Rediscovering Apollonius in the Renaissance: Francesco Maurolico and Federico Commandino

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Abstract
The sixteenth-century revival of Greek mathematics followed multiple – often divergent – paths. This paper explores the distinct yet complementary approaches of Francesco Maurolico and Federico Commandino to Apollonius' *Conics*, focusing on the editorial strategies and innovations each introduced in their Latin editions. Special attention is paid to how each mathematician engaged with both the textual content and the geometrical diagrams, revealing two modes of Renaissance mathematical humanism that would later shape the seventeenth-century reception of Apollonius.

Keywords
Commandino, Maurolico, Apollonius, conic sections

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1. Introduction

The different attitudes of Francesco Maurolico (1494–1575) and Federico Commandino (1509–1575) towards the re-appropriation of the classics are well known, at least from the work of Clagett and Rose in the 1970s.[1] In this contribution, however, we will attempt to make it more concrete and visible by analysing how these two mathematicians approached the subject of conic sections, which was a novelty in the 16th century.

Maurolico and Commandino were leading figures in the sixteenth-century recovery of Greek mathematical knowledge. Both shared the ambition of renewing modern science through the rediscovery of ancient methods – yet their approaches diverged. Commandino engaged with Greek texts first as a philologist and then as a mathematician; Maurolico approached them from the outset as a practicing mathematician. They represent two distinct forms of Renaissance mathematical humanism: Commandino pursued an *imitatio* of the ancients, Maurolico an *æmulatio*. These categories, however, should be used with caution: Commandino was far more than a literal translator of ancient texts, while Maurolico's innovations must also be seen as part of a broader effort to restore the Greek heritage in its entirety.

Commandino's work was guided by a deep reverence for classical models. When confronted with textual lacunae in Euclid, Archimedes, Ptolemy, Apollonius, Serenus, or Pappus, he gathered every available Greek source to restore the original text. When philological tools proved insufficient, he sought to reconstruct the ancients' reasoning – sometimes with brilliant results, as in his work on Archimedes' *On Floating Bodies* or the lost proofs of Serenus.[2] At the same time, his *Liber de centro gravitatis solidorum* (1565) was the first printed work in which the recovery of Archimedean mathematics became a source of genuine innovation rather than mere restitution.

Maurolico, by contrast, was less deferential. Drawing on fragmentary sources or imperfect Latin versions, he intervened freely whenever he identified errors or gaps – rewriting demonstrations *ex traditione Maurolyci*. On the one hand, he edited or reworked the writings of Euclid, Archimedes, Apollonius, Serenus, Theodosius, Menelaus, and Ptolemy; on the other, he composed original treatises on optics, arithmetic, statics, and astronomy that often went beyond ancient results.[3]

1 Marshall Clagett, *A supplement on the medieval Latin traditions of conic sections (1150-1156)* (Philadelphia: The American Philosophical Society, 1980); Paul Lawrence Rose, *The Italian Renaissance of Mathematics* (Genéve: Droz, 1975), 159–221.

2 See Marshall Clagett, *The Fate of the Medieval Archimedes, 1300 to 1565*, III (Philadelphia: The American Philosophical Society, 1978), 623–635; Argante Ciocci, *Federico Commandino: Umanesimo matematico e rivoluzione scientifica* (Urbino: Quaderni del Centro Urbino e la prospettiva, Urbino University Press, 2023), 116–140; Id., "Federico Commandino and the Latin Edition of Apollonius's *Conics* (1566)," *Archive for History of Exact Sciences* 77, issue 4 (2023): 393–421.

3 See Pier Daniele Napolitani, "Le edizioni dei Classici: Commandino e Maurolico," in *Torquato Tasso e l'Università* (Firenze: Olschki, 1997), 119–141.

The two men worked at a distance – Maurolico in Messina, Commandino in Urbino. Commandino, supported by the Farnese and Della Rovere courts, combined philological rigor with privileged access to manuscripts. Maurolico, deeply embedded in the intellectual, civic, and political life of Messina, and later in contact with Jesuit mathematicians, cultivated a more speculative and independent approach.[4] However, the two categories, *imitatio* and *æmulatio*, used to describe Commandino and Maurolico are ultimately too reductive to fully capture the complexity of their respective bodies of work. Though separated geographically, they were aware of each other's work, and Commandino likely benefited from Maurolico's advice when preparing the 1558 *Archimedis Opera non nulla*.[5]

2. Francesco Maurolico and the reconstruction of Apollonius: a lifelong work in progress

On 24 June 1547, in Palermo, Francesco Maurolico completed his *emendatio* of Giovan Battista Memmo's Latin translation of the first four books of Apollonius' *Conics*, which had been published posthumously a decade earlier.[6] Maurolico's interest in conic sections, however, long predated this moment.[7]

Before 1537, no complete Latin translation of Apollonius' treatise was available,[8] with one partial but significant exception: Giorgio Valla's *De expetendis et fugiendis rebus opus* (1501). In book XIII, under the heading *de conica sectione*, Valla included the definitions of the three conic sections according to Apollonius, followed by a section *de cylindrica sectione* containing long excerpts from Serenus' *De sectione cylindrica*.

Relying on such limited materials, Maurolico began his early studies on conics in the late 1520s and early 1530s. Already in the *Photismi de lumine et umbra* (1521), he referred to the circle obtained by the *sectio subcontraria*, one of the few Apollonian propositions transmitted by Valla and entirely unknown to the medieval tradition.[9]

4 Pier Daniele Napolitani, "Maurolico e Commandino," in *Il meridione e le scienze. Secoli 16°-19°*, Atti del convegno di Palermo, 14-16 maggio 1985, ed. by Pietro Nastasi (Palermo: Istituto Gramsci Siciliano – Istituto italiano per gli studi filosofici, 1988), 281–316.

5 Beatrice Sisana, "Tempi, luoghi e contenuti della corrispondenza tra Federico Commandino e Francesco Maurolico," *Bollettino di Storia delle Scienze matematiche* 51, 2 (2021): 277–314; Ciocci, *Federico Commandino: Umanesimo matematico e rivoluzione scientifica*, 63–75.

6 The autograph manuscript is preserved in the Real Biblioteca del Monasterio de San Lorenzo de El Escorial, J. III. 31. Memmo's translation had appeared in Venice in 1537, published by Bernardino Bindoni.

7 For a general overview, see Pier Daniele Napolitani, *Introduzione* to vol. 8 of the *Opera mathematica*, https://maurolico.it/Maurolico/sezione.html?path=8.

8 Clagett, *A Supplement on the Medieval Latin Traditions of Conic Sections (1150–1556)*, vol. IV, 311–316.

9 Maurolico, *Optica*, vol. 10 of the *Opera mathematica*, 54–55.

In the following decade, while reconstructing Serenus' *De sectione cylindrica* on the basis of Valla's excerpts, Maurolico found himself compelled to rebuild the underlying foundations of conic theory. This work culminated in a now-lost treatise, the *Elementa conicorum*, which offered a systematic account of conic sections and included an early treatment of geometric similarity. The latter likely arose from Maurolico's engagement with Serenus' discussion of cylindrical sections similar or equal to conic sections – specifically ellipses.[10]

The reconstruction diverged significantly from Serenus' original – both in its demonstrations and its overall structure – and extended toward a broader theory of similarity in conic sections. Maurolico completed this work on Serenus in 1534 and probably composed his own treatise on conic sections that same year, consisting of at least two, possibly three, books.

He drew on these early investigations in his emendation of Archimedes' *Quadratura parabolae* (1534),[11] but his views required revision after 1537, when he encountered Memmo's translation of Apollonius. Maurolico realized that his earlier reconstruction had captured only part of Apollonius' theory: it lacked the concept of the general diameter and was restricted to Conics referring to their axes with perpendicular ordinates. Still, he remained convinced that his work had introduced results absent from Memmo's version – particularly concerning the similarity of conic sections.

