Defending Hypatia: Ramus, Savile, and the Renaissance Discovery of Mathematical History by Robert Goulding

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The title of this book is somewhat misleading. Do not expect much on Hypatia or even on the history of mathematics. The figure of Hypatia is merely used in a metaphorical sense, as a virgin body exemplifying both the unity and the beauty of Euclid's *Elements*. This book deals first and foremost with the historiography of mathematics: how and why histories of mathematics are written. While the book contains six chapters, we can distinguish three main parts. The first part gives an overview of histories of mathematics written before 1570. A second part, mainly chapter 5, concerns the forgotten history of the conflation of Euclid of Megara and Euclid the mathematician. The third and most substantial part deals with the role of the history of mathematics in the understanding and teaching of mathematics by Petrus Ramus (1515–1572) and Henry Savile (1549–1622).

The first part, on the lineages of learning, provides the reader with a brief but useful overview of the historiography of mathematics before 1570. Goulding covers Diodorus Siculus (first century BC), Josephus (first century AD), Proclus (fifth century), Regiomontanus (1564), Vergil (1499), Cardano (1535), and Melanchthon (1536). This overview is particularly useful and the topic deserves more elaboration than it receives over 18 pages. Most historians in antiquity attributed great importance to the Chaldeans and the Egyptians. Participation in a long genealogy of mathematical learning would become an idea that the Renaissance humanist could not resist. Josephus added the role of the Jews to the narrative and was the source for the belief that the entire Mediterranean civilization was indebted to the Jews for the transmission of learning. Proclus was crucial for Renaissance historiography as he provided a model for the history of mathematics

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as a process of progress. He saw Euclid as a culmination of ancient mathematics. This would lead to two distinctive but related views on ancient Greek mathematics. On the one hand, there was the belief of continuous progress—held by Regiomontanus and Savile—in which the Greeks perfected the achievements of mythical ancients as the moderns did with Greek mathematics. On the other hand, some authors such as Ramus held a cyclic view of degeneration and recovery, where Euclid was blamed for the degeneration of Platonist mathematics.

Goulding makes a strong case for the claim that Renaissance historiography of mathematics was not so much concerned with describing what actually happened but rather with justifying the very discipline of mathematics. Scholarly mathematics in the late Middle Ages was considered of little practical value, obscure, and indecorous. In order to justify the study of mathematics, humanists had to establish a 'rhetorically powerful, morally edifying historical narrative'. The humanist practice of mathematics was therefore by nature historically oriented. Humanists were concerned with analyzing and criticizing the newly discovered ancient texts, harmonizing them with prevailing knowledge and practices, establishing the authorship of texts, and tracing biographical data.

The second part [ch. 5] tells the curious and forgotten story of the conflation of the philosopher Euclid of Megara (*ca* 435–*ca* 365 BC) with the mathematician Euclid of Alexandria. The first Euclid was a student of Socrates and a friend of Plato, while the second Euclid was born after Plato had died. Although the first traces of the confusion date back to Valerius Maximus, it was mostly the humanist Bartolomeo Zamberti who was responsible for the Renaissance conflation by compiling a biography of Euclid for his Latin translation of Euclid's works, published in 1505. Many Euclid editions after Zamberti then included Euclides Megarensis on the title page, such as those by Pacioli (Venice, 1509), Faber (Paris, 1512), Hervagius (Basel, 1537), Finé (Paris, 1544), Scheubel (Basel, 1550), Tartaglia (Venice, 1565), de Foix Candale (Paris, 1566), as well as Sacrobosco's edition of *The Sphere* of 1527. It was only with Frederico Commandino's edition of 1572 that the matter was put straight. Goulding demonstrates that the humanists required a biography to establish the authority of Euclid. In the construction of an account of Euclid's life, Zamberti misappropriated the then unpublished commentaries by Proclus.

Goulding also convincingly shows that Petrus Ramus' meticulous collation of prosopographical data in the *Prooemium mathematicum* was the source for Commandino's corrections. Ramus had a good reason for doing so, as he wanted to disentangle Euclid the mathematician from the golden age of Plato's Academy. After Commandino,

> the Megarian error disappeared, as such obvious errors tend to do, into a kind of embarrassed silence. Euclid of Megara, the Platonic mathematician, simply ceased to exist. [142]

The third and major part of the book deals with the narratives on the history of mathematics by Ramus and Savile. Ramus' account of the evolution of mathematics took shape in three stages between 1555 and 1567 in the mathematical prefaces, the *Scholae mathematicae*, and the *Prooemium mathematicum*. Goulding's case of Renaissance history of mathematics as a justification of the discipline is well illustrated by the narrative developed in Ramus' works. He envisaged an educational program of mathematics at the University of Paris much as mathematics was in its formative beginnings. Ramus praised the kind of mathematics that was raised by Plato through abstraction to a philosophical level and by Archimedes and Heron to a useful kind of mathematics. Although both his own ambitions for the chair of mathematics as well as his reform program ultimately failed to be realized at Paris, his writings had a lasting influence on the course of mathematics in Europe. Savile's history of mathematics, taught at Oxford, was strongly influenced by the *Prooemium*. His ideals for the teaching of mathematics were well established through the Savilian Professorship founded in 1622 and would strongly influence mathematics education at Oxford. Goulding convincingly demonstrates the influence of Ramus on Savile through extant manuscripts of his lectures preserved at the Bodleian Library.

