Research workshop
Reading Euclid in the early modern world

Thursday and Friday 14 and 15 December 2017
All Souls College, Oxford

ABSTRACTS

Philip Beeley, University of Oxford: *Euclid in the World of Early Modern London's Practical Mathematicians*

Mattia Brancato, University of Milan: *Leibniz and the German Interpretations of Euclid's* Elements

Gottfried Wilhelm Leibniz spent most of his life trying to demonstrate Euclid's *axiomata*, while his *analysis situs* was developed for the purpose of founding the whole of mathematics on *Elements* Common Notion 5, the principle by which the whole is greater than its part. Such interest in the *Elements* undoubtedly rests at first on Leibniz's reading of Hobbes' *De corpore*, which happened at a very early stage of his scientific education, but this influence cannot adequately explain Leibniz's minimalistic and reductionistic approach in dealing with Euclid's text.

In this paper I will argue that, by the time Leibniz adopts Hobbes' idea of a geometrical foundation of mathematics based on Euclid, he was greatly influenced by the syncretistic tradition active in the Saxon universities during the 17th century. By combining the idea of a *mathesis universalis* based on Proclus' *Commentary* with key Scholastic concepts revised in the light of the scientific revolution, this tradition helped to spreading an interest in Euclid's geometry in Germany, with remarkable results. In this wider context, Leibniz assumed a leading role in interpreting Euclid because of his superior mathematical expertise, but the core ideas, such as the connection between universal logical principles and geometrical laws or the use of superposition to define quantity, were already surfacing at the time of his education and they were part of a cultural tradition which survived even after Leibniz's death.

Robert Goulding, Notre Dame*: Ramus and Euclidean Arithmetic*

Peter Ramus was one of the most critical readers of Euclid in the sixteenth century. Under the influence of Proclus's *Commentary*, most other readers saw the *Elements* as a single, coherent, and logically perfect text. Ramus, by contrast, was unimpressed by its logical rigour, in part because it failed his (and, he thought, Plato's) criteria of method. It was, he argued, a composite text, assembled haphazardly over a long period of time, and preserving the insights and errors of mathematicians from Pythagoras to Theon. In this paper, I will examine Ramus's logical and historical critique of the arithmetical books of the *Elements*, and his attempts, in the several editions of his *Geometria*, *Arithmetica*, and *Algebra*, to create a science of number that would avoid the errors fossilized in the *Elements*, and conform to the principles (as he believed) inherent in nature itself that the earliest mathematicians had laid down – principles that could be discovered through his historicizing approach to the *Elements*.

Catherine Jami, CNRS, Paris*: Reading —and rewriting— Euclid in China (1607–1723)*

In 1607, the first six books of Euclid's *Elements* were translated into Chinese by Matteo Ricci (1552-1610), the founder of the Jesuit mission to China, and Xu Guangqi 徐光啟 (1562-1633), a high official who was one of the main supporters of Christianity. This translation was part of a plan to systematically introduce the mathematical sciences of Europe into China. During the seventeenth century, the translation, entitled *Jihe yuanben* 幾何原本, was read, commented on, supplemented, and sometimes rewritten by a number of Chinese scholars. In the 1690s, another work with a similar title was produced by translating a French geometry textbook, the *Elémens de géométrie* (1671) by Ignace Gaston Pardies (1636-1673), who taught mathematics at the Jesuit College in Paris. This second translation was done under imperial patronage.

One of the striking features of the 1607 translation is that it entailed the coining of an entire terminology for geometry, as Chinese mathematical texts until then did not name objects such as points, lines, surfaces, solids or angles. Neither were there any equivalents for notions such as definition, proposition, axiom, and postulate. I propose to understand the varying success of these two sets of words in the light of the conditions in which the *Jihe yuanben* was read, that is, entirely divorced from the background against which geometry was typically studied in Europe. Another, related issue that will be discussed is the ways in which Euclidean geometry was integrated into mathematics as it was then practiced in China and the extent to which the field was reshaped by this integration.

Laura Kotevska, University of Sydney*: Rewriting Euclid: The ambitions of Antoine Arnauld*

This paper will examine the *Nouveaux éléments de Géométrie* of 1668, a seemingly unlikely intervention in the mathematical culture of the mid-seventeenth century for Antoine Arnauld, a firebrand theologian and author of works on topics in logic and grammar. The aim of this paper is to describe Arnauld's motivations for penning a revised edition of Euclid's *Elements* particularly given the hostile attitudes of fellow theologians who insisted that the practice of mathematics was a futile, trivial, and vainglorious misuse of time.

Arnauld's ambition for the *Nouveaux éléments* was twofold. First, Arnauld engaged in the rewriting of Euclid for the propaedeutic benefits he believed accrued to those acquainted with the *Elements*. On Arnauld's view, practising mathematics could initiate a process of personal betterment, primarily the cultivation of moral, spiritual, and intellectual virtues. Mathematics, he believed, could train an individual to be just, fair, and judicious in judgment and action, a goal that appeased his collaborators and contemporaries who believed mathematics pursued in this way was worthy of one's time.

Arnauld pursued a second, and related, objective in rewriting Euclid's *Elements*. In order for the *Elements* to serve the propaedeutic, particularly epistemic, goals described above, Arnauld believed a new edition of Euclid was required, one cleaned of the epistemological, methodological and mathematical confusions he thought common to contemporary editions. To pursue this ameliorative task, Arnauld implemented philosophical, epistemological and methodological insights articulated in his famous *Logique* to which, I will show, the *Nouveaux éléments* was to serve as the practical corollary. Logic and geometry were, for Arnauld, coextensive programs for the pursuit of intellectual betterment.

Sébastien Maronne, University of Toulouse*: The reception of Euclid's* Data *in early modern France from Hardy to Pascal*

In 1625, Claude Hardy published the *editio princeps* of Euclid's *Data.* In the propositions of this tract, Euclid proves how we can deduce from some given (positions, magnitudes, ratios) that other things are given. Some of the propositions of Euclid's *Data* correspond to propositions of Euclid's *Elements* so that we can speak of a *Data* style. After having sketched the direct reception of Euclid's *Data* in Hardy and in the French translations of Hérigone and Henrion, I will show how the *Data* style diffused into the French mathematics by examining texts of Descartes, Fermat, and, more at length, Pascal's *Lettres de Dettonville* which provides an original theory of givens.

Yelda Nasifoglu, University of Oxford*: From Construction to Abstraction: The changing nature of Euclidean diagrams*

Medieval manuscripts of Euclid's *Elements* descended with diagrams carefully drawn with compass and rule, laid out on the folio alongside the theorems and propositions they referenced. Early printed editions of the *Elements* emulated this tradition, reproducing the diagrams with woodcuts of varying quality painstakingly printed alongside the text. A Euclidean diagram was not a static illustration, however, but a map to a step-by-step construction. Material evidence from the period, such as marginalia or scrap paper extant with mathematical diagrams, demonstrate a mode of active reading with a pen or pencil and drawing implements at hand; a practice facilitated by the diagram which provided a snapshot of the end result of a process. That process in turn was to illuminate a visual understanding of geometry, to enable to see 'by the strength of imagination in the darke' as John Aubrey explained. Beginning in late 17th century, the status of the Euclidean diagram underwent significant changes. This was partly due to the developments in printing technology as it became cheaper to group together and engrave the diagrams, inserting them at the end of the volume. Yet more significant was the invention of analytical geometry and the increasing use of algebra. As the idea of geometric construction became more abstract with shapes reduced to formulae, reading Euclid no longer necessitated a compass and rule at hand. This paper will examine these changes in the nature and function of diagrams in Euclidean print in this period.

Vincenzo De Risi, Max Planck Institute for Mathematics in the Sciences, Leipzig: *The Development of Euclidean Axiomatics*

The talk examines the long tradition of translation, transmission and transformation of Euclid's *Elements* from antiquity to the early modern age under the special perspective of the systems of axioms employed in order to ground elementary geometry. While the corpus of theorems and proofs of the *Elements*, in fact, underwent only minor changes in the modern tradition of the text, the principles grounding the whole construction were enormously debated. Hundreds of different systems of axioms were conceived and incorporated in the Euclidean text, and over 350 different axioms were employed to ground elementary geometry. I will sketch a few lines of this development, showing how many different influences and aims contributed to shape these various editions: mathematical difficulties, philological uncertainties, epistemological qualms, pedagogical concerns, political and even theological differences played important roles in determining various systems of principles for elementary geometry. After having exemplified a few of these developments through Grynaeus's *editio princeps*, Commandino's and Clavius's mathematical works, the Jesuit textbooks and their Jansenist rivals, the philosophical editions by Pascal or Patrizi, Legendre's *Elements* conceived for the French Revolution, and a few others, the talk closes with the normalization of the Euclidean text at the beginning of the 19th Century (Peyrard's edition from 1814).

Paolo Rossini, Scuola Normale Superiore, Pisa: *Giordano Bruno, Reader of Euclid: Renaissance mathematics and mathematization of nature*

The aim of this paper is to analyze Giordano Bruno's reading of Euclid's *Elements* as a part of his larger project to set forth a new geometry. Bruno repeatedly makes use of Euclid's geometry in his mathematical works, and proves to be familiar with the most important Euclid editions and commentaries of the time (e.g. Peletier's and Gracilis's). On the other hand, Bruno's geometry is characterized by the presence of infinitely small quantities (i.e. the *minima*), which will formally enter Euclidean geometry only with the advent of the calculus in the seventeenth century. The paper investigates (i) to what extent Bruno's reading of Euclid is in line with or differs from the original text; (ii) how Bruno's project of a new geometry is to be framed within his innovative conception of the universe. My claim is that the goal of Bruno's reform of geometry is to create a mathematical language to describe the physical world. In particular, I argue that Bruno's *minima* are the geometrical counterpart of the atoms of which, in Bruno's opinion, the world is composed.

JB Shank, University of Minnesota: *Euclid and Materialist Geometry in sixteenth- and seventeenth-century Europe*

By "materialist geometry" I refer to the brand of geometry that is practiced through a disregard, whether expressly stated or simply implied through the practice itself, of the distinction essential to Euclid between the triangles we draw in the sand and those we conceive in our mind. Albrecht Dürer expressed his materialist conception of geometry explicitly when he declared in his *Underweysung der Messung, mit dem Zirckel und Richtscheyt, in Linien, Ebenen und gantzen corporen* that he would treat lines as if they were like pieces of string. Leon Battista Alberti did the same when he asked readers of his *Della pittura* to remember that he was writing for artists, not philosophers, in his book, and would therefore not worry about treating his geometrical objects as material objects. The pioneering 1482 Ratdolt print edition of the *Elements* illustrates the implicit use of materialist geometry in its inclusion of material illustrations of the Euclidean point and line next to the definitions that specify the immaterial nature of these objects. Materialist geometry can also be seen through its opposite: the fully idealist (i.e. non-material) geometry practiced by the liberal artists who taught geometry as part of the *quadrivium* in the early modern university.

I am in the very early stages of a research project centered on tracing the presence and influence of materialist readings of Euclid's *Elements* in 16^{th} and 17^{th} century Europe. This paper will survey my research thus far, and attempt a preliminary analysis of the networks that supported materialist understandings of Euclidean geometry, their location, magnitude and influence, and the nature of their relationship with the idealist/immaterial understandings of Euclidean geometry present in Europe at the same time.

Kevin Tracey, Swansea University and the Science Museum, London*: "Disturbed" by Euclid: Ramus's Readers in the Wittenberg sammelband*

Comprised of Peter Ramus's *Arithmeticae libri duo, Geometriae septem et viginti*, Thomas Fincke's *Geometriae rotundi libri XIIII*, and John Peckham's *Perspectivae communis libri tres* bound together in one volume and littered with mathematical marginalia, the 1586 *sammelband* held by the Science Museum, London, is a unique artefact in the study of the history of mathematics, reading, and the material culture of the book alike. The *sammelband*'s owners and users can be traced to Leipzig and Wittenberg through their inscriptions and *album amicorum*, and the interplay between its construction, its printed texts, and its annotations exhibits both a pedagogical and a personal remaking of mathematical practice.

This paper presents evidence of such remaking. In particular, it will consider how the methodological influence of Peter Ramus was further transmitted to students by the mathematical work of Thomas Fincke, before suggesting that idiosyncratic users tangled with authoritative interpretations of Euclid by incorporating their own reading and notational practices.

I suggest that the *sammelband* itself bears evidence of a network of pedagogical rhetoric, method, and use pertinent to Northern European education in particular. 'Disturbed' by Euclid's methods of presentation, yet content to use the *Elements* as one of his foundational texts, Thomas Fincke's spherical geometry was constructed within such an educational framework. Whilst Fincke's work was aimed toward students familiar with Ramist teaching, the notes of these pupils reinterpret his intentions: demonstrating an idiosyncratic reflexivity shared between Fincke, his predecessors, and the later readers of the volume.

Gerhard Wiesenfeldt, University of Melbourne*: Euclid: Philosopher of Practice? The Elements in the Dutch Republic*

The paper will discuss the use of Euclid's *Elements* in the Dutch Republic during the seventeenth century. It will focus on the relation between the established – Latin – mathematics and the practical 'Dutch' mathematics that was taught at universities after 1600 in the vernacular with craftsmen and artisans as intended audience. In both teaching curricula, the *Elements* – at least its first six books – played a central role. Historiographically, Latin and Dutch mathematics courses have often been treated as distinct subjects with little overlap between them. This paper will argue that such a distinction is misleading, at least until 1670. The editions of Euclid that were published in the Dutch Republic as well as other sources suggest a close connection between them. In both versions of mathematics education, Euclid was also attributed a particular philosophical significance, as he was embedded in Simon Stevin's methodology of 'Spiegheling & Daet' (reflection and practical demonstration), which was adapted to university teaching by Willebrord Snellius and Frans van Schooten (sr. and jr.). On the other hand, knowledge of Euclidean geometry acquired in Dutch mathematics courses became an important means for artisans to acquire senior administrative positions in the cities of Holland. Euclidean geometry thus played an important role in linking Dutch urban culture to a specific understanding of natural knowledge.

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