Introduction: The Idiosyncratic Nature of Renaissance Mathematics

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Ever since its foundation in 1540, the Society of Jesus had had one mission—to restore order where Luther, Calvin and the other instigators of the Reformation had brought chaos. To stop the hemorrhage of believers, the Jesuits needed to form a united front. No signs of internal disagreement could to be shown to the outside world, lest the congregation lose its credibility. But in 1570s two prominent Jesuits, Cristophorus Clavius and Benito Perera, had engaged in a bitter controversy. The issue at stake had apparently nothing to do with the values on which Ignazio of Loyola had built the Society of Jesus. And yet the dispute between Clavius and Perera was matter of concern for the entire Jesuit community. They were arguing over the certitude of mathematics.

There are many ways of telling the stories of Renaissance mathematics. Starting with the *Quaestio de certitudine mathematicarum*—the dispute that involved Clavius and Perera—is just an example. One may, as Carl Boyer does in his *A History of Mathematics* (Merzbach and Boyer 2011), begin by outlining the conditions that allowed mathematics to reach new heights in the sixteenth and seventeenth centuries. Chief among these conditions were the rediscovery of Greek geometry—in particular the works of Euclid and Apollonius—and the Latin translations of Arabic algebraic and arithmetic treatises. Or, following the example of Klein (1968), one may trace the transformations undergone by ancient concepts such as that of *arithmos* (number in Greek) during Renaissance times. But, I believe, no event epitomizes the spirit of Renaissance mathematics better than the *Quaestio*.

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To begin with, the participation of the Jesuits in the *Quaestio* tells us that, in the Renaissance, mathematics was not just the business of mathematicians. To be sure, Clavius was a leading mathematician of his time, but Perera was a theologian and philosopher. Even those scholars who committed themselves to mathematical research for its own sake—and not as part of an educational program, like the Jesuits did—had broader interests. Gerolamo Cardano was an astrologer, natural philosopher, and instrument maker. Niccolò Tartaglia was a fine humanist and translator. Simon Stevin was an engineer and a man of letters—Dutch language owes much of its scientific terminology to Stevin's neologisms.

But the most important lesson that can be learned from the *Quaestio* is that the transition from Renaissance to modern mathematics did not happen overnight. We see mathematics as the foundation of natural sciences, whereas in the second half of the sixteenth century the question was whether mathematics was a science at all. Those who sided with Perera believed that mathematics did not deserve this title because of the nature of its demonstrations. Mathematical demonstrations, their critics argued, were not syllogisms in the Aristotelian sense, therefore they could not be said to engender scientific knowledge. Renaissance mathematics was a long way from being modern.

Of course, Renaissance mathematics contained the seeds of what would later become modern mathematics. Yet the historiographical tendency to project one onto the other has led us to neglect aspects of Renaissance mathematics now considered to be less modern, if not outdated.

Proclus is a case in point. His *Commentary on the First Book of Euclid's Elements* had a great impact on Renaissance mathematics. In the context of the *Quaestio*, advocates of the certitude of mathematics, such as the Padoa professor Francesco Barozzi, appealed to Proclus's *Commentary* as evidence of the robustness of mathematical demonstrations (De Pace 1993). Perhaps more relevant is the role of Proclus in the narrative of *mathesis universalis*—a universal mathematics capable of producing certain knowledge. In early modern times, many philosophers and mathematicians—from Descartes to Leibniz—embarked on the quest for *mathesis universalis*. As a consequence, scholars since Heidegger ([1934] 1987) have recognized *mathesis universalis*—and the related project of mathematizing nature—as one of the staples of modern philosophy and science (see also Crapulli 1969). More recent studies have revealed that *mathesis universalis* had in fact a longer history, reaching back to Proclus and Aristotle (Rabouin 2009). This, on the one hand, has elevated Proclus to the status of forerunner of modernity. On the other hand, it seems to have obliterated the fact that Proclus was writing at a time when mathematics was part of a larger system of knowledge that included religious elements.

The truth is, Robert Goulding writes in his article in this collection, that not all of Proclus' Euclid commentary is about mathematics. Images of the divine populate various passages of the work, as Proclus uses mathematical symbols to invoke the gods and transcend discursive thinking. Readers of Proclus, then and now, have treated these passages as if they were relics of a bygone era—embellishments rather than integral parts of the text. But what would happen if we took Proclus' godly interludes seriously? We would find out, Goulding argues, that the objective of the *Commentary* lies beyond the borders of mathematics, in the pious lands of "inner theurgy"—the complex of rituals and practices developed by the Neoplatonists to ascend towards the One. By exploring the theurgic dimension of Proclus's *Commentary*, Goulding adds a puzzling layer to our understanding of this text. His essay is a lesson in the richness of mathematical history.

To tell the untold stories of Renaissance mathematics, we also need new tools. In recent years, Matteo Valleriani and his team at the Max Planck Institute for the History of Science have demonstrated that the study of astronomical treatises—such as the *Sphere* of Johannes de Sacrobosco—can be a test bed for the application of statistical methods to the humanities. Here, together with Beate Federau and Olya Nicolaeva, Valleriani shows how qualitative and quantitative approaches are both essential in unearthing a hidden fragment of Georg Joachim Rheticus's intellectual biography. Despite being a disciple of Copernicus and one of the editors of his *De revolutionibus orbium coelestium* (*On the Revolutions of Heavenly Spheres*, 1543), Rheticus, the authors claim, advocated for geocentricism—the opposite view of his master. He did so by authoring or editing texts that were reused in several printed editions of Sacrobosco's *Sphere* over almost a century (1538–1629). This was in line with what Westman (1975) has called the "Wittenberg interpretation" of the Copernican theory—an interpretation proposed by the members of the Melanchthon circle to fit the Copernican models into a geostatic view of the universe. Rheticus, however, published his texts anonymously, which is why his geocentric sympathies have gone unnoticed until now. In their article, Valleriani, Federau, and Nicolaeva force Rheticus out of the shadows and reveal how his silent influence allowed the earth to stay at the center of the universe a little longer.

Both the cases of Proclus and Rheticus prove that misconceptions about authors and texts—resulting from the habit of analyzing them through the lens of modernity—have impoverished our knowledge of Renaissance mathematics. Another source of misconceptions has been the anachronistic distinction between pure and applied science. For a long time, historians have been under the impression that Renaissance mathematics was a pure science, the mathematician a scholar whose only job was to solve abstract problems (Roux 2010). Few scholars have done more to debunk this myth than Mario Biagioli. He has shown us that even the most skilled mathematician needed a patron in Renaissance times (Biagioli 1993); and that theoretical ambitions must be accompanied by a penchant for practical matters, such as designing mathematical instruments and, consequently, claiming authorship for them (Biagioli 2006). In this special issue, Biagioli outlines a peculiar way of defending intellectual property. When accused of not being the inventor of his compass, Galileo did not reply to these charges by patenting his instrument. Instead, he let his students speak for him. As part of the same defensive strategy, he also printed an instruction manual titled *Operazioni del compasso geometrico et militare* (*Operations of the Geometric and Military Compass*, 1606). Taken together, the students' testimonies and the instructions demonstrated that only Galileo could teach how to build and operate his compass—a fact that established him as its inventor.

By the time Galileo had secured the rights to his compass, the *Quaestio* was also fading off—although echoes of it could be heard into the seventeenth century (see Malet 1997; Mancosu 1996). At the *Collegio Romano*—the headquarters of the Society of Jesus in Rome—Clavius had gained the upper hand over Perera. As a result, Euclid's *Elements* had become a compulsory reading for the students of hundreds of Jesuit colleges over the world. A few of those students would turn out to be brilliant mathematicians: Grégoire de Saint-Vincent, Honoré Fabri, André Tacquet. This was the intellectual climate in which Claude François Milliet Dechales—another disciple of Ignatius of Loyola—published his monumental history of mathematics in 1674. In the article that concludes this volume, Antoni Malet gives a thorough account of what he sees as "a late contribution to the genre, probably the last substantial one before histories inspired by 'enlightened' perspectives appeared." Jean-Etienne Montucla's 1758 *Histoire des mathématiques* has long been recognized as the starting point of mathematical historiography. Malet's study adds to the evidence that histories of mathematics were written well before Montucla—in fact as early as the sixteenth century (see also Goulding 2010). By means of a close reading of Milliet Dechales' treatise, Malet reveals how the French Jesuit saw the history of mathematics as an irresistible progress. Discovery after discovery, mathematics was bound to replace speculative natural philosophy as the queen of sciences. Clavius would have been happy.

References

Biagioli, Mario. 1993. *Galileo, Courtier: Practice of Science in the Culture of Absolutism*. Chicago: University of Chicago Press. https://doi.org/10.7208/chicago/9780226218977.001.0001

Biagioli, Mario. 2006. *Galileo's Instruments of Credit: Telescopes, Images, Secrecy*. Chicago: University of Chicago Press. https://doi.org/10.7208/chicago/9780226045634.001.0001

Crapulli, Giovanni. 1969. *Mathesis universalis. Genesi di un'idea nel XVI secolo*. Rome: Edizioni dell'Ateneo.

De Pace, Anna. 1993. *Le matematiche e il mondo: ricerche su un dibattito in Italia nella seconda metà del Cinquecento*. Milan: Franco Angeli.

Goulding, Robert. 2010. *Defending Hypatia: Ramus, Savile, and the Renaissance Rediscovery of Mathematical History*. Dordrecht/New York: Springer. https://doi.org/10.1007/978-90-481-3542-4

Heidegger, Martin. 1987. *Die Frage nach dem Ding: zu Kants Lehre von den transzendentalen Grundsätzen. 3. Durchges. Aufl*. Tübingen: Niemeyer.

Klein, Jacob. 1968. *Greek Mathematical Thought and the Origin of Algebra*, trans. Eva Brann. Cambridge, MA: MIT Press.

Malet, Antoni. 1997. "Isaac Barrow on the Mathematization of Nature: Theological Voluntarism and the Rise of Geometrical Optics." *Journal of the History of Ideas* 58(2): 265. https://doi.org/10.2307/3653869

Mancosu, Paolo. 1996. *Philosophy of Mathematics and Mathematical Practice in the Seventeenth Century*. New York: Oxford University Press.

Merzbach, Uta C., and Carl B. Boyer. 2011. *A History of Mathematics*. 3rd ed. Hoboken, NJ: John Wiley.

Rabouin, David. 2009. *Mathesis universalis: l'idée de mathématique universelle d'Aristote à Descartes*. Paris: Presses universitaires de France. https://doi.org/10.3917/puf.rabou.2009.01

Roux, Sophie. 2010. "Forms of Mathematization (14th–17th Centuries)." *Early Science and Medicine* 15(4–5): 319–337. https://doi.org/10.1163/157338210X516242

Westman, Robert S. 1975. "The Melanchthon Circle, Rheticus, and the Wittenberg Interpretation of the Copernican Theory." *Isis* 66(2): 165–193. https://doi.org/10.1086/351431