2015).

Even though students are encouraged to attend the statistics courses offered by the biometrics department of a university, many biology students do not enjoy taking these classes . This is because many of them lack context and are designed for a different audience. Teaching statistical methods as a set of rules to be applied to a certain biological problem removes context. And removing context will prevent students from gaining deep understanding. Starting with Aristotle in the 4th century B.C.E., scholars have emphasized the importance of context in learning (Weibell C. J. 2011). Students will better appreciate a statistical method if they understand why a certain statistical method is used rather than just how a method is used. This in turn, will enhance their understanding of statistical methods while simultaneously improving their confidence and creativity in data analysis.

Science History in Pedagogy

One of the first to suggest the use of history of science in general education was the renowned Harvard chemist (and later president), Dr. James B. Conant. He believed that learning science history would help students understand the strategies and "tactics" of science. Under his leadership a book titled *Harvard case histories in experimental sciences* was published (Conant 1957). The book contained eight specific cases of scientific innovation that described the process of science through case studies. Following this model, case studies such as "Davy's visit to France and the investigation of Iodine" were used in chemistry education to describe the process of science to students (Klopfer 1969).

Later, physicists came to understand the value of science history and have used it in various undergraduate physics classrooms (Gooday et al. 2008). For example, Demirci et al (2017) have implemented science history as a successful tool to facilitate deep understanding of neutrinos in a physics classroom. History of science can help especially in teaching commonly unclear concepts to students. For example Coelho (2010) uses the history of science to teach the complicated definition and understanding of "force" in physics.

However, some educators have argued that the history of certain scientific concepts might provide a poor model for responsible conduct of research and that beginners should be shielded from knowing the history of those concepts (Brush 1974). Considering that the person who coined the term "regression" in statistics is also the person who coined the term "eugenics," some argue that teaching science history might not be the best idea in statistics.

However, teaching the history of statistics is not only helpful but vital because students need to understand how usage of statistics in science has "evolved" over time. Student do need to know that Galton invented statistics for purposes that today we would call racist. That way, they can understand both the power of statistics and the care that needs to be used in applying and interpreting statistical tools. Unfortunately, almost all statistical textbooks oversimplify data analysis methods and represent an image of comprehensive certainty. This culture in the pedagogy of statistical training in biology has the potential to be disastrous, especially considering that we live in a time where data analysis is the most challenging problem of the field (Diggle 2015). With little or no information on how or why statistical methods were developed, students may become frustrated and leave the field; even more critical, not knowing the importance of context could lead to incorrect interpretation of experimental results.

Data generated in biological sciences requires unique statistical methods that can be significantly different from the methods used in other disciplines such as astronomy. In the past, when biologists were challenged with this problem, innovative individuals like Frank Wilcoxon and Charles Spearman were brave enough to invent appropriate statistical methods that worked for their field. We need the current learners of statistics to have the same mindset of innovation in analyzing data, science history can play a major role in inspiring them to do that.

Incorporating science history into undergraduate biology courses

Designing an introductory biology class is a massive challenge by itself. It is hard to incorporate the essentials of the broad field of biology in a single class. Even though a wide range of materials are covered in these courses, instructors also somehow

manage to introduce basic statistical analysis. Students are exposed to these statistical methods and are asked to perform quick data analyses to get to some results and conclusions. Due to this limited exposure of statistics, most students do not consider themselves as experts in these statistical methods after an introductory biology course. Despite this, many of them start their research carriers by working in research labs where statistics appear all the time (National Research Council 2003).

Generating and evaluating scientific evidence is considered a fundamental requirement for literacy in science by the US National Academies of Science (National Research Council 2009). Despite the importance of this issue, very little research has been done on integrating statistics in undergraduate biology courses (Bialek & Botstein 2004; Colon-Berlingeri et al. 2011; Metz et al. 2008).

Before teaching students the history of statistical methods, it is important to know the student perspective on learning statistics. We conducted a survey about learning the history of statistical methods in a large introductory biology class (~400 students) at Cornell University. The course "Investigative Biology Labs" (BioG1500) introduces students to college level statistics for the first time. One of the major conclusions from the study was that the majority of the students felt learning science history would improve their understanding of statistical methods (Palanichamy et al. 2018).

