History and Philosophy of Mathematics
Histoire et philosophie des mathématiques

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TOM ARCHIBALD, Simon Fraser University

Counterexamples in the work of Weierstrass

In this paper we examine the function of counterexamples in the work of Weierstrass. The point is to nuance a little the difference between the later emphasis on classifying pathology and the earlier, more naturalistic view of mathematical objects. The famous examples of Weierstrass will be placed in context of his rivalry with Riemann. The choice of topic is influenced by the fact that Weierstrass turned 200 on October 31, 2015.

MARIYA BOYKO, University of Toronto

Mathematical School Reforms in Post-War America and the Soviet Union: A Comparative Study

North American historians of mathematics education have provided detailed accounts of the 1960s "new mathematics" movement, its goals, features and aftermath. Parallel to the reforms in the West, but somewhat later, innovative and fundamental changes to mathematics education were also being carried out in the Soviet Union. Soviet educational theorists were aware of the Western developments and discussed them in periodicals devoted to mathematics education. The Soviet reforms and their lasting legacy have not been covered adequately in the literature thus far. The paper will examine aspects of these reforms and provide a comparison of the Russian experience with what took place in the West.

GWENNAËL BRICTEUX, Université de Montréal

Le processus de substitution dans la constitution des formalismes

Nous considérons comment la substitution détermine les notions de catégorie, de signe et de fonction dans les formalismes mathématiques et logiques. La théorie des catégories comme mathématique de synthèse, selon Lambek et Scott, tire l'une de ses motivations dans la tentative d'axiomatisation du processus de substitution (chez Mac Lane, Lawvere), origine commune au développement des calculs fonctionnels (combinateurs de Curry et calcul lambda de Church). Nous examinons donc le rôle que joue la substitution dans la structure élémentaire de la théorie des catégories, de même que dans les combinateurs et le calcul lambda, définissant les notions fondamentales de catégorie et de fonction. Nous apportons un point de vue critique supplémentaire en faisant le parallèle avec la théorie des signes de Peirce, comme grammaire élémentaire de la logique, selon laquelle le signe est défini par sa fonction de lieutenance, dans le cadre d'une relation triadique de signification. La synthèse des trois points de vue se fait suivant le motif de la correspondance (dite de Curry-Howard-Lambek) entre calcul fonctionnel, logique et catégories, ce qui permet de formuler une conception générale de la substitution dans les formalismes logico-mathématiques.

NICOLAS FILLION, Simon Fraser University

The surprisingly old origins of modern decision and game theory

The origins of modern game theory, with its emphasis on solution concepts that apply to arbitrary games, is typically associated with the works of von Neumann and Morgenstern in the 1930s and with the works of Nash in the 1950s. However, already in 1713, Part V of the second edition of Pierre Rémond de Montmort's Essay d'analyse sur les jeux de hazard contained correspondence on probability problems between Montmort and Nicolaus Bernoulli. It concludes with the first mixed-strategy solution of a game (called Le Her), which is attributed to their colleague Waldegrave. However, their work has been criticized and its significance downplayed by most historians. I challenge this view on the basis of an additional 44 unpublished letters between them (and Waldegrave) found in the archives in Basel. This correspondence addresses many confusing aspects of their earlier discussion of the concept of solution to strategic games. I will describe this body of correspondence as it relates to the discovery of the concept of mixed strategy equilibria and put it in its historical context. I will also argue that, far from

falling short of the conceptual rigour found in modern analyses, their discussion anticipates refinements of Nash equilibria that only gained traction starting in the 1970s.

CRAIG FRASER, University of Toronto
Hamilton-Jacobi Theory and Celestial Mechanics 1860-1900

During the 19th century the mathematical methods of celestial mechanics drew heavily on Hamilton-Jacobi theory. The primary ideas of course derived from William Hamilton and Carl Jacobi, although independent contributions were made by Siméon Poisson, Mikhail Ostrogradsky and Jacques Binet. While researchers from several countries worked on celestial mechanics, in the second half of the century the field came to be dominated by French figures. Looking at the writings of such major authors as Charles Delaunay, Félix Tisserand, and Henri Poincaré the paper examines some aspects of the mathematical foundations of celestial mechanics in the period from 1860 to 1900. A focus of interest is how the concept of contact transformation appeared and became established as a fundamental part of the theory.

MICHAEL HALLETT, McGill

ORAN MAGAL, McGill University
The Universe is not a Supercomputer

This talk concerns the relations between physics and mathematics and aims to uncover the metaphysical presuppositions that underlie the use of mathematics in the natural sciences. It will be argued that mathematics gives us both too much and not enough: more structure and fine-grained detail than may be physically applicable, and not necessarily all that might be needed for a comprehensive physical account of the world.

JEAN-PIERRE MARQUIS, Université de Montréal
An intrinsic epistemological dualism

In this talk, I want to introduce and defend the idea that contemporary mathematics is permeated with a new form of epistemological dualism. Basically, I will argue that there are two types of mathematical developments and constructions. The first type is attached to what is usually called "canonical maps". These constructions and the situations in which one finds them are transversals. The second type are specific to the field or domain in which one works, be it a domain of numbers or an algebraic context or an analytic context or what have you. I will briefly indicate how this distinction arose historically and suggest some its philosophical significance.

DUNCAN MELVILLE, St. Lawrence University
The case for and against computational devices in early Mesopotamia

The evidence for how mathematical computations were performed in third millennium Mesopotamia before the introduction of the sexagesimal place-value system is thin, weak, indirect, and contradictory. We survey this unsatisfactory state of affairs.

SYLVIA NICKERSON, York University
The John Tyndall Correspondence Project

Through the Irish Ordnance Survey and work as a railway engineer, the British physicist John Tyndall met the mathematician Thomas Archer Hirst in 1843. The two began a lifelong friendship and lively correspondence that lasted until Hirst's death in 1892. Tyndall received his mathematical training in Germany where he studied chemistry with Robert Bunsen and mathematical physics with Christian Gerling and Hermann Knoblauch in Marburg. While Tyndall himself mostly avoided mathematics and remained a classic physical experimentalist, his research into radiant heat and electromagnetism overlapped with that of Julius Plücker and Gustav Magnus, and Tyndall remained engaged with mathematics in so far as he frequently gossiped about the mathematicians of Europe with best friend Hirst. York University has collected, transcribed and edited the correspondence of John Tyndall. This paper explores the development of this correspondence as a historical repository and discusses the dimensions of this resource that will be of interest to historians of mathematics.

DIRK SCHLIMM, McGill University

Towards a cognitive and pragmatic account of notations for propositional logic

In this talk I will consider Frege's *Begriffsschrift* (1879), the dot-notation introduced by Peano and employed by Whitehead and Russell in *Principia Mathematica* (1910), the so-called Polish notation of Łukasiewicz (1929), and the now common notation, as it can be found, e.g, for the most part in Hilbert and Ackermann's *Grundzüge der theoretischen Logik* (1928) and in contemporary logic textbooks. Notable differences between these notations include the use of a two-dimensional representation, the methods for grouping sub-expressions (parentheses vs. dots), and the order in which the connectives and their arguments are written. For the systematic comparison, I shall introduce *abstract syntax trees* (sometimes also called parsing trees) as canonical representations of propositional formulas and show how to translate between them and each of the other notations. I will argue that the amount of effort with which these translations can be effected gives us some information about the complexity of parsing the various notations, which impacts the cognitive effort needed for understanding them. Moreover, various advantages and disadvantages of the notations, in relation to certain particular aims, will be discussed and some historical reflections on the trade-offs regarding the use of the notations will be presented.