This realization marked the beginning of a more ambitious project: the *Emendatio ac restitutio Apollonii Pergaei conicorum elementorum*. In a letter to the Viceroy of Sicily, Juan de Vega (written between 1554 and 1556), Maurolico described the inadequacy of Memmo's edition and articulated the guiding principles behind his own approach:

> Giovan Battista Memmo has recently translated the four books of the *Conics*, working from a manuscript so defective that he omitted entire sections where the text was illegible. In translating word for word, he occasionally altered the meaning – which shows he translated even what he did not understand. This is hardly surprising, since Giorgio Valla had done the same when translating certain works of the geometers: so rare are those who truly master this part of philosophy. To Memmo's errors must be added the printer's carelessness, especially in the diagrams, to the point that even the author himself would have struggled to correct the work. From all this, one may judge how much effort we have expended in restoring Apollonius' *Conics*. Learned men will also recognize how we have provided clearer demonstrations and added the necessary propositions and figures.

10 Roberta Tassora, "I *Sereni Cylindricorum libelli duo* di F. Maurolico e un trattato sconosciuto sulle sezioni coniche"; and in the National Edition, ed. Tassora, https://maurolico.it/Maurolico/sezione.html?path=8.1.

11 See Beatrice Sisana's Note on the Text to her edition of the *Quadratura parabolae* in *Francisci Maurolyci, Archimedea, Edizione Nazionale dell'opera matematica di Francesco Maurolico*, ed. by Riccardo Bellé, Pier Daniele Napolitani, Beatrice Sisana (Pisa-Roma: Fabrizio Serra Editore, 2022), 275–284 (English version, 285–294).

> I have not yet seen Apollonius' remaining four books, but – based on his letter to Eudemus and what may be inferred from it – I have composed certain theorems pertaining to the fifth and sixth books myself.[12]

These labours, however, were destined to remain unpublished. While we possess the Escorial autograph for the *emendatio* of the first four books, the *restitutio* survives only in the edition printed in Messina in 1654.

As Ken Saito has demonstrated, the *emendatio* was certainly based on Memmo's translation, and most likely relied on it as its sole source – although it cannot be ruled out that Maurolico may have consulted other Latin or Greek manuscripts.[13]

As for the *restitutio* – Maurolico's own reconstruction, inspired by the brief remarks Apollonius makes in his letter to Eudemus (the fifth book would have treated "maxima and minima," the sixth, similar and equal conics) – Fabrizio Baccetti has advanced the well-grounded hypothesis that it originated from a reworking of the materials found in the lost *Elementa conicorum* (1534).[14]

Already at this stage, a defining trait of Maurolico's engagement with ancient mathematics becomes apparent: he worked with whatever sources were available, approached classical texts with considerable freedom, and reworked and clarified them through his own mathematical imagination. On that basis, he developed original results and new perspectives. He often recast such material into concise compendia or presented it in the form of *quaestiones*, designed to serve as tools for renewed mathematical learning.[15]

[12] Transl. from Maurolico's letter to the Viceroy of Sicily, Juan de Vega (1554–1556): National Edition, vol. 2, sect. A3, §§58–64. https://maurolico.it/Maurolico/sezione.html?path=2.

[13] Ken Saito, "Quelques observations sur l'édition des Coniques d'Apollonius de F. Maurolico," *Bollettino di Storia delle Scienze matematiche* 14, 2 (1994): 239–258; and Id., "Francesco Maurolico's edition of the *Conics*," in *Medieval and Classical Traditions and the Renaissance of Physico-Mathematical Sciences in the 16th Century*, Proceedings of the XXth International Congress of History of Science (Liége, 20–26 July 1997) (Turnhout: Brepols 2001), 41–46.

[14] Fabrizio Baccetti, *Origine e destino dei Conicorum Elementorum Quintus et Sextus*, Tesi di laurea (rel. Pier Daniele Napolitani, Università di Pisa, A.A. 2005–2006); see also Aldo Brigaglia, "La ricostruzione dei libri V e VI delle Coniche da parte di F. Maurolico," *Bollettino di storia delle scienze matematiche* 17, 2 (1997): 267–307, and Id., "Maurolico's Reconstruction of the Fifth and Sixth Book of Apollonius' *Conics*," in *Medieval and Classical Traditions and the Renaissance of Physico-Mathematical Sciences in the XVIth Century*, 47–57.

[15] See this passage from the letter to Juan de Vega (§§ 177–180): "For what harm, I ask by the immortal God, would I do if I were to gather into a single work the definitions, concepts, postulates, problems, and theorems of Euclid's *Elements*, Theodosius' and Menelaus' *Spherics*, Apollonius' *Conics*, Serenus' *Cylindrica*, the works of Archimedes, Jordanus' *Arithmetica*, and the doctrines of music, perspective, astronomy, and mechanical inventions? Nothing at all, certainly; indeed, such a work could even restore the authors themselves to their full integrity, and scholars [*studiosi viri*] would have at hand a library of such great investigations."

Indeed, the work on Memmo's *Conics* proved fruitful in several directions. After 1544, Maurolico turned to texts newly available through the *editio princeps* of Archimedes' works, especially the *Conoids and Spheroids*. In this treatise, Archimedes assumes many properties of conic sections without demonstration. Building on his earlier studies and, above all, on his continued work on Memmo's translation, Maurolico produced his own version of the text. Divided into two books, his *De conoidibus et sphaeroidibus* devotes the entire first part to rigorously proving what Archimedes had left implicit.[16]

Only a few years later, in July 1553, he completed the *De lineis horariis libri tres*, whose third book is an original treatise on conics. There he presented their main properties and offered methods for constructing them graphically, departing in form and method from the Apollonian tradition. The treatise was published posthumously in the *Opuscula mathematica* of 1575 (Venice, Francesco de Franceschi), and it had considerable influence – certainly on Christoph Clavius (who reports having seen the manuscript)[17] and later on Giovanni Alfonso Borelli, who in his *Elementa Conica Apollonii Pergaei et Archimedis Opera Nova et breviori methodo demonstrata* (Rome, Mascardi 1679) wrote: "nostrae propositiones tanti viri [scil. Maurolyci] genium imitantur."[18]

This tendency toward reorganisation and clarity naturally led him to take yet another step. As in many of his other writings, Maurolico felt compelled to recast his work on Conics in the form of a compendium, easily accessible to the *studiosi viri*. In his *Ordo congruus compendiorum*, likely dating from the late 1560s, he described a new synthesis:[19]

> Compendium of Apollonius' *Conics* in three books, with the key and most necessary conclusions, especially those pertaining to the demonstration of the burning mirror, the quadrature of the parabola, and the areas of ellipses, which are of greatest importance for the application of conics to hour lines. Likewise, the *Cylindrica* of Serenus, with superfluities omitted.

16 See Beatrice Sisana's Note on the Text to her edition of the *De conoidibus et sphaeroidibus* in *Francisci Maurolyci, Archimedea*, 391–400, especially, 393–394 (English version, 401–410, esp. 403–404).

17 Cristoph Clavius, *Gnomonices libri octo* (Rome: Francesco Zannetti, 1581), 58; see also pages 8 and 29.

18 On Maurolico's treatise and its influence on Borelli, see Andrea Del Centina and Alessandra Fiocca, "Gli Elementa conica di G. A. Borelli, un'opera dimenticata tra tradizione e innovazione," *Bollettino di storia delle scienze matematiche* 43, 1 (2023): 61–104.

