

Anachronism(s) in the History of Mathematics

On 13–14 April 2018 an international conference was held at Caltech, “Anachronism(s) in the History of Mathematics: The Seventh Biennial Bacon Conference.” The conference was organized by Niccolò Guicciardini, Professor at the University of Bergamo and recipient of the 2018 Francis Bacon Award in the History and Philosophy of Science and Technology, under the general direction of Caltech Professor Jed Buchwald. The organization of the workshop was assisted by Caltech staff members Sinikka Elvington and Emily de Araújo as well as by Professor Diana Kormos-Buchwald, Director of the Einstein Papers Project at Caltech. Presenters at the conference came from Canada, France, Germany, Italy, UK and USA.

On the first day of the conference Guicciardini delivered the Bacon lecture, “*Un Altro Presente: On the Historical Interpretation of Mathematical Texts*”; in the evening the Bacon Award was conferred on him at a ceremony.

The subject of the conference was expressed by the organizers as follows: “Anachronism is often declared the greatest failure, almost a mortal sin, a historian can commit. Yet, some have spoken in favor of anachronism, considering it either as an inevitable, or even as a desirable feature of an historical work. The purpose of this two-day international conference is to reflect on the uses and abuses of anachronism in

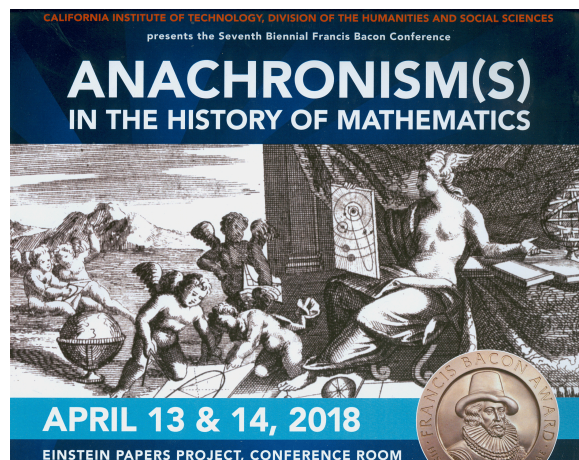


Figure 7: Conference Poster

the historical study of the mathematical sciences.”

In some opening remarks Guicciardini called attention to one of the earliest descriptions of historical anachronism, by Jean Leclerc in his *Ars Critica* of 1697. He referred to Quentin Skinner’s 1969 essay in *History and Theory*, titled “Meaning and Understanding in the History of Ideas,” where Skinner observed (p. 9), “We should not credit a writer with a meaning he could not have intended to convey, since that meaning was not available to him.” In his Bacon address Guicciardini discussed the case of Newton’s scientific writings and those of his contemporaries, and the narrative tension involved in rendering them comprehensible to a modern reader without compromising their historical character.

A list of the speakers at the conference including a précis of each of their talks is given below.

Karine Chemla (CNRS and University Paris Diderot), “Reading Problems as Problems, Books as Books, and the Like: Discussing a Widespread and yet Little-discussed Form of Anachronism in the History of Mathematics and Beyond”: Karine Chemla identified a form of anachronism that is most widespread in the history of mathematics. It consists of taking the forms of text and inscription that we read in ancient sources (like a mathematical problem, an algorithm, a proof, a diagram, a chapter and a book, and also inscriptions on a calculating surface) as being the same as their modern counterparts, and interpreting these forms of text and inscription relying precisely on this tacit assumption. This form of anachronism has caused misinterpretations of several kinds. Chemla examined how ancient Chinese proce-

dures were read successively by Edouard Biot (1803–1850), Mikami Yoshio (1875–1950), Joseph Needham (1900–1995) and Wang Ling (1917–1994). She analyzed how the assumptions about procedures that each of these authors made, and the material conditions of their work, influenced the views they formulated about the mathematics of ancient China. In the last part of her presentation Chemla argued that the development since the 1950s of algorithms by authors such as Donald Knuth, introduced new forms and ideas to interpret ancient texts less anachronistically. A historical approach to the history of reading thus sheds light on the fact that anachronism itself has a history.

Martina R. Schneider (Johannes Gutenberg University), “On Mathematical Reconstruction as a Historiographical Method”: Martina Schneider examined a 19th-century European example of mathematical reconstruction in the history of Chinese mathematics. In 1852 the English missionary Alexander Wylie published “Jottings on the Science of the Chinese” in the *North-China Herald*. This article was “translated” into German by K. L. Biernatzki and published in Crelle’s journal in 1856. Biernatzki rearranged and changed Wylie’s text, thereby adding mistakes. This led to an unfavorable evaluation of Chinese arithmetic by Moritz Cantor and Hermann Hankel. Ludwig Matthiessen, professor of physics in Rostock, spotted two of Biernatzki’s mistakes regarding the Dayan rule (Chinese remainder theorem). On the basis of translated original Chinese quotations and the close study of an example, Matthiessen in 1881–1882 was able to reconstruct the Dayan rule for arbitrary moduli and discussed conditions of solvability. He stressed that the Chinese had “exactly the same” method as Gauss had for moduli that were not relatively prime, a finding that led to a more favorable reception of Chinese mathematics. Schneider pointed to the complexity of the time structure (“time-knot”, in Achim Landwehr’s terminology) at work in the example. She concluded that it showed some common features of mathematical reconstruction (no use of original sources; use of contemporary mathematics; conjectural) and could also be seen as a correction of a contemporary text (Biernatzki’s).

Kim Plofker (Union College), “Anachronism/Anachorism in the Study of Infinitesimal Mathematics in India”: The lineal descent of fundamental ideas and methods in modern mathematics from classical

antiquity makes the concept of “anachronism” a natural concern when studying pre-modern successors to Hellenistic mathematics: are we projecting back onto earlier thinkers our own awareness of modern versions and developments of these ideas? Kim Plofker introduced another fundamental concept. In studying the history of other mathematical traditions such as those of India and China, we should be aware of a form of projection that’s more geographical in nature than temporal, which is called “anachorism”. For instance, when we label/equate some ancient non-Greek mathematical development with its classical “equivalent”, our interpretation is not so much “out of time” as “out of place”. Important aspects of this combined phenomenon of anachron/chorism include its potential for both insights and misunderstandings in reading texts (both of which arise in the historiographical controversy about whether the infinitesimal mathematics of the late medieval Kerala school in south India is “calculus”), and its almost entirely overlooked presence in pre-modern mathematical works themselves (as in an example presented by Plofker of an 18th-century Sanskrit synopsis of an Arabic explanation of Islamic algebra in terms of traditional Indian algebra concepts).

Jacqueline Feke (University of Waterloo), “Re-examining the Distinction between Philosophy and the Mathematical Sciences in Greek Antiquity”: Jacqueline Feke examined the relationship between mathematics and philosophy in Greek antiquity, and the perspectives brought to the study of ancient Greek thought by modern historians. For the ancient Greeks, mathematics was part of philosophy, along with physics and theology. Modern disciplinary differences between philosophy and mathematics are reflected in the approach that historians of philosophy take today to classical Greek texts. The implicit modern separation of mathematics and philosophy is imposed anachronistically on the study of ancient Greek thought, where no such separation existed. The examination of some ancient Greek mathematical texts, moreover, reveals that some mathematicians were aiming to solve the traditional, most fundamental problems of philosophy.

Joseph W. Dauben (Lehman College CUNY), “Anachronism and Incommensurability: Words, Concepts, Contexts, and Intentions”: Joseph Dauben presented examples of anachronism in the history of mathematics, two that involved non-standard analysis and sev-

eral concerning historical accounts of ancient Chinese mathematics. A case study that is perhaps not widely known involves a 1995 attempt by the philosopher Hilary Putnam to use ideas from non-standard analysis (in a suitably qualified form) to illuminate Charles Peirce's conception of continuity, set forth by Peirce in an 1898 lecture at Harvard. Dauben argued that Putnam's study provides an instance of the successful application of anachronism in the history of mathematics. Examples of ancient Chinese mathematics that have given rise to anachronistic historical interpretations include Liu Hui's double-distance method for determining heights, presented in the *Sea Island Mathematical Manual* (Haidao suanjing) of 263 AD, and methods for the extraction of roots found in Hui's famous *Nine Chapters of the Mathematical Arts* (Jiuzhang Suanshu).

George E. Smith (Tufts University), "Reading the *Principia*? Anachronistic Renderings of Newton's Mathematics": George Smith discussed Propositions 39–42 of Book One of Newton's *Principia* (1687 and later editions). Through a close analysis of their content he established the intellectual linkage of this part of the *Principia* with Huygens's *Horologium Oscillatorium* of 1673. Smith pointed out that the danger of introducing anachronism is present not simply in the translation into English from Latin but also in the formulation of Newton's distinctive geometric idiom in terms of later mathematics. He suggested that the tendency to interpret the *Principia* anachronistically was already present in the work of early Continental mathematicians, such as Johann Bernoulli, as they developed Newtonian methods using the calculus. One consequence of this historical practice was to obscure the role played by Huygens's *Horologium* in the genesis of the *Principia*.

Craig Fraser (University of Toronto), "Historiographical Issues in the Interpretation of Euler's Work on Divergent Series": Modern commentators such as Morris Kline believe that the theory of summability—developed at the end of the 19th century by Frobenius, Cesàro and others—may be found in Euler's work on divergent series. This thesis is in line with the view of some historians, such as A. P. Yushkevich, that Euler possessed a kind of visionary intuition of mathematical concepts and lines of development that would only develop much later. Fraser examined the anachronism implicit in this point of view. Euler understood divergent series as things that were given

as part of objective reality, and not simply defined as they are in summability theory to be whatever the investigator wishes them to be. The subject of summability grew out of researches in complex analysis within a mathematical framework that was foreign to Euler's mathematics. In the conclusion Fraser commented on some parallels between claims for the historiographical relevance of summability theory and non-Archimedean analysis.

Jemma Lorenat (Pitzer College), "Portraying Projective Geometry: The Presence and Absence of Measurement in Nineteenth Century Pure Geometry": By the early 20th century projective geometry had come to be seen as an approach to geometry that was essentially non-metric. This conception is apparent, for instance, in Oswald Veblen and John W. Young's 1910 book on the subject. While historians and mathematicians anachronistically attributed the conception to Jean-Victor Poncelet, the French geometer in fact employed metric notions such as cross ratio in a fundamental way. Not until Karl Georg von Staudt's *Geometrie der Lage* in 1847 were projective properties defined as properly non-metric. The history of a non-metric projective geometry developed alongside an increased focus on the axiomatic foundations of geometry in late nineteenth and early twentieth-century research. Authors writing at this time tended to read a foundational interest that was not there into the work of early 19th-century authors.

Jeremy Gray (Open University emeritus), "Anachronism: The Case of Non-Euclidean Geometry": Jeremy Gray examined Roberto Bonola's influential history, "La geometria non euclidea. Esposizione storico critica del suo sviluppo" (1905; German translation 1908, English translation 1912), focusing on Bonola's account of Lobachevskii's work. Bonola was writing within an educational tradition prevalent in early 20th-century Italy that made a distinction between elementary and advanced mathematics. Elementary geometry was the geometry in the style of Euclid, perhaps updated to include axiomatic ideas in the manner of Pasch and Hilbert. Advanced geometry was the differential geometry of Riemann and Beltrami. Bonola anachronistically placed Lobachevskii within the tradition of elementary geometry, and in so doing missed the central importance of basing geometry on a primitive concept of distance in Lobachevsky's pioneering work and of establishing non-Euclidean geometry through the formulae of hyperbolic trigonometry.

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The organizers plan to publish a volume of essays based on the conference.

Craig Fraser

