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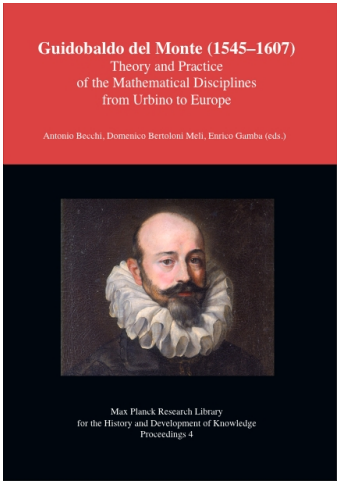

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Introduction: Searching for Order in Theory and Practice

Domenico Bertoloni Meli

Over the last few years, Guidobaldo del Monte has emerged as a key figure in the mathematical disciplines from the end of the sixteenth to the beginning of the seventeenth century, especially in the science of perspective and in mechanics, broadly conceived. The recent updated entry by Enrico Gamba and Kirsti Andersen in the *New Dictionary of Scientific Biography* (Andersen and Gamba 2008) highlights precisely these aspects.[1] The revival of studies on the Marquis del Monte and the new results emerging from them served as catalysts for a conference held in Urbino and Monte Baroccio—Guidobaldo's fief—coinciding with the four hundredth anniversary of his death in 1607. The present volume stems from that conference and brings together a number of contributions grouped under four categories dealing with mechanics, mathematics and perspective, civil and military architecture, and the political and cultural contexts of Guidobaldo's work. A common feature among all the contributions is their close reliance on documentary evidence in the form of printed texts, manuscripts, and mathematical instruments. We very much hope that this volume will stimulate new studies and lead to the editions of Guidobaldo's *Meditatiunculae de rebus mathematicis*—an important and complex manuscript unfortunately known only piecemeal—and of his correspondence.

Quite appropriately, the first five contributions deal with mechanics, an area in which Guidobaldo's *Mechanicorum liber* (Pesaro 1577) emerged at the end of the Renaissance as a pivotal text; it defined a style based on rigorous foundations that relied on the balance and on the reduction of all simple machines to it. In "Argumentandi modus huius scientiae maxime proprius," Maarten van Dyck challenges traditional interpretations of Guidobaldo's mechanics, specifically the attempt to frame it within the category of mixed sciences. According to van Dyck, although this category is commonly used by historians of science, it is ill-suited to carry out a process of mathematization in mechanics and neither Guidobaldo nor Galileo applied it. Rather, they sought appropriate principles and developed a mode of argumentation specifically suited to mechanics itself.

[1] See for example the monumental work by (Andersen 2007). See also (Van Dyck 2006; Bertoloni Meli 2006; Palmieri 2008; Henninger-Voss 2000).

Roy Laird provides a more accurate characterization of del Monte's mechanics in "Guidobaldo del Monte and Renaissance Mechanics," arguing that his signal achievement was to provide a rigorous basis for the theory of simple machines based on Archimedes's doctrine of the lever. In Laird's account, Guidobaldo saw motion as the result of disequilibrium and was unhappy with Jordanus of Nemore and Niccolò Tartaglia because they mistook effects for causes: since motion stems from disequilibrium, it cannot be used to explain equilibrium, regardless of whether conclusions drawn from such premises seem correct or not.

"Guidobaldo del Monte's Controversy with Giovan Battista Benedetti" is the only contribution that was not presented at the 2007 workshop; we are grateful to Jürgen Renn and Pietro Omodeo for this essay which explores a new aspect of Guidobaldo's mechanical thinking. The authors examine del Monte's notes on the section "De Mechanicis" in *Diversarum speculationum mathematicarum et physicarum liber* (Turin 1585) by Giovanni Battista Benedetti, court mathematician at Turin, discussing their significance and potential relevance to Galileo's *De motu*.

In "Guidobaldo del Monte: Galileo's Patron, Mentor and Friend," William Shea reminds us of the deep friendship between Guidobaldo and Galileo, reexamining their correspondence in detail.

Lastly, Domenico Bertoloni Meli's "Guidobaldo, Galileo, and the History of Mechanics" examines the fortunes of *Mechanicorum liber*, starting from the French historian Pierre Duhem, and then moving back in time to Joseph-Louis Lagrange, Pierre Varignon, and then to Galileo himself. Bertoloni Meli argues that for over two centuries, mathematicians from Lagrange to Galileo perceived Guidobaldo's work in different ways and considered it to be more significant than Duhem believed it to be.

The second set of contributions examines Guidobaldo's works in mathematics and the science of perspective, two areas displaying the same emphasis on rigor and precision that characterizes his work in mechanics. Enrico Giusti's "Guidobaldo e la teoria delle proporzioni" highlights del Monte's role as privileged spectator of the developments of the theory of proportions, as a student of Federico Commandino on the one hand, and friend and mentor to Galileo on the other. Giusti shows that Guidobaldo closely followed Commandino's edition of Euclid, wishing to systematize and pursue the classical tradition rather than challenge or extend it in problematic new directions.

Kirsti Andersen analyzes Guidobaldo's work on perspective, *Perspectiva libri sex* (Pesaro 1600). In "Guidobaldo: The Father of the Mathematical Theory of Perspective," she argues that del Monte can be rightly called the "father of the mathematical theory of perspective" for his creation of the concept of general vanishing point and for his recognition of the importance of the perspective im-

ages of sets of parallel points. Paradoxically, however, Andersen argues that del Monte was not fully aware of the power of the mathematical tool he had created.

In "Guidobaldo del Monte e Piero della Francesca: raffronti prospettici" Stefano Marconi investigates Guidobaldo's work in relation to the tradition of two major figures in the history of perspective, Leon Battista Alberti and Piero della Francesca. Both had profound links to Urbino: the former was a frequent guest at the court of Duke Federico da Montefeltro, whilst the latter painted the portraits of Federico and his wife Battista Sforza, as well as the celebrated Flagellation, now in Urbino.

In "La nuova teoria prospettica nei Perspectivae libri sex" Livia Tiriticco identifies *Perspectivae libri sex* as a key work in the history of perspective. She places the rigorous mathematical formulation of perspective attained by Guidobaldo in the context of the Renaissance debate on the arts. She argues that as a consequence of perspective becoming a "science," painting and architecture complete their transition from "artes mechanicae" to "artes liberales."

Lastly, the useful comprehensive study of "Gli strumenti scientifici di Guidobaldo del Monte" by Enrico Gamba and Roberto Mantovani provides a detailed analysis of the mathematical instruments used and perfected by Guidobaldo. The authors have identified five classes of instruments for drawing, surveying, computing, experimenting, and measuring time. Their essay offers a vivid picture of the importance of this area to Guidobaldo and of the care he devoted to perfecting and improving instruments, including the *squadro*, theodolites, compasses, balances, and solar clocks.

Architecture plays a major role in the activities of Guidobaldo and of the Urbino mathematicians: the three contributions in this area offer one of the most original features of this volume. Antonio Becchi's essay "...zoticamente non intendendo le Mechaniche" deals with the relations between mechanics and architecture, focusing especially on the pivotal role of Bernardino Baldi, a student of Federico Commandino, and Guidobaldo whose edition of the pseudo-Aristotelian *Quaestiones mechanicae* contains key analyses of architectural problems.

In "Guidobaldo del Monte: architetto di palazzo Gradari a Pesaro," Grazia Calegari makes available the contracts documenting Guidobaldo's role in the construction of Palazzo Gradari in Pesaro, thus underscoring that the range of his mathematical activities included civil architecture as well.

The importance of Francesco Menchetti's contribution on "Guidobaldo del Monte nel Granducato di Toscana e la scuola roveresca di architettura militare" goes well beyond the topic suggested by its title. Menchetti offers a sketch of the tradition of military architecture in the Duchy of Urbino, focusing in particular on Guidobaldo's visit to the fortresses of the Grand Duchy of Tuscany in 1589, and not in 1588 as previously believed. It appears that in those years Guidobaldo's

son Orazio was Provedditore of the Fortress in Pisa and that Guidobaldo himself visited his son there in the late spring of 1589. Although direct evidence of contact between Guidobaldo and Galileo at Pisa is lacking, the presence of Orazio at Pisa and Guidobaldo's visit there raise tantalizing questions about the personal contact between Guidobaldo and Galileo at a time when the latter was likely drafting his celebrated works, later known as *De motu antiquiora*. It is thus entirely plausible that at that time Guidobaldo and Galileo would have discussed and possibly experimented on matters of common interest, including mechanics and the science of motion.

The political and cultural contexts of Guidobaldo's work took different shapes in different contexts, such as in Italy and Germany, where Guidobaldo's work was translated. Marcus Popplow's "Court Mathematicians, Rosicrucians, and Engineering Experts" provides a vivid picture of the role of the mathematical disciplines in Germany, at the intersection between theoretical interests and practical pursuits. Popplow highlights interesting differences between the German and Italian contexts, such as the links between new knowledge and Protestant Reformation, which were lacking south of the Alps.

In "Guidobaldo del Monte e i nuovi corpi celesti," Alessandro Giostra has examined Guidobaldo's study of the new star of 1604—the same one that prompted Galileo's attack against the Aristotelians' claim of the incorruptibility of the heavens. Giostra has studied both the correspondence of Guidobaldo and a strictly contemporary manuscript, *De stella magorum*, situating both texts within their astronomical, philosophical, and theological contexts.

Gianluca Montinaro's "Guidobaldo del Monte e Francesco Maria II della Rovere duca di Urbino" examines the relationships between Guidobaldo and the Dukes of Urbino, situating them in the evolving and difficult situation of the Duchy at that time when the lack of a male heir threatened its very survival.

Lastly, Riccardo Paolo Uguccioni's study of "I del Monte feudatari di Monte Baroccio" provides a wealth of details on Guidobaldo's fief and its administration.

Seen together, the contributions presented in this volume offer a more complex and detailed analysis of Guidobaldo's activities and milieu. The image that emerges is that of a scholar and a practical man, active in his study, in the field, and at court. As Marcus Popplow aptly emphasizes, in this period the activities of mathematicians included both theoretical and practical aspects: the contributions to this volume amply show that for Guidobaldo the mathematical disciplines included theoretical and practical mechanics, geometry and perspective, Greek texts and material instruments, civil and military architecture. He searched for order, rigor, precision, and elegance in them all.

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