19 The *Ordo congruus compendiorum* – preserved in ms. Par. Lat. 7466, ff. 4r–5r of the Bibliothèque Nationale de France – presents all the mathematical disciplines in the form of compendia. It is found in the same manuscript as one of the versions of the *Index lucubrationum*. This project was closely linked to Maurolico's collaboration with the Jesuits of Messina in developing a mathematical *cursus*, a project only partially realised and never published. See Rosario Moscheo, *I Gesuiti e le matematiche nel secolo XVI. Maurolico, Clavio e l'esperienza siciliana* (Messina: Società Messinese di Storia Patria, 1998).

This compendium, unfortunately, appears to be lost.[20] Yet Maurolico's engagement with conic sections did not end there. For him, the task was never complete. A comparison between the 1654 printed edition and the Escorial autograph manuscript shows that he continued to revise and refine the text throughout his life. As Roberta Tassora writes:[21]

> The elements just described seem to indicate, with a high degree of probability, that Maurolico may have revised the 1547 draft, introducing changes that are now preserved in the printed edition. These considerations – together with the fact that the 1654 edition is the version that circulated, was read, and was possibly commented upon by contemporary mathematicians – suggest the appropriateness of preparing a critical edition that takes the 1654 printing as the reference text.

The study of conic sections, like much of Maurolico's oeuvre, remained a perpetual *work in progress* – a workshop he never closed.

3. Maurolico's mathematical rewriting of the text

The Madrid manuscript (Escorial J.III.31) shows that Maurolico approaches the *Conics* not as a philologist attempting to reconstruct a damaged text, but as a mathematician intent on restoring the coherence of its demonstrations. Working – as already noted – essentially on Memmo's defective Latin edition, he recasts the material into a clearer and more systematic form. The additions and *scholia* – especially numerous in Book I – do not merely clarify the argumentation but often provide new links, auxiliary propositions, or alternative proofs. Their style closely recalls that of the youthful *Elementa Conicorum*, now lost, to which several of these reconstructions seem to trace back.

Although the overall structure of Apollonius' work is preserved, Maurolico intervenes freely whenever he perceives gaps, obscurities, or inconsistencies in the inherited text. In such cases, he does not attempt to infer the "Apollonian" solution but instead constructs a demonstration that is mathematically rigorous by his own standards. As noted by Saito,[22] this occurs, for instance, in Propositions I.2 and III.7, where the lack of a fully preserved diagram or argument leads Maurolico to develop an autonomous reconstruction. These proofs are rigorous,

[20] It was still in the hands of Maurolico's nephew, Francesco Jr., Baron della Foresta, at least until the end of the sixteenth century, as attested by letters from the Jesuits Vincenzo Carnava and Vincenzo Reggio (1588–89), who intended to publish it together with other writings. See Cristoph Clavius, *Corrispondenza*, ed. Ugo Baldini and Pier Daniele Napolitani (Pisa: Dipartimento di Matematica, 1992), vol. 4, letters 150 and 151.

[21] Tassora, Note on the Text to the edition of the *Apollonii conica elementa*, National Edition, vol. VIII, sect. 2 (https://maurolico.it/Maurolico/sezione.html?path=8.2).

[22] Saito, "Quelques observations sur l'édition des *Coniques* d'Apollonius de F. Maurolico," 239–258.

though sometimes more elaborate than what might have emerged from a Greek exemplar.

This attitude is also evident in his handling of the order and composition of the propositions. Maurolico does not hesitate to add what he deems necessary for the flow of the demonstration, or to suppress what he finds superfluous. The resulting exposition is more schematic and formally controlled than that of Memmo: while the underlying demonstrative structure often remains Apollonian, its presentation is recast in a concise and uniform mathematical style.

4. Federico Commandino and the philological restoration of Apollonius Greek sources and working method

Federico Commandino approached Apollonius' *Conics* from a fundamentally philological perspective. Unlike Maurolico, he based his 1566 Latin edition directly on Greek manuscripts. His method combined rigorous philological inquiry, systematic collation, and selective use of late-antique commentaries.

The result was the 1566 edition of Apollonius' *Conics*, entitled *Apollonii Pergaei Conicorum libri quattuor* (Bologna, Alessandro Benacci, 1566),[23] which included his Latin translation of the first four books of the *Conics*, together with Eutocius' commentary, selected lemmas from Book VII of Pappus' *Collection*, and the two treatises of Serenus: *On the Section of a Cylinder* and *On the Section of a Cone*. In putting together this volume, Commandino actively sought out Greek manuscripts, evaluated their textual authority, and integrated them into his editorial work.

From the outset, Eutocius' commentary played a central role in this project. To prepare his Latin translation of the commentary, Commandino certainly had access to Urb. Gr. 73, which contains only Eutocius' commentary on Apollonius' *Conics*.[24] His hand can be recognised in marginal additions on the opening folio and, in fact, on almost all the folios of the manuscript; therefore, Urb. Gr. 73 must be counted among the Greek codices underlying the Latin version of Eutocius printed in 1566.

23 *Apollonii Pergaei Conicorum libri quattuor. Una cum Pappi Alexandrini Lemmatibus, et Commentariis Eutocii Ascalonitae. Sereni Antinsensis philosophi Libri duo nunc primum in lucem editi. Quae omnia nuper Federicus Commandinus Urbinas mendis quamplurimis expurgata a graeco convertit et commentariis illustravit*.

24 On Urb. Gr. 73 and its relationship to Mutinensis A. V. 7.16 (gr. 103), see Decorps-Foulquier, Eutocius d'Ascalon, *Commentaire sur les Livres I-IV des Coniques d'Apollonius de Perge, Fragmenta, Lemmes de Pappus aux Coniques I-IV.* Texte grec, établi, traduit et commenté par Micheline Decorps-Foulquier et Michel Federspiel, (Berlin, New York: Walter de Gruyter, «Scientia Graeco-Arabica», 2014), LXXIV-LXXX, and Heiberg, in *Apollonii Pergaei quae graece exstant cum commentariis antiquis.* Edidit et latine interpretatus est I.L. Heiberg, Lipsiae: In Aedibus G.B. Teubneri 1893, vol. II, LXXXII.

As regards the lemmas from Book VII of Pappus' *Collection*,[25] Commandino relied for their Greek text on Ms. 115 of the Newberry Library in Chicago (**k**), which transmits Book VII alone.[26]

Identifying the Greek sources used for Apollonius' *Conics* and for the two books of Serenus has long been a difficult problem. In his Latin edition, Commandino mentions *codices graeci* – in the plural – only a few times, and Heiberg already noted that these scattered remarks did not suffice to determine his Greek base text.[27] Modern work by Micheline Decorps-Foulquier has shown, however, that his Latin translation incorporates the corpus of corrections to Vat. Gr. 203 transmitted by Bodl. Canonicianus Gr. 106; Commandino thus stands within the "Canonicianus" line of the Apollonian tradition.[28]

Although we know from the loan registers of the Biblioteca Marciana that, on 7 August 1553, during a stay in Venice with Cardinal Ranuccio Farnese, Commandino borrowed Bessarion's Marcianus codex (Z. Gr. 518 = 539), which contains Apollonius' *Conics* together with the works of Serenus,[29] the Apollonius-Serenus text on which he actually worked is the later copy *Vindobonensis Suppl. Gr. 9*, prepared in 1557 by Camillo Zanetti – who used Bessarion's Marcianus as his exemplar – and later completed by Manuel Provataris with additional geometrical material.[30] This manuscript contains numerous marginal

25 For the distribution of Pappus' lemmas in the 1566 edition, see Argante Ciocci, "Federico Commandino and the Latin Edition of Pappus' *Collection*," *Archive for History of Exact Sciences* 76, issue 2 (2022): 129–151.

26 On **k** as the source of the Greek text used by Commandino for the lemmas from Pappus VII, see Athanasius P. Treweek, "Pappus of Alexandria. The Manuscript Tradition of the *Collectio mathematica*," *Scriptorium* 11 (1957): 195–233, and Ciocci, "Federico Commandino and the Latin Edition of Pappus' *Collection*," 129–151.