Since students are exposed to only a few basic statistical methods in an introductory biology course, adding additional science history to the course material is feasible. Developing case studies related to specific statistical methods and adding them to the statistics course material could be a viable teaching strategy. This could be followed by classroom discussions, reflection papers etc.

Providing students with supplemental reading materials such as biographical articles or books related to the development of statistical methods is another strategy that one could consider (Klopper 1969). Another method is to develop short science history videos and share them in an educational online platform. For more advanced classes, one might consider providing students with original research art-

icles or conference proceedings by scientists and discuss them in class. Science history could also be taught in a lecture format by strategically incorporating relevant history before introducing a certain statistical method. Although the educational efficacy of science history in teaching statistics needs to be experimentally shown, it is worthwhile to experiment with novel pedagogical approaches to improve statistics education in biology.

Conclusion

Developing a biology course with statistics and science history of statistical methods can be a challenging task. However, without a sound data analysis curriculum in biology we might not be training competent graduates for the current era of big data biology. Instructors are aware of this problem and are trying to improve their courses. One of the major concerns in biological research is the failure of identification of causations in big data projects. Some skeptics believe that without meaningful biological results the current trend of funding big data projects in biology could be short lived, which in turn might slow down the progress of research and development (Singer 2013). These reasons justify the urgent need for better pedagogical research on teaching statistical methods in undergraduate biology courses. Inspiring innovation in data analysis for aspiring biologists is no longer an option but a necessity. The traditional statistics instruction in biology fails in this area. Learning statistics with context using science history could be the missing link in statistics instruction of undergraduate biology courses.

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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 in the OPINION folder at the HPS&ST web site:

http://www.hpsst.com/.

Previous HPS&ST Note Opinion Pieces at http://www.hpsst.com/

Frederick Grinnell, Biology Department, University of Texas, Teaching research integrity – Using history and philosophy of science to introduce ideas about the ambiguity of research practice (November 2018)

New York Times, Creeping Bias in Research: Negative Results Are Glossed Over (October 2018)

Michael Matthews, School of Education, UNSW, An Occasion to Celebrate: Mario Bunge's 99th Birthday (September 2018)

Cormac Ó Raifeartaigh, Waterford Institute of Technology, Ireland, History of Science in Schools (July 2018)

Hugh Lacey, Philosophy Department, Swarthmore College, Appropriate Roles for Ethics and Social Values in Scientific Activity (June 2018)

Gerald Holton, Physics Department, Harvard University, Tracing Tom Kuhn's Evolution: A Personal Perspective (April/May 2018)

Monica H. Green, History Department, Arizona State University, On Learning How to Teach the Black Death (March 2018).

Stephen Pinker, Psychology Department, Harvard University, The Intellectual War on Science (February 2018).

Michael Ruse, Philosophy Department, Florida State University, Does Life Have Meaning? Or is it Self-Deception at Best and Terrifyingly Absurd at Worst? (January 2018).

Mario Bunge, Philosophy Department, McGill University, In Defence of Scientism (December 2017).

Susan Haack, Philosophy and Law Departments, University of Miami, The Future of Philosophy, the Seduction of Scientism (November 2017).

Nicholas Maxwell, University College London, What's Wrong with HPS and What Needs be Done to Put it Right? (June 2017).

Heinz W. Drodste, An Interview with Mario Bunge (May 2017).

Nicholas Maxwell, University College London, The Crisis of Our Times and What to do About It (April 2017).

Eric Scerri, UCLA, Bringing Science Down to Earth (March 2017).

Robert Nola, University of Auckland, Fake News in the Post-Truth World, (February 2017).

Michael D. Higgins, President of Ireland, The Need to Teach Philosophy in Schools (December 2016).

Philip A. Sullivan, University of Toronto, What is wrong with Mathematics Teaching in Ontario? (July 2016).

Gregory Radick, Leeds University, How Mendel's legacy holds back the teaching of science (June 2016).

Matthew Stanley, New York University, Why Should Physicists Study History?

PhD Theses in HPS&ST Domain

Candidate's name and email: Cody Williams, cody.t.williams@wmich.edu

Institution: Western Michigan University

Supervisor: Dr. David Rudge

Thesis title: *Effects of Historical Story Telling on Student Understanding of NOS and Mendelian Genetics*

Abstract:

Science education researchers have long advocated the central role of the nature of science (NOS) for our understanding of scientific literacy. NOS is often interpreted narrowly to refer to a host of epistemological claims associated with the process of science and the limitations of scientific knowledge. Practitioners and researchers alike acknowledge that students have difficulty learning NOS and that this in part reflects how difficult it is to teach. One promising method for teaching NOS and science content involves an explicit and reflective approach using historical stories. The purpose of this study is to compare a traditionally taught genetics unit in a non-major introductory biology course, to the same genetics unit taught using a historical story based on Gregor Mendel. Mixed methods were used to determine whether and how the use of historical stories influences undergraduates' understanding of NOS and genetics content. Particular attention was paid to the explanations students used for their understandings. Intervention and control groups completed the SUSSI instrument and a two-tier genetics instrument pre-and post-instruction. Participants were also interviewed regarding their responses to both instruments and their experiences in the course.

The SUSSI Likert results showed that the intervention group made statistically significant gains in their understanding of the role of imagination and creativity in science. These results indicate historical stories helped participants gain a better understanding of this aspect of NOS. The interviews provided additional support in that participants mentioned historical stories in their explanations for why they changed towards more informed views on SUSSI items related to imagination and

creativity. Additionally, students recognized that stories were used in the intervention group without prompting and felt they were helpful for learning about science. The current study adds to a growing body of literature regarding the use of stories in the science classroom.

Weblink: https://scholarworks.wmich.edu/dissertations/3158

This is a new section of the monthly HPS&ST Note. The Note is the ideal medium for publicizing 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

Billingsley, B., Nassaji, M., Fraser, S. et al. (2018 Framework for Teaching Epistemic Insight in Schools. *Research in Science Education*, 1-17. doi:10.1007/s11165-018-9788-6 online first

Burke, L. C.-A., Wessels, A. & McAvella, A. (2018) Using Theater and Drama to Expose and Expand the Epistemic Insights of Youth Regarding the Nature of Science. *Research in Science Education*, 1-19. doi:10.1007/s11165-018-9782-z

Carman, C. C., & Recio, G. L. (2018) Ptolemaic planetary models and Kepler's laws. *Archive for History of Exact Sciences*, 1-86. doi:10.1007/s00407-018-0219-x Online first

Currie, A. & Walsh, K. (2018) Frameworks for Historians & Philosophers. *HOPOS The Journal of the International Society for the History of Philosophy of Science*. doi:10.1086/699797 just accepted

Erduran, S. & Kaya, E. (2018) Drawing Nature of Science in Pre-service Science Teacher Education: Epistemic Insight Through Visual Representations. *Research in Science Education*, 1-17. doi:10.1007/s11165-018-9773-0 online first

García-Carmona, A. (2018) Improving Pre-service Elementary Teachers' Understanding of the Nature of Science Through an Analysis of the Historical Case of Rosalind Franklin and the Structure of DNA. *Research in Science Education*, 1-27. doi:10.1007/s11165-018-9798-4 online first

Hawley, P. H., & Sinatra, G. M. (2018) Declawing the dinosaurs in the science classroom: Reducing Christian teachers' anxiety and increasing their efficacy for teaching evolution. *Journal of Research in Science Teaching*, 1-27. doi:10.1002/tea.21479 online first

Melo, É., & Bächtold, M. (2018) A Theater-Based Device for Training Teachers on the Nature of Science. *Science & Education*, 1-24. doi:10.1007/s11191-018-0009-5

Stadlbauer, J.M., Kehrer, L.K., & Bauer, S. (2018) Using history to foster critical scientific thinking: Aristotle and Galileo's debate resolved through high-speed motion tracking in the classroom. *American Journal of Physics* 86, 903, doi:10.1119/1.5062167

Recent HPS&ST Related Books

Ambrosio, Chiara & Maclehose, William (Eds.) (2018) *Imagining the Brain: Episodes in the History of Brain Research* (Volume 243). Cambridge, MA: Academic Press. ISBN: 9780128142578

> "Progress in Brain Research series, highlights new advances in the field, with this new volume presenting interesting chapters. Each chapter is written by an international board of authors." (from the Publisher)

More information available here.

Ben-Menahem, Yemima (2018) *Causation in Science*. Princeton, NJ: Princeton University Press ISBN9781400889297

> "*Causation in Science* puts forward a new way of thinking about causality and is a shining example of intelligent and sophisticated philosophical analysis. I highly recommend this book." – Margaret Morrison, author of *Reconstructing Reality: Models, Mathematics, and Simulations*
>
> "An important and novel scholarly contribution. Against those who would relegate causality to 'folk science,' Ben-Menahem convincingly argues that causal notions and their associated constraints permeate science, moreover that this is true both in fundamental sciences such as physics as well as in the higher-level sciences." – Michael Cuffaro, Rotman Institute of Philosophy, University of Western Ontario

More information available here.

Bliss, Catherine (2018) *Social by Nature: The Promise and Peril of Sociogenomics*. Redwood City, CA: Stanford University Press. ISBN: 9781503603967

> "Sociogenomics has rapidly become one of the trendiest sciences of the new millennium. Practitioners view human nature and life outcomes as the result of genetic and social factors. In Social by Nature, Catherine Bliss recognizes the promise of this interdisciplinary young science, but also questions its implications for the future. As she points out, the claim that genetic similarities cause groups of people to behave in similar ways is not new–and a dark history of eugenics warns us of its dangers.
>
> "Over the last decade, sociogenomics has enjoyed a largely uncritical rise to prominence and acceptance in popular culture. Researchers have published studies showing that things like educational attainment, gang membership, and life satisfaction are encoded in our DNA long before we say our first word. Strangely, unlike the racial debates over IQ scores in the '70s and '90s, sociogenomics has not received any major backlash. By exposing the shocking parallels between sociogenomics and older, long-discredited, sciences, Bliss persuasively argues for a more thoughtful public reception of any study that reduces human nature to a mere sequence of genes.
>
> "This book is a powerful call for researchers to approach their work in more socially responsible ways, and a must-read for anyone who wants to better understand the scholarship that impacts how we see ourselves and our society. (From the Publishers)

More information available here.

Bordoni, Stefano (2017) *When Historiography Met Epistemology*. Leiden, The Netherlands: Brill. ISBN: 978-90-04-31523-5

> "In *When Historiography Met Epistemology*, Stefano Bordoni shows the emergence of sophisticated histories and philosophies of science in French speaking countries in the second half of the nineteenth cen-

> tury. That process involved mathematicians, scientists, and philosophers, and was deeply linked to other processes that transformed the cultural and material landscape of Europe. In the literature, the emergence of the history and philosophy of science is chronologically associated with the turn of the twentieth century: the author points out that this meaningful starting point should be moved backwards. Since the 1860s, sophisticated histories of science and critical metatheoretical remarks on scientific practice began to compete with naïve historical reconstructions and dogmatic views on science." (From the Publishers)

More information available here.

Coventry, Angela M. & Sager, Alexander (Eds.) (2018) *The Humean Mind*. Abingdon, UK: Routledge ISBN: 9781138909878

> "This volume is a singular achievement in its unique combination of depth and breadth. The range is dazzling and is not sacrificed for quality – the volume is exemplary for its mix of established and excellent younger scholars as well as drawing on contributors from a wide range of subjects. Although there are many collections on Hume this one really is a must. – Aaron Garrett, Boston University, USA

More information available here.