While *Defending Hypatia* is a valuable study contributing to our understanding of Renaissance historiography of mathematics, it suffers from two hiatuses. Two important Renaissance themes have not been explored by Goulding: the role of Arab translations on the understanding of Euclid's *Elements* and the place of algebra within mathematics. Both are essential in the motivations and directions taken in the humanist reform program of mathematics, including Ramus'. Let us take up the Arab influence first.

Goulding touches on the point in relation to the Theonine edition of Euclid [150–178]. At some stage, Renaissance scholars came to the conclusion that the original *Elements* by Euclid contained only the text of the propositions and believed that the demonstrations were the work of Theon of Alexandria (late fourth century), the father of Hypatia. While there circulated Latin editions based on Boethius' translation of the sixth century, they hardly found any readers: according to Menso Folkerts [1989], only Fibonacci and Campanus actually used them. Campanus' book of the 13th century became the first printed Euclid edition (1482 in Venice). This edition was based on a 12th-century Arabic-Latin translation by Adelard of Bath. Campanus' edition shows an influence of Arab commentaries by al-Nayrizi's and the *Arithmetica* by Jordanus, especially in the definitions of books 7 and 8. Hence, it is no exaggeration to state that almost all knowledge of Euclidean geometry in Medieval Europe was based on translations from the Arabic scholarly tradition.

It is only by the end of the 15th century that any serious work was undertaken to study the *Elements* beyond the first two books and to reconstruct the original text from Greek manuscripts. Regiomontanus started the task aided by Bessarion's Greek manuscripts [Folkerts 2006]. Giorgio Valla published books 14 and 15 in 1498 in Venice. Then came Zamberti in 1505 with a complete new translation based on Greek manuscripts. Goulding shows how Zamberti was primarily responsible for the division of the *Elements* into a part by Euclid with propositions and another part with demonstrations attributed to Theon. It is only since the late 19th-century discovery of a non-Theonine manuscript by Peyrard [Vatican gr. 190] that scholars such as Heiberg and Heath became able to pinpoint the extent of Theon's contributions, which were much more modest than was believed by Zamberti.

Goulding explains the role Ramus and Savile played in restoring Euclid's *Elements* as a single body of geometrical knowledge, exemplified in Hypatia's virgin body. However, he bypasses an important motivation of humanist mathematicians to restore the original Euclid on the basis of Greek manuscripts.

A second essential aspect of Renaissance historiography of mathematics is the question of the origin of algebra. This issue, which is related to the humanist concern with the contamination of Greek works by Arabic authors, is completely overlooked in the book. Shortly before delivering his *Oratio introductoria in omnes scientias mathematicas*, part of a series of lectures at the University of Padua in 1464, Regiomontanus reported his find of the six books of the *Arithmetica* of Diophantus in a letter to Giovanni Bianchini. In this *Oratio*, he introduces the idea that Arabic algebra descended from Diophantus' *Arithmetica*. His formulation is subtle. He does not claim that the Arabs learned algebra from Diophantus, but it can be—and it was—understood as if Arabic algebra was derived from the *Arithmetica*. Regiomontanus was one of the few men who had seen the Greek text of Diophantus in 1464 and he was aware of its importance. By then he was also well-acquainted with Arabic algebra. He owned a copy of the Latin translation of the algebra by al-Khwārizmī, possibly from his own pen (MS. Plimpton 188). He must have been aware of the very different nature of the two traditions [see Folkerts 1980]. The term he uses, the 'art of *rei* and *census*' is the typical Latin nomenclature employed only in the Latin translations of Arabic works. Here however, he uses this terminology to refer to Diophantus and claims this is known today as 'algebra, after its Arabic name'. The question of the Greek roots of algebra became central to the historiography of mathematics in the following centuries. As Jens Høyrup [1996, 1998] has pointed out, it divided authors into two opposing camps: those who acknowledged the Arabic origins of algebra and those who chose to deny any credit to Arabic authors. The first category included Luca Pacioli, Girolamo Cardano, and Michael Stifel; the latter, Ramus, Rafaello Bombelli, and François Viète. As Viète wrote in his dedication of the *Isagoge* to Princess Mélusine, he

> considered it necessary, in order to introduce an entirely new form into it, to think out and publish a new vocabulary, having gotten rid of all its pseudo-technical terms (*pseudocategorematis*) lest it should retain its filth and continue to stink in the old way. [Klein 1968, 318–319]

In the *Scholae mathematicae*, Ramus [1569, 37] strengthens the claim that the Arabs learned algebra from the Greeks and adds Theon as a confirmation since he mentioned Diophantus.

Defending Hypatia is well researched and pleasingly written work. It broadens our understanding of Renaissance historiography of mathematics. Despite the erroneous claims made in the histories written by Ramus and others, their narratives turned out to be fruitful. Renaissance historiography allowed mathematicians and philologists to look at ancient Greek works, in particular the *Elements*, as historical texts which can be studied as such, and which facilitated an understanding of mathematics as historically contingent.

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