History and Philosophy of Mathematics
Histoire et philosophie des mathématiques

(Org: **Maritza Branker** (Niagara) and/et **Nicolas Fillion** (Simon Fraser University))

AMY ACKERBERG-HASTINGS, MAA Convergence

HoM Toolbox: Historiography and Methodology for Mathematicians

How and where do mathematicians learn to research and write history? How easily can they find out about current methods and discussions by historians of mathematics and science? MAA Convergence is helping address both questions with a new article series that will give an overview of professional practice in history and provide examples of how historians of mathematics have applied specific methods and theories of historical interpretation. The initial installment considers:

1. What is history? Why should readers want to research and write it well?
2. How do we know about the past?
3. How do we create history based on what we know about the past?
4. What is the history of the history of mathematics?
5. How can readers articulate their own philosophies of the history of mathematics?

This talk will focus on the fifth activity as an exercise that not only encourages researchers, educators, and students to consume quality scholarship in the history of mathematics but also calls them to join the effort to produce original research in this field. I will end the presentation by asking for audience feedback on what mathematicians new to the endeavor need to know to research and write the history of mathematics.

TOM ARCHIBALD, Simon Fraser University

MARISSA BENNETT, University of Toronto

Non-trivial Automorphism and the Metaphysics of Quantity

The mass of a particular object can be specified numerically, relative to a given mass-measurement scale, but it is difficult to give a clear and uncontroversial account of what, exactly, is attributed to an object by such a specification. J. E. Wolff (2020) argues that a quantity (such as mass) is a homogeneous space consisting of points and relations. On Wolff's view, what it is for an object to have a specific mass is for it to occupy a particular point in mass-space. The homogeneity of quantity spaces accounts for the invariance of their measurement scales under permissable transformations, as identified by the relevant uniqueness theorems in the context of the Representational Theory of Measurement. Because the structure of mass-space is homogeneous, the space has non-trivial automorphisms, and this is claimed to be sufficient as an explanation for why specific masses seem to be non-individual entities, in the sense that a rearrangement of them with respect to the relational structure would not constitute a distinct metaphysical scenario. This explanation, I argue, is unsatisfactory because the notion of a non-trivial automorphism (in the context of a structured set) presupposes that the set elements are individual objects capable of bearing labels.

ROB CORLESS, Western University

TOM DONALDSON, Simon Fraser University

Abstraction and Modality

In The Foundations of Arithmetic, Frege put much emphasis on "abstraction principles" such as this one, arguing that such principles are analytic:

The shape of x = the shape of y if and only if x is similar to y.

Neo-Fregean abstractionists today continue to defend this view. I will consider abstraction principles in the context of modal and tense logic, arguing that neo-Fregean abstractionism conflicts with both "serious presentism" and "serious actualism".

JAMES FRANKLIN, University of New South Wales, Australia

Aristotelian Realist Philosophy of Mathematics

Marc Lange writes that "Aristotelian realism allows mathematical facts to be explainers in distinctively mathematical explanations" in science as (some) mathematical facts are themselves about the physical world, while Paul Thagard describes Aristotelian realism as "the current philosophy of mathematics that fits best with what is known about minds and science." The talk gives an introduction to these developments. Aristotelian or naturalist (non-Platonist) realism breaks the impasse between Platonist realism and nominalism. It holds that the objects of mathematics are realizable in the physical (or other non-abstract) world. Though favored by many thinkers from Aristotle to Mill, such a view receded in twentieth century philosophy of mathematics. It has been revived by such authors as Franklin, Gillies, Jacquette, Irvine and Hossack. Mathematical features of the world include quantity, structure, pattern, complexity, relations. Aristotelian realism begins with applied mathematics and the mathematical properties of physical things such as symmetry, ratio and continuity, rather than with (apparent) abstracta such as sets and numbers. The main objections to Aristotelian realism are addressed, such as the fact that large infinities and perfect geometrical figures cannot be physically realized.

PIERRE JORAY, Université de Rennes

CONOR MAYO-WILSON,

Expectation and Fairness in Huygens' "Value of All Chances"

In "An Essay towards solving a Problem in the Doctrine of Chances", Thomas Bayes defines "probability" in terms of "expectation" rather than conversely, as is now standard. Bayes' definition continued the tradition of Fermat, Pascal, and Huygens, who studied expectation first-and-foremost and discussed probability only secondarily. Historians of probability now widely agree that (1) Bayes' definition was not circular because 17th and 18th century thinkers routinely defined "expectation" in terms of "fairness" in games of chance, and (2) "fairness" was a "nonmathematical" notion (e.g., see Daston (1995)).

I accept the first conclusion but reject the second. I argue that there is a mathematically rigorous definition of "fairness" that validates Huygens' proofs in "The Value of All Chances."

I conclude by defending a methodological precept. Existing scholarship on classical probability has focused on the definitions of "expectation" or "probability" offered by Huygens and Laplace, among others. By contrast, historians of geometry argue that Euclid's definitions are of little interest and that to understand Ancient Greek geometry, we must carefully study the implicit rules of inference in Euclid's work. Similarly, I argue that we must investigate the implicit rules and axioms used in the proofs in the "classical" theory of probability.

DORA MUSIELAK, University of Texas at Arlington

The Marquise, the Philosopher, and the Mathematician: Debate over Newtonian and Leibnizian Ideas

In the 1730s, the scientific climate in Paris was infused with ideas from two savant groups: Cartesians and Newtonians, i.e., those who followed Descartes theories of motion and those who believed in Newton's natural philosophy (science of motion and universal gravitation). Leibniz had added an additional layer to their debate when he challenged Descartes's conservation law for "quantity of motion." Leibniz also drew a distinction between "dead forces" and "living forces," the latter being conserved universally.

In 1740, Gabrielle Émilie Marquise Du Châtelet published "Physical Institutions" to expound the theories of Newton and Leibniz. An ardent Newtonian, she questioned the idea of forces promoted by Dortous de Mairan, a Cartesian and Secrétaire Perpétuel of the French Academy. He responded with a disparaging essay, starting a public dispute that centered on the concept of les forces vives. In 1741, Du Châtelet asked Euler for support, as neither Maupertuis nor Clairaut (her teachers) had come to her defense. Leonhard Euler, the incomparable Mathematicorum Principi, was the most eminent authority in mechanics.

The Châtelet-Mairan debate occurred during a time when philosophical disagreements, clashing personalities, and confusing terminology clouded the physical understanding of forces and motion. Did mathematical formulations settle the questions the debate had raised?

DAVID ORENSTEIN, Independent Scholar

The Mathematical Sciences at the December 1921 Toronto Meeting of the American Association for the Advancement of Science

AAAS first met in Toronto in 1889. Hosting the 1913 International Geological Congress led to inviting AAAS to hold 1915 Meeting in Toronto. After World War I, invitation accepted for 1921 Winter Meeting.

While framework and some programme highlights provided by the Association's headquarters and Toronto committee, bulk of programming from Sections and related Societies. Sections, from A Mathematics to Q Education.

These congresses allowed Canadian mathematicians to meet colleagues and share work. Section A had short joint session with AMS and MAA. Vice-Presidential address, "A Mechanical Analogy in the Theory of Equations", then three papers of general interest to mathematicians. A new Section V-P: George Abram Miller.

AMS programme: 32 papers, 84 members attending. Canadian presenters: J.S.C. Glashan (Isodyadic Equations), and Samuel Beatty (Algebraic Functions). Miller, two papers on Group Theory. Two women: Olive C. Hazlett (Orthogonal Functions) and Louise D. Cummings (Weddel Surface). 110 members MAA members present. Seven papers, none by women. Ten American women present, including Hazlett and Cummings; one Canadian : Jennie A. Kinnear. Afterwards, mathematicians joined physicists at joint banquet, possibly some at simultaneous Women's Dinner.

Section B Physics, with Vice-President UofT's J. C. McLennan, a Canadian-American partnership; Section D Astronomy largely Canadian. American Physical Society at Toronto, but American Astronomical Society at Strathmore College. Section D Astronomy relied on Royal Astronomical Society of Canada for programming.

The 1921 Toronto AAAS Meeting's success necessary for success of the International Mathematical Congress, Toronto, August 1924. Both chaired and organised by Toronto mathematician, J. C. Fields.

MARIO BACELAR VALENTE, Pablo de Olavide University

Geometric cognition: a hub-and-spoke model of geometric concepts

Here, we develop a model of the neural representation of geometric concepts. From the perspective of a philosophy of mathematical practices, we should consider actual practices in their historical context. We will develop a model for Euclidean geometry. To arrive at a coherent model, we found it necessary to consider earlier forms of geometry. The models will be based on the hub-and-spoke theory. According to this theory, the neural representation of concepts is made in terms of spokes, which are modality-specific brain regions that codify modal features of concepts (e.g., visual and verbal representations). There are also integrative regions – the hub – which blends, in an amodal format, the different aspects codified in the spokes and gives rise to coherent concepts. The hub enables a modality-free codification of further aspects of concepts. Notice that we can address a particular concept directly in terms of 'spokes' and a 'hub' not has regions in the brain but as 'parts' of the concept. Here, we will start by addressing the practical geometry of ancient Greece. Then we consider Hippocrates of Chios' work. We develop models for these two cases. Finally, we develop the model of the neural representation of geometric objects in Euclidean geometry.

MARYAM VULIS, Maryam Vulis

William Friedman's Contributions to American Cryptology.

William Frederick Friedman (1891-1969) is rightfully called the father of American cryptology, William Friedman was born in the Russian Empire, and was fortunate to grow up in Pittsburg, where his family settled after escaping Russian atrocities. Studying Electrical Engineering was not affordable, and he turned to genetics studies at Cornell University. The degree in Genetics brought him to the Riverbank Laboratories thus to cryptology where he met his future wife Elizebeth Smith, herself an outstanding cryptologist. William Friedman (WFF) started his career as an Army Cryptologist in 1917 when the US entered WWI and was eventually put in charge of the research division of the Army's Signal Intelligence Service (SIS). For over 30 years William Friedman was instrumental in providing cryptological security to the US Government. Friedman shrewdly saw the mathematical foundations in the science of deciphering and the necessity of involving trained mathematicians in his Army cryptological group. In 1920s, William Friedman introduced a clever use of the Index of Coincidence, a particular formula from probability One cannot about talk about William Friedman, and the success of breaking the Japanese diplomatic code Purple. Friedman's group successfully decrypted the Japanese Navy communications and reconstructed the Japanese cipher machine Purple giving cryptanalysis the decisive role in the victory at Midway in 1942. After WWII, William Friedman joined the NSA, whose existence was not even known to the public at the time and became chief NSA cryptologist. The 2015 declassification of his work brought in the recognition that William Friedman deserved.