Curry, Helen Anne, Jardine, Nicholas, Secord, James Andrew & Spary, Emma C. (Eds.) *Worlds of Natural History*. Cambridge, UK: Cambridge University Press. ISBN: 9781316649718

> "This massive, comprehensive, and extremely rich collection of essays features a stellar cast of contributors who have created a worthy sequel to *Cultures of Natural History*. From its elegant introduction to

its colorful chapters and provocative afterword on the continuing vitality of natural history in the twenty-first century, this book fascinates and instructs. Dazzled by its contents, readers will have a difficult time deciding which compartment in this cabinet of curiosities to open first. This is scholarship in the history of science at its finest." – Bernard Lightman, Fellow of the Royal Society of Canada, President of the History of Science Society, and York University

"This volume offers a cornucopia of new approaches to writing the history of natural history from the Renaissance to today. With attention to shifting epistemologies and material cultures, it situates ancient traditions of collecting, classifying, and preserving nature in relation to the modern biological and earth sciences. In our present era of vanishing biological diversity, the authors consider the lessons of the past for the future of both elite and popular scientific institutions, from seed banks to museums and zoos." – Deborah R. Coen, Yale University, Connecticut

"*Worlds of Natural History* comes as close as is humanly possible to living up to its title. The essays illuminate almost every aspect of the vast enterprise of natural history, from collecting, networking, and voyaging to preserving, image-making, and classifying. Its sites are as various as the Renaissance apothecary's shop and the contemporary genetics lab; its locales criss-cross the globe. This book crystallizes decades of historical scholarship, and is the single best introduction to the topic." – Lorraine Daston, Director, Max Planck Institute for the History of Science, Berlin

More information available here.

Gillett, Carl (2018) *Reduction and Emergence in Science and Philosophy*. Cambridge, UK: Cambridge University Press. ISBN: 9781107428072

"This impressive book by Carl Gillett offers a new perspective on an

old idea, emergence, an idea that has refused to go away in spite of the many damaging criticisms over the years. It is noteworthy that the concept has found many champions among the practicing scientists working in fields such as physics, life science, cognitive neuroscience, and systems theory. Gillett's account is based in a deep knowledge of the history of emergence in both philosophy and science, presenting a formidable challenge to the critics and skeptics in the field. It should help to elevate the debates to a new level. Highly recommended to all who are interested in mind, philosophy of mind, and philosophy of science." – Jaegwon Kim, Brown University, Rhode Island

"Carl Gillett's masterful book is a comprehensive and original contribution to the philosophical discussion of emergence and reduction in science and philosophy." – Barry Loewer, Rutgers University, New Jersey

More information available here.

Maxwell, Nicholas (2018) *The Metaphysics of Science and Aim-Oriented Empiricism: A Revolution for Science and Philosophy.* Dordrecht: Springer. ISBN 978-3-030-04143-4

"This book tackles two fundamental problems: How can our human world exist and best flourish embedded as it is in the physical universe? What role do untestable, metaphysical ideas about the nature of the physical universe play in science?

"In connection with the first, it is argued that physics is concerned only with a highly selective aspect of all that there is - that aspect that determines how events unfold. Physics ignores human experience and consciousness, first because they are not needed to fulfil the predictive and explanatory tasks of physics, and second because they must be ignored if physics is to develop the beautifully explanatory theories that it does develop.

> "In connection with the second fundamental problem, it is argued that physics, as a result of accepting unified theories only, makes a highly problematic metaphysical assumption about the nature of the physical universe: it is such that some unknown, unified "theory of everything" is true. Precisely because this assumption is so profoundly problematic, it needs to be made explicit within physics, so that it can be critically assessed and, we may hope, improved. The author puts forward a revolutionary philosophy of science called aim-oriented empiricism (AOE), designed to facilitate improvement in the metaphysics of physics, as physics proceeds.
>
> "The author has devoted many years developing AOE and publishing papers on it. Here he spells out the implications of AOE for the metaphysics of science. The main body of the book expounds and critically assesses many key works in the metaphysics of science published from 2007 to 2018. The book concludes by considering the broader implications of aim-oriented empiricism, for science, for academic inquiry and, even, for the future of humanity." (From the Publisher)

More information available here.

O'Connor, Cailin & Weatherall, James Owen (2019) *The Misinformation Age: How False Beliefs Spread*. New Haven, CT: Yale University Press. ISBN: 9780300234015

> "Why should we care about having true beliefs? And why do demonstrably false beliefs persist and spread despite consequences for the people who hold them? Philosophers of science Cailin O'Connor and James Weatherall argue that social factors, rather than individual psychology, are what's essential to understanding the spread and persistence of false belief. It might seem that there's an obvious reason that true beliefs matter: false beliefs will hurt you. But if that's right, then why is it (apparently) irrelevant to many people whether they believe true things or not?

> "In an age riven by 'fake news,' 'alternative facts,' and disputes over the validity of everything from climate change to the size of inauguration crowds, the authors argue that social factors, not individual psychology, are what's essential to understanding the persistence of false belief and that we must know how those social forces work in order to fight misinformation effectively." (From the Publisher)

More information available here.

Stegenga, Jacob (2018) *Care and Cure: An Introduction to Philosophy of Medicine*. Chicago, IL: The University of Chicago Press. ISBN: 9780226595177

> "The philosophy of medicine has become a vibrant and complex intellectual landscape, and *Care and Cure* is the first extended attempt to map it. In pursuing the interdependent aims of caring and curing, medicine relies on concepts, theories, inferences, and policies that are often complicated and controversial. Bringing much-needed clarity to the interplay of these diverse problems, Jacob Stegenga describes the core philosophical controversies underlying medicine in this unrivaled introduction to the field.
>
> "The fourteen chapters in *Care and Cure* present and discuss conceptual, metaphysical, epistemological, and political questions that arise in medicine, buttressed with lively illustrative examples ranging from debates over the true nature of disease to the effectiveness of medical interventions and homeopathy. Poised to be the standard sourcebook for anyone seeking a comprehensive overview of the canonical concepts, current state, and cutting edge of this vital field, this concise introduction will be an indispensable resource for students and scholars of medicine and philosophy." (From the Publishers)

More information available here.

Smythies, John R. & French, Robert (Eds.) (2018) *A Neurophilosophical Debate on Consciousness*. Cambridge, MA: Elsevier. ISBN: 9780128121412

> "*Direct versus Indirect Realism: A Neurophilosophical Debate on Consciousness* brings together leading neuroscientists and philosophers to explain and defend their theories on consciousness. The book offers a one-of-a-kind look at the radically opposing theories concerning the nature of the objects of immediate perception–whether these are distal physical objects or phenomenal experiences in the conscious mind. Each side–neuroscientists and philosophers–offers accessible, comprehensive explanations of their points-of-view, with each side also providing a response to the other that offers a unique approach on opposing positions.
>
> "It is the only book available that combines thorough discussion of the arguments behind both direct and indirect realism in a single resource, and is required reading for neuroscientists, neurophilosophers, cognitive scientists and anyone interested in conscious perception and the mind-brain connection." (From the Publisher)

More information available here.

Tallis, Raymond (2018) *Logos. The Mystery of How We Make Sense of the World*. New, York, NY: Columbia University Press. ISBN: 9781788210874

> "Our sense-making capabilities and the relationship between our individual and collective intelligence and the comprehensibility of the world are both remarkable and deeply mysterious. Our capacity to make sense of the world and the fact that we pass our lives steeped in knowledge and understanding, albeit incomplete, that far exceeds what we are or even experience have challenged our greatest thinkers for centuries.
>
> "In *Logos*, Raymond Tallis steps into the gap between mind and world to explore what is at stake in our attempts to make sense of our world

and our lives. With his characteristic combination of scholarly rigor and lively humor he reveals how philosophers, theologians, and scientists have sought to demystify our extraordinary capacity to understand the world by collapsing the distance between the mind that does the sense-making and the world that is made sense of. Such strategies–whether by locating the world inside the mind, or making the mind part of the world–are shown to be deeply flawed and of little help in explaining the intelligibility of the world. Indeed, it is the distance that we need, argues Tallis, if knowledge is to count as knowledge and for there to be a distinction between the knower and the known.

"Tallis brings his formidable analysis to bear on the many challenges we face when trying to make sense of our sense-making. These include the idea of cognitive progress, which presupposes a benchmark of complete understanding; cognitive completion, which unites the separate strands of our understanding (from the laws of nature to our ineluctable everyday understanding of things, incorporating the meanings we live by); and the knowing subject–us–with our partial and limited viewpoint mediated by our bodies.

"The book showcases Tallis's enviable knack of making tricky philosophical arguments cogent and engaging to the non-specialist and his remarkable ability to help us see humankind more clearly. For anyone who has shared Einstein's observation that 'the eternal mystery of the world is its comprehensibility,' the book will be fascinating and insightful reading." (From the Publisher)

More information available here.

Zwierlein, Cornel (2018) *Imperial Unknowns: The French and British in the Mediterranean, 1650–1750*. Cambridge, UK: Cambridge University Press. ISBN: 9781316617502

"In this major study, the history of the French and British trading empires in the early modern Mediterranean is used as a setting to test

a new approach to the history of ignorance: how can we understand the very act of ignoring - in political, economic, religious, cultural and scientific communication - as a fundamental trigger that sets knowledge in motion? Zwierlein explores whether the Scientific Revolution between 1650 and 1750 can be understood as just one of what were in fact many simultaneous epistemic movements and considers the role of the European empires in this phenomenon. Deconstructing central categories like the mercantilist 'national', the exchange of 'confessions' between Western and Eastern Christians and the bridging of cultural gaps between European and Ottoman subjects, Zwierlein argues that understanding what was not known by historical agents can be just as important as the history of knowledge itself." (From the Publisher)

More information available here.

Authors of HPS&ST-related papers and books are invited to bring them to attention of the Note's assistant editors, Paulo Maurício at paulo.asterix@gmail.com or Nathan Oseroff at nathanoseroff@gmail.com for inclusion in these sections.

Coming HPS&ST Related Conferences

January 17-18, 2019. Double-Helix History: DNA and the past Abstract deadline: 15 September
Details available here.

February 25-27, 2019, Third International Conference of the German Society for Philosophy of Science (GWP.2019), Cologne, Germany.
More information available here.

March 29-30, 2019, The Philosophy of Ian Hacking. Institute of Philosophy, Research Centre for the Humanities, Hungarian Academy of Sciences

Inquiries to Dr. Akos Sivado, akos.sivado@gmail.com

March 31 – April 3, 2019, NARST Annual Conference, Baltimore, USA
Details at: https://www.narst.org/

April 1-4, 2019, Evolution Evolving: Process, Mechanism and Theory, Churchill College, University of Cambridge, UK
Details at: https://evolutionevolving.org/

April 24-26, 2019, British Society for the History of Philosophy Annual Conference, King's College London. Strand Campus, London, UK.
Details available here.

May 13-16, 2019, Second Hermann Minkowski Meeting on the Foundations of Spacetime Physics, Albena, Burgaria
Details available here

May 24-27, 2019, American Symposium on the History of Logic: Validity throughout History, University of California, Los Angeles, US.
For further information: Graziana Ciola (grazianaciola@g.ucla.edu)

May 29-31, 2019, Plastics Heritage: History, Limits and Possibilities. Museu da Famácia (Pharmacy Museum) in Lisbon, Portugal
Details available here

July 15-19, 2019, International History, Philosophy and Science Teaching Group, Biennial Conference, Thessaloniki, Greece.
Details from conference chair, Fanny Seroglou, fannyseroglou@gmail.com

July 22-26, 2019, The 46th Annual Hume Society Conference, University of Nevada, Reno, NV, USA.
Details available here.

July 26-28, 2019, 4th International Periodic Table Conference: 'Mendeleev 150', ITMO University, St Petersburg, Russia
Details available here.

August 5-10, 2019, 16th Congress of Logic, Methodology and Philosophy of Science and Technology (CLMPST), Prague, Czech Republic.
For updates and details see here.

September 2-4, 2019. European Conference for Cognitive Science (EuroCogSci 2019), Ruhr-Universität Bochum, Germany.
More information: EuroCogSci2019@rub.de.