27 Heiberg, in *Apollonii Pergaei quae graece exstant cum commentariis antiquis*, II, LXXXII: "in Apollonio vero, quae de codicibus suis dicit, tam pauca sunt, ut inde de eo nihil certi concludi possit." See Apollonius, *Apollonii Pergaei Conicorum libri quattuor. Vna cum Pappi Alexandrini lemmatibus, et commentariis Eutocii Ascalonitae. Sereni Antinsensis philosophi libri duo nunc primum in lucem editi. Quae omnia nuper Federicus Commandinus mendis quamplurimis expurgata e Graeco conuertit, & commentariis illustrauit* (Bononiae: Ex officina Alexandri Benatii, 1566), f. 30v (comment B to I.46), f. 100r (comment A to III.55), f. 109r (comment B to IV.38); and, for Serenus, part II, f. 28v (comment B to *De sectione coni* 43).

28 Micheline Decorps-Foulquier, *Recherches sur les Coniques d'Apollonios de Pergé et leurs commentateurs grecs: histoire de la transmission des livres I-IV* (Paris: Klincksieck, 2000); Ead., "La tradition manuscrite du texte grec des Coniques d'Appollonios de Pergé (livres I-IV)," *Revue d'histoire des textes* 31 (2001): 61–116, especially 98 and LXI–LXII.

29 See Carlo Castellani, "Il Prestito dei codici manoscritti della Biblioteca di San Marco in Venezia ne' suoi primi tempi e le conseguenti perdite de' codici stessi," *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti* 55 (1896–1897): 350–351.

30 For the compilation and contents of Vindobonensis Suppl. Gr. 9 (Apollonius, Serenus, Euclid, Aristarchus, Hypsicles, etc.), and for its relationship to Marc. Gr. 518 and Vat. Gr. 191, see

and interlinear corrections, attributable to two hands: an earlier corrector,[31] and Commandino himself, who added Greek notes, textual supplements, and various emendations. In this codex he also filled the lacunae at the beginning of the preface and adopted variants drawn from Pappus' *Collection* (VII.32); comparison with his autographs preserved in Urbino confirms the identification.[32]

The corrections introduced by Commandino in the *Vindobonensis* – marginal additions, textual integrations from Pappus, and the restoration of lacunae at the beginning of the preface – were incorporated into the 1566 Latin translation and are traceable in several places in the printed edition. Taken together, these elements reflect a remarkably structured philological approach. The 1566 Latin edition does not rely on a single Greek witness, but on a sustained process of collation across several manuscripts: Urb. Gr. 73 (Eutocius); Ms. 115 (**k**) (Pappus); the *Vindobonensis Suppl. Gr. 9*, itself derived from the Marciana codex (Apollonius and Serenus); and readings from Vat. Gr. 203, which tie Commandino's text to the corrective tradition of the *Canonicianus* group. In this light, his repeated references to *codices graeci* – notably in the plural – are to be taken in a strictly literal sense: his edition emerged from a broad and carefully controlled engagement with multiple strands of the Greek textual tradition.

Against this background, the significance of Commandino's 1566 edition becomes fully apparent. It represents a distinctive moment in the Renaissance recovery of Greek mathematics: a fusion of textual scholarship and mathematical insight that established a lasting point of reference for later generations of mathematicians and editors.[33]

5. Typographical design and textual interventions

The structure of the 1566 edition offers a concrete reflection of its philological ambition. Rather than conflating its sources, Commandino presents the text of Apollonius, Eutocius's commentary, his own annotations, and the lemmas drawn from Pappus's *Collection* as distinct textual layers, each marked by specific typographical features and coordinated through

Decorps-Foulquier, "La tradition manuscrite du texte grec des Coniques d'Apollonios de Pergé (livres I–IV)," 98.

31 This corrector carefully rectified the faults inherited from the Marcianus and inserted many variants belonging to the tradition made known to us by *Canonicianus* Gr. 106.

32 For examples of Commandino's corrections in Vindobonensis Suppl. Gr. 9 and their incorporation into the Latin text, see the additions filling the lacuna in the preface (f. 1r, lines 13–15) and the marginal note on f. 1v; see Apollonius, *Apollonii Pergaei quae graece exstant*, II, 15–17, and Apollonius, *Apollonii Pergaei Conicorum libri quattuor*, 4r–4v.

33 From a philological point of view, Commandino amends many corrupted passages he found in his *graeco exemplari*. Apollonius *Apollonii Pergaei Conicorum libri quattuor*. (I.12 (p. 15r), I.13 (p. 16r), I.41 (p. 30v), I.54 (p. 38v), I.55 (p. 38v), pp. 45v, 47v, 62r, II.51 (p. 65r), II.52 (p. 66r), II.53 (p. 67r et 67v), III.20 (p. 82r), III.21 (p. 82v), III.25 (p. 85v), III.36 (p. 91r).

alphabetical cross-references. This design – documented in manuscript Vitt. Em. 1510 of the Biblioteca Nazionale Centrale di Roma[34] – allows readers to navigate seamlessly among the Greek sources, the Latin translation, and Commandino's explanatory apparatus.

From a textual standpoint, the edition is notable for the precision of its emendations. Drawing on multiple Greek witnesses, Commandino corrected numerous corrupted passages in Books I–III and restored the internal coherence of many demonstrations.[35] A particularly revealing case is that of Proposition II.4. The construction of a hyperbola through a given point with assigned asymptotes is present in the transmitted text, yet Eutocius – in his commentary on Archimedes, *De Sphaera et Cylindro* II.4 – explicitly states that this proposition is *not* found in the *Conic Elements*. He then provides a demonstration that coincides *verbatim* with the one printed in II.4.[36] Commandino thus concludes that the proposition must be a later interpolation, inserted either by Eutocius himself or by someone drawing directly on his commentary. A further argument comes from Pappus, who includes the same construction among the lemmas to *Conics* Book V – a task that would have been superfluous if the proposition had belonged to the authentic Book II.[37]

The case of II.4 exemplifies Commandino's critical method: meticulous attention to the manuscript tradition, systematic comparison with ancient sources, and a mathematically informed evaluation of the internal structure of the text. Through this synthesis of philological rigor and technical insight, the 1566 edition becomes not merely a Latin translation, but a genuinely critical reconstruction of Apollonius's treatise.

6. Two different styles of mathematical language

Having outlined the general features of Maurolico's and Commandino's approaches to Apollonius in the previous section, we shall now turn to a closer comparison of their mathematical and linguistic styles.

At the beginning of the *Conics*, Apollonius introduces the basic geometrical notions—cone, axis, vertex, base, and the key fundamental elements of a conic, the diameter and

[34] This manuscript preserves traces of Commandino's collaboration with the printer Alessandro Benacci, particularly regarding the typographical layout and the structure adopted for the 1566 edition. See A. Ciocci, "Federico Commandino and the Latin Edition of Apollonius's *Conics* (1566)," 393–421.

[35] For selected corrected loci, see *Apollonii Pergaei Conicorum libri quattuor*, I.12, I.13, I.41, I.54–55, etc.

[36] For this concordance, see Wilbur Knorr, "The Hyperbola-Construction in the *Conics*, Book II: Ancient Variations on a Theorem of Apollonius," *Centaurus* 25, 4 (1982): 253–291, 256.

[37] See Pappus, *Pappi Alexandrini Collectionis quæ supersunt e libris manu scriptis edidit latina interpretatione et commentariis instruxit Fridericus Hultsch* (Berolini, apud Weidmannos, 1877), vol. II, VII.204; Knorr, "The Hyperbola-Construction in the *Conics*, Book II," 261–282.

the ordinates. The first ten propositions deal mainly with the properties of the cone and its sections, before the three curves are formally defined. It is only in propositions 11–14 that Apollonius introduces the parabola, ellipse, hyperbola, and the so-called "opposite sections," together with another essential parameter, the *latus rectum*. As Fried and Unguru have observed, what Apollonius *shows* in propositions 1–10 is the way the cone is to be cut, whereas in propositions 11–14 what he *deduces* is the *symptōma*, the defining property of each section.[38] This brief reminder will suffice to situate the passages compared below, which concern the definition of the hyperbola in *Conics* I.12.

6.1. Mathematical and Philological Ways: Maurolico vs. Commandino on *Conics* I.12

Comparing the manuscript of Maurolico with Commandino's printed edition, we can observe significant differences in expository style and in the Latin lexicon used to translate key Greek terms typical of conic geometry.

Let us consider, for instance, the two Latin versions of the enunciation (πρότασις) of *Conics* I.12 – the proposition that defines the hyperbola.[39]

Maurolico, *Apollonii Conica Elementa* (ms. Escor. J. III. 31, 7r-v)	Commandino, *Apollonius* (1566)
Si conus plano secetur per **axim**, secetur autem et altero plano secante basim coni per rectam ad rectos existentem basi trianguli per axim: et diameter sectionis producta coincidat uni laterum trianguli per axim extra coni verticem; quae a sectione ducta est aequidistans communi sectioni secantis plani et basis coni usque ad diametrum sectionis, poterit id, quod superficies adiacens ad	Si conus plano per **axem** secetur, secetur autem et altero plano secante basim coni secundum rectam lineam, quae ad basim trianguli per axem sit perpendicularis: et sectionis diameter producta cum uno latere trianguli per axem, extra verticem coni conveniat; recta linea, quae a sectione ducitur aequidistans communi sectioni plani secantis, et basis coni usque ad sectionis diametrum, poterit spacium adiacens linea, et ad quam ea, quae

38 Michael Fried and Sabetai Unguru, *Apollonius of Perga's Conica* (Leiden–Boston–Köln: Brill, 2001), 79–92.

39 The comparison below concerns Maurolico's and Commandino's Latin renderings of *Con.* I.12. For the Greek text, see *Con.* I.12 in *Apollonius de Perge, Coniques, Texte grec et arabe, établi, traduit et commenté*, sous la direction de Roshdi Rashed, tome 1.2: *Livre I*. Édition et traduction du texte grec par Micheline Decorps-Foulquier et Michel Federspiel (Berlin, New York: Walter de Gruyter, «Scientia Graeco-Arabica», 2008). For an English paraphrase, see Thomas L. Heath, *Apollonius of Perga: Treatise on Conic Sections, Apollonius of Perga: Treatise on Conic Sections* (Cambridge: Cambridge University Press, 1896) 9–11. Our focus here is not on the Greek original, but on the lexical and stylistic choices made by the two Renaissance editors. See Fried and Unguru, *Apollonius of Perga's Conica*, 79–90.

quamdam lineam, ad quam **rationem** habet linea in rectum manens diametro sectionis occurrensque exterius lateri trianguli, quam quadratum, quod sit a ducta a summitate coni penes diametrum sectionis in basim trianguli ad contentum sub basis segmentis a ducta factis, et latitudinem habens receptam sub ipsa a diametro ad verticem sectionis, excedens **specie** simili et similiter iacente, contento sub coincidente lateri trianguli, et sub illa, ad quam possunt ductae. Vocetur autem haec sectio hyperbole.

in directum constituitur diametro sectionis, subtenditurque angulo extra triangulum, eandem **proportionem** habet quam quadratum lineae, quae diametro aequidistans à vertice sectionis usque ad basim trianguli ducitur, ad rectangulum basis partibus, quae ab ea fiunt, contentum: latitudinem habens lineam, quae ex diametro abscinditur, inter ipsam et verticem sectionis interiectam; excedensque **figura** simili, et similiter posita ei, quae continetur linea angulo extra triangulum subtensa, et ea, iuxta quam possunt quae ad diametrum applicantur. Vocetur autem huiusmodi sectio hyperbole.

The comparison reveals both shared vocabulary and telling divergences. Maurolico translates λόγος as *ratio* and Commandino as *proportio* – a difference that is consistent throughout their works. More significant, however, is the rendering of εἶδος. In Apollonius, the term designates one of the key elements in describing the hyperbola and the ellipse, namely the rectangle defined by the *latus rectum* and the *latus transversum* – that is, by the diameter and its corresponding parameter in modern terminology. In Proposition I.12, however, the term refers specifically to the rectangle constructed from the abscissa and the *latus rectum*. Following Memmo, Maurolico uses *species*, the traditional Latin rendering of εἶδος. Commandino, by contrast, introduces the term *figura*, which refers more directly to the visible form as it appears in the diagram. His choice thus places emphasis on geometric visualization, whereas Maurolico's wording remains closer to the customary Latin vocabulary of the ancient tradition.

Now, let us get a look at the setting-out (*ἔκθεσις*) and determination (*διορισμός*) of the object.[40]

[40] I provide in this note an English translation of Commandino's Latin text (1566), dealing with the setting-out (ἔκθεσις) and the determination (διορισμός): Let there be a cone whose vertex is the point ***a*** and whose base is the circle ***bc***, and let it be cut by a plane through its axis, and let it make as a section the triangle ***abc***. And let the cone also be cut by another plane, cutting the base of the cone in ***de*** perpendicular to ***bc***, the base of the triangle **abc**, and let this second cutting plane make as a section on the surface of the cone the line ***dfe***, and let the diameter of the section ***fg*** when continued meet ***ac***, one [lateral] side of the triangle ***abc*** beyond the vertex of the cone at ***h***. Let ***ak*** be drawn through ***a*** parallel to the diameter of the section ***fg*** and let it cut ***bc*** [at ***k***]. And let ***fl*** be drawn from ***f***, perpendicular to ***fg***, and let it be contrived that as sq.(***ka***) is to rec.(***bkc***), so ***fh*** is to ***fl***. And let some point ***m*** be taken, at random, on the section and through

Maurolico, Escor. J.III.31, 1547, 7r-v

Conus, cuius vertex ***a*** basisque circulus **bg** secetur plano per axim: sitque sectio **per 3^{am}** △ ***abg*** secetur et altero plano secante basim coni per rectam ***de*** ad rectos ipsi ***bg*** et faciente in conica superficie sectionem ***dze*** cuius diameter ***zh*** coincidat uni laterum, quod sit ***ga*** apud ***t***. Item ***ac*** penes ***zh***. Et ***zl*** ad rectos ipsi ***zh*** ita ut ***tz*** — **zl** sit sicut □ ***ac*** — ▭ ***bcg***. Et a contingenti puncto sectionis, utpote ***m*** ducatur ***mn*** penes ***de***. Et connexa ***tl*** compleatur ▭ ***zlon***. Et collapsis in unum ***tl no*** apud ***x*** compleatur ▭ ***lpxo***.
Dico iam quod ***mn*** potest ▭ ***zx*** adiacens scilicet ad ipsam ***zl*** sub latitudine ***zn*** et excedens specie ***lx*** simili ▭^{lo} ***tzl***.

Commandino, Apollonius 1566

Sit conus, cuius vertex ***a*** punctum, basis circulus ***bc***: et secetur plano per axem, quod sectionem faciat triangulum ***abc***: secetur autem et altero plano secante basim coni, secundum rectam lineam ***de*** ad ***bc*** basim triangulo ***abc*** perpendicularem faciatque sectionem in superficie coni lineam ***dfe***: et sectionis diameter ***fg*** producta cum ipso ac latere trianguli ***abc*** extra coni verticem conveniat in puncto ***h***: deinde per ***a*** ducatur linea ***ak*** diametro aequidistans, quae fecet ***bc***: et ab ***f*** ducatur ***fl*** ad rectos anguls ipsi ***fg***: fiatque ut quadratum ***ka*** ad rectangulum ***bkc***, ita ***hf*** linea ad lineam ***fl***. Sumatur autem in sectione quodlibet punctum ***m***; et per ***m*** ducatur ***mn*** aequidistans ***de***; et per ***n*** ipsi ***fl*** aequidistans ducatur ***nox***. Postremo iuncta ***hl***, et ad **x** producta, per ***lx*** ipsi ***fn*** aequidistantes ducantur ***lo, xp***. Dico ***mn*** posse spatium ***fx***, quod quidem adiacet lineae ***fl***, latitudinem habens ***fn***, exceditque figura ***lx*** simili ei, quae ***hfl*** continetur.

A comparison of the setting–out (ἔκθεσις) and the determination (διορισμός) in Proposition I.12 reveals a further and more substantial divergence between Maurolico and Commandino.[41] Although both mathematicians present the same geometric construction – a cone whose axial section is a triangle, a second plane perpendicular to the base of the triangle, which generates the section *dfe* (rendered as *dze* in Maurolico's version), whose

m, let ***mn*** be drawn parallel to ***de***, and through ***n,*** let ***nox*** be drawn parallel to **fl**. Let ***hl*** be joined and continued to ***x***, and ***lo*** and ***xp*** be drawn through ***l*** and ***x*** parallel to ***fn***. I say that **mn** is equal in square to the rectangular plane ***fx***, applied to ***fl*** having ***fn*** as breadth, and increased by a figure ***lx*** similar to rec.(***hfl***).

41 In the *Conics*, Apollonius generally follows the formal pattern of Euclid's *Elements*: πρότασις (general enunciation); ἔκθεσις (setting–out with reference to a diagram); διορισμός (a brief statement of what is to be proved or asserted about the configuration); and κατασκευή (auxiliary construction).

diameter *fg* is extended to meet one side of the axial triangle, along with the auxiliary lines required for the proof – their mode of exposition differs markedly (Fig. 1).

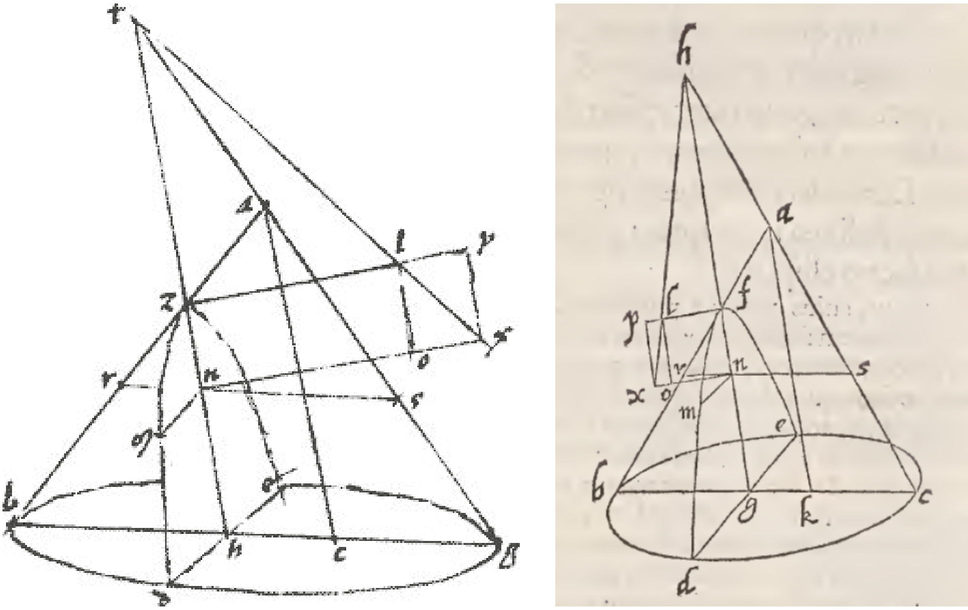


Fig. 1 – Diagrams of Proposition I.12. Maurolico (Escor. J.III.31) and Commandino (Apollonius 1566).

Commandino follows the Greek text with great fidelity. His Latin ἔκθεσις reproduces Apollonius' order clause by clause: the vertex *a* and base circle *bc* of the cone, the section *abc* cut by the axial plane, the second plane cutting *dc* perpendicular to *bc*, the curve *dfe* on the conical surface, and the construction of the diameter *fg* continued to *h*. Each step corresponds closely to the syntax and sequencing of the Greek, and Commandino regularly signals Euclidean dependencies in the margin. His aim is not to simplify the construction but to transmit it as part of a philologically reliable Latin version of Apollonius.

Maurolico's setting-out is of an entirely different nature. The Escorial manuscript compresses the same material into a remarkably compact paragraph, often into a single long sentence. Maurolico does not hesitate to depart from Memmo's earlier Latin version, nor does he follow the Greek clause structure. Instead, he reorganizes the construction according to his own mathematical idiom: symbols replace phrases, constructions are abbreviated, and references to Euclidean propositions are integrated directly into the flow of the text. The diagram plays a central role in this style, and Maurolico adapts the wording to match closely what appears in the figure rather than what stands in Apollonius' wording.

A further technical difference concerns the transcription of the Greek letters in the diagrams. Commandino adopts a systematic Latin transliteration of the Greek alphabet, whereas Maurolico simply follows the conventions already used by Memmo in the 1537 Latin edition of the *Conics*. This confirms — in a minor but telling way — Maurolico's dependence on Memmo's text, which was his only source for Apollonius. For Maurolico, however, such conventions have no philological purpose: they form part of a more general tendency to streamline notation and to prioritise the clarity of mathematical reasoning.

Gr. alphabet	A	B	*Γ*	*Δ*	E	**Z**	**H**	*Θ*	I	**K**	*Λ*	M	N	O	*Π*	X	*P*	*Σ*	*T*	*Ξ*	*Υ*	*Φ*	*Ψ*	*Ω*
Commandino	A	B	**C**	d	E	**f**	**g**	**H**	I	**K**	L	M	n	O	P	q	r	s	T	x	y	v	z	Ω
Maurolico	A	B	**G**	d	E	**z**	**h**	**T**	I	**C**	L	M	n	O	P	x'	r	s	Θ	x	y	f	*Ψ*	Ω

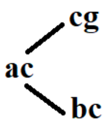
Such a difference emerges from a comparison of the text dealing with the construction (κατασκευή) and proof (ἀπόδειξις) in the two editions that Maurolico and Commandino elaborate. Let us look at the two approaches.

Maurolico shortens the construction (κατασκευή) to one line.[42] Moreover, his proof (ἀπόδειξις), compared to the one by Apollonius, is abbreviated. Maurolico aims to take over Apollonius' results and demonstrates the proposition in his way, breaking away from

[42] I provide in this note an English translation of Commandino's Latin text (1566), dealing with the construction (κατασκευή) and proof (ἀπόδειξις): For let ***rns*** be drawn through ***n*** parallel to ***bc***. And ***nm*** is also parallel to ***de***. Therefore [according to Proposition XI.15 of Euclid], the plane through ***mn*** and ***rs*** is parallel to the plane through ***bc*** and ***de***, which is to the base of the cone. Therefore, if the plane is drawn through ***mn*** and ***rs***, the section [according to Proposition I.4] will be a circle whose diameter is ***rns***. And ***mn*** is perpendicular to it. Therefore rec. ***(rns)*** is equal to sq. ***(mn)***. And since as sq.(**ak**) is to rec.(**bkc**), so ***fh*** is to ***fl***, and [according to Proposition VI.23 of Euclid] the ratio sq.(**ak**) to rec.(**bkc**) is compounded of [the ratios] ***ak*** to ***kc*** and ***ak*** to ***kb***, therefore also the ratio ***fh*** to ***fl*** is compounded of [the ratios] ***ak*** to ***kc*** and ***ak*** to ***kb***. But as ***ak*** is to ***kc***, so ***hg*** is to ***gc***, and ***hn*** is to **ns;** and as ***ak*** is to ***kb***, so ***fg*** is to ***gb*** and ***fn*** is to ***nr***. Therefore, the ratio ***hf*** to ***fl*** is compounded of [the ratios] ***hn*** to ***ns*** and ***fn*** to ***nr***. And [according to Proposition VI.23 of Euclid], the ratio rec.(**hnf**) to rec.(**snr**) is compounded of [the ratios] ***hn*** to ***ns*** and ***fn*** to ***np***. Therefore, as rec.(**hnf**) is to rec.(**snr**), ***hf*** is to ***fl*** and ***hn*** is to ***nx***. But, with ***fn*** taken as common height [according to Proposition VI.1 of Euclid] as ***hn*** is to ***nx***, rec.(***hnf***) is to rec. (***fnx***). Therefore also [according to Proposition V.11 of Euclid] as rec.(**hnf**) is to rec.(**snr**), so rec**.**(**hnf**) is to rec.(**xnf**), and [according to Proposition V.9 of Euclid] rec.(**snr**) is equal to rec.(**xnf**). But it was shown that sq.(**mn**) is equal to rec.(**snr**); therefore, also sq.(**mn**) is equal to rec.(**xnf**). But rec.(**xnf**)is the parallelogram ***xf.*** Therefore, ***mn*** is equal in square to ***xf,*** which is applied to ***fl,*** and having ***fn*** as breadth increased by the parallelogram ***lx*** similar to rec.(**hfl**). I will call such a section a hyperbola, and ***lf*** be called the straight line of application [of rectangular planes] to which the ordinates drawn to ***fg*** are equal in the square. I will call this straight line the *latus rectum* and the straight line ***fh*** the *latus transversum*.

Maurolico, Escor. J.III.31, 1547

Nam, ducta primum ***rns*** penes **bg** iam **per 24^{am} 6^{i}** Euclidis ratio □ ***ca*** — ▭ ***b**cg* componitur ex rationibus



Et propter similitudinem triangulorum [**acg, thg** atque **acb, zhb**] et proportionem laterum eadem ratio componetur ex rationibus ***th, hg*** atque ***zh,hb*** et similiter eadem componetur ex rationibus **tn** — **ns** atque **zn** — **nr**.

Verum, **per 24^{am}** predictam ratio ▭ **tnz** — ▭ **snr** componitur ex rationibus **tn** — **ns, zn** — **nr**.

Igitur ▭ **tnz** — ▭ **snr** erit sicut □ **ca** — ▭ **bcg** et ideo sicut **tz** — **zl** ac sicut **tn** — **nx** propter △ △ similitudinem.

Verum **per primam sexti tn** — **nx** sicut ▭ **tnz** — ▭ **znx.**

Igitur ▭ **tnz** — ▭ **znx** erit sicut ▭ **tnz** — ▭ snr.

Quare, **per 9^{am} 5^{i}** ▭ **snr** — aequale — ▭ **znx.**

Cumque **per 15^{am} 11^{i}** planum, in quo **mn, rs** aequedistet plano circuli **bgd** quae basis est coni.

Ideo **per 4^{am} huius** puncta **rms** erunt in periferia circuli, cuius diameter **rs.**

Ergo **per 8^{am} 6^{i}** Euclidis ▭ **snr** — aequum erit — □ **mn** quare et □ **mn** aequum ▭^{lo} **znx.**

Quod erat demonstrandum.

Vocetur autem talis sectio hyperbole: ipsa autem **lz** ad quam possunt ductae ad **zh** ordinatae: voceturque eadem et recta: transversa autem **zt**: ipsum autem ▭ **tzl** species sectionis.

om.:

Et manifestum est, quod sicut **tz** — **zl** sic est ▭ **tnz** ad ▭ **znx** hoc est ad □ **mn** namque eadem ra**tio fuit,** quae **tn** — **nx.**

Commandino, Apollonius 1566

Ducatur enim per **n** linea **rns** aequidistans **bc**: est autem et **mn** ipsi **de** aequidistans. Ergo planum, quod transit per **mnrs** aequidistat plano per **bc, de**, hoc est basi coni [**15. Undecimi**]. Si igitur planum per **mnrs** producatur, sectio circuli erit, cuius diameter **rns** [**4 huius**]: atque est ad ipsam perpendicularis **mn**. Ergo rectangulum **rns** aequale est **mn** quadrato. Itaque quoniam ut **ak** quadratum ad rectangulum **bkc**, ita est **hf** ad **fl**: proportio autem quadrati **ak** ad rectangulum **bkc** componitur ex proportione, quam habet **ak** ad **kc**, et ex ea, quam **ak** habet ad **kb**: et proportio **hf** ad **fl** composita erit ex proportione, **ak** ad **kc**, et proportione **ak** ad **kb**. Sed ut **ak** ad **kc**, ita **hg** ad **gc**, hoc est **hn** ad **ns**: et ut **ak** ad **kb**, ita **fg** ad **gb**, hoc est **fn** ad **nr.** Proportio igitur **hf** ad **fl** componitur ex proportione **hn** ad **nf**, et **fn**, ad **nr**. Ac proportio composita ex proportione **hn** ad **ns**, et **fn** ad **nr**; est ea, quam **hnf** rectangulum habet ad rectanguum **snr** [**23 sexti**]**.** Ergo ut rectangulum **hnf** ad **snr,** ita **hf** ad **fl**, hoc est **hn** ad **nx.** Ut autem **hn** ad **nx**, sumpta **fn** communi altitudine, ita **hnf** rectangulum ad rectangulum **fnx** [**1 sexti**]. Quare ut rectangulum **hnf** ad rectangulum **snr**, ita rectangulum **hnf** ad ipsum **fnx**: rectangulum igitur **snr** aequale est rectangulo **xnf** [**9 quinti**]. Sed quadratum **mn** ostensum est aequale rectangulo **snr.** Ergo quadratum **mn** rectangulo **xnf** aequale erit. Rectangulum autem **xnf** est parallelogrammum **xf.** Linea igitur **mn** potest spatium **xf**, quod lineae **fl** adiacet; latitudinem habens **fn**, excedensque figura **lx** simili ei, quae **hfl** continetur. Dicatur autem huiusmodi sectio hyperbole; et linea **lf,** iuxta quam possunt, quae ad **fg** ordinatim applicantur, quae quidem etiam recta appellabitur, transversa vero **hf.**

the Latin version by Memmo. He reworks the demonstration substantially. Exploiting the similarity of triangles *acg, thg* and *acb, zhb,* Maurolico produces a version that is shorter and more direct than Apollonius', reconstructing the chain of ratios in a compact form suited to his symbolic notation. The logical core of Apollonius' argument is preserved, but the manner of presentation is unmistakably Maurolycian: abbreviations, compounded ratios expressed graphically, and reliance on the diagram rather than on the periodic structure of the Greek text (See Fig. 2).

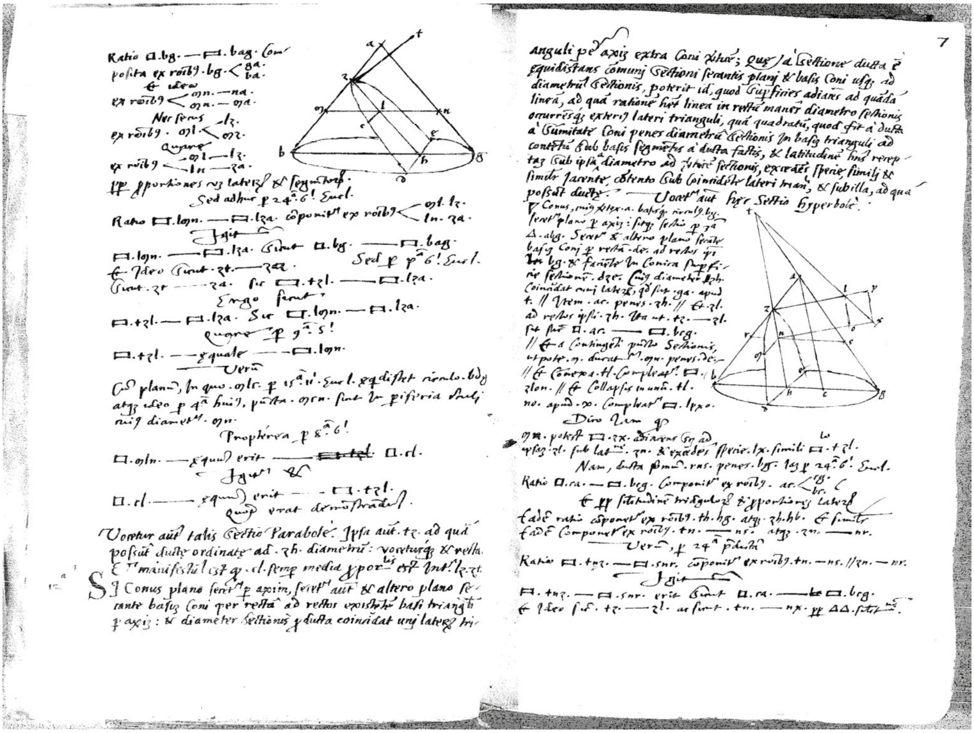


Fig. 2 – Folios 6v-7r of ms. Escorial J.III.31 (end of Prop. I. 11 and beginning of Prop. I.12, parabola and hyperbola).

Commandino again follows the opposite strategy. He preserves the sequence and phrasing of Apollonius, and he makes explicit – though only in the marginalia – the Euclidean propositions that justify each step: XI.15, I.4 of the *Conics*, VI.23, VI.1, V.9 of the *Elements*. His demonstration is not shortened but explained; not reworked but annotated. Maurolico rewrites; Commandino edits.

In sum, Proposition I.12 offers a clear illustration of the divergent editorial programs of the two mathematicians. Maurolico seeks to assimilate Apollonius' results into his own compact and operational mathematical idiom, rewriting the demonstrations in a style geared toward efficiency and internal coherence. Commandino, by contrast, seeks to transmit a faithful and carefully annotated Latin version of the Greek text, contextualized through Eutocius, Pappus, and the broader ancient tradition. The one rewrites in pursuit of mathematical clarity, the other edits in the name of philological accuracy.

7. Drawing the diagrams: Maurolico and Commandino. From schematic medieval diagrams to Renaissance reconstructions

The diagrammatic tradition of Greek mathematical texts follows stable and highly schematic conventions. Figures are drawn with ruler and compass, and even complex curves – such as conic sections or spirals – are represented through circular arcs or intersections of arcs, often producing the familiar lens-shaped forms. These diagrams are not intended to convey metrical accuracy but only to indicate the relative placement of points and lines within the argument.[43]

This pattern is also evident in the humanistic transmission of Archimedes: in Iacopo da San Cassiano's Latin translation (ca. 1450), the diagrams of the conics still follow the schematic conventions of the medieval Greek tradition. Mathematicians such as Piero della Francesca – or even one of Regiomontanus' stature – reproduced them uncritically. Only with the Basel edition of 1544 were the curves relevant to Archimedes' arguments drawn in a geometrically meaningful way.[44]

These limitations appear even more starkly in the manuscript tradition of Apollonius' *Conics*, where essential geometric relations – such as the inclination of the cutting plane or the mutual disposition of diameter, ordinates, and parameter – are rendered in schematic

[43] For general discussions of diagrammatic conventions in Greek and late-antique mathematical texts, see *inter alia*: Reviel Netz, *The Shaping of Deduction in Greek Mathematics: A Study in Cognitive History* (Cambridge: Cambridge University Press, 1999); Ken Saito, "A Preliminary Study in the Critical Assessment of Diagrams in Greek Mathematical Works," *SCIAMVS* 7 (2006): 81–144; Fabio Acerbi, "The mathematical *Scholia Vetera* to Almagest I.10–15," *SCIAMVS* 18 (2017): 133–259; Saito and Sidoli, "Diagrams and arguments in ancient Greek mathematics"; Sidoli, "The manuscript diagrams of Theodosios' *Spherics*," in *The History of Mathematical Proof in Ancient Traditions*, ed. by Karine Chemla (Cambridge: Cambridge University Press, 2012), 135–162; Reviel Netz, "Why Were Greek Mathematical Diagrams Schematic?" *Nuncius* 35 (2020): 506–535.

[44] On the figures in the manuscript tradition descending from Iacopo da San Cassiano's translation, see Paolo D'Alessandro and Pier Daniele Napolitani, *Archimede Latino / Archimedes Latinus. Iacopo da San Cassiano e il corpus archimedeo alla metà del Quattrocento con edizione della Circuli dimensio e della Quadratura parabolae* (Paris: Les Belles Lettres, 2012), 283–327.

ways that can contradict the very hypotheses of the propositions. The diagrams known to Maurolico (through Memmo's 1537 Latin translation) and to Commandino (through the *Vindobonensis Suppl. Gr. 9*) typically fail to reflect the structure of Apollonius' constructions.

Against this background, the work of the two Renaissance editors marks a decisive break with the medieval tradition. Maurolico systematically corrected the figures found in Memmo's edition,[45] while Commandino redrew the entire corpus of diagrams for Apollonius, Eutocius, Pappus, and Serenus. Their aims were convergent: to restore diagrams that were metrically consistent with the text and that rendered visually the logical structure of the demonstrations. Maurolico worked largely freehand, whereas Commandino relied on the constructive procedures described in his *Liber de Horologiorum descriptione* (1562); yet both inaugurated a new attention to the explanatory and epistemic role of the diagram, anticipating the more sophisticated iconography of seventeenth-century mathematics.

7.1 Maurolico and Commandino on the parabola (*Conics*, I.11)

The contrast between Maurolico and Commandino emerges most clearly when they confront the same defective material: the diagram of Proposition I.11, where Apollonius establishes the *symptoma* of parabola. Both mathematicians inherit schematic figures that crystallise the conventional features of the Byzantine tradition. In Memmo's 1537 edition, the parabola is drawn as a lens-shaped intersection of circular arcs; the diameter is not parallel to the side of the axial triangle; the line drawn parallel to the common section of the cutting plane is misplaced; and the axial triangle itself is geometrically inconsistent with the proposition's hypotheses. In short, the resulting figure cannot be regarded as a parabola in Apollonius' sense.

Maurolico reacts by reconstructing the pair of figures freehand, restoring the conditions that Apollonius' demonstration presupposes. He redraws the diameter so that it is parallel to the relevant side of the axial triangle; corrects the direction of the line drawn parallel to the common section; and replaces the medieval "lens" with a curve that is metrically coherent with the properties stated in the proposition. The result is not a revival of ancient drawing conventions, but an explicit analytic tool – a diagram constructed to express the logical structure of the proof (See Fig. 3).

Commandino, by contrast, approaches the same proposition through the constructive procedures outlined in his *Liber de Horologiorum descriptione* (1562). His redesign of the figure is regular, symmetrical, and metrically controlled. Yet in doing so, he tends to normalise the configuration: the diameter is presented in an axially oriented setting, and the

45 On Maurolico's conception of the diagram as an epistemic component of geometrical reasoning, see Michela Malpangotto, "Graphical Choices and Geometrical Thought in the Transmission of Theodosius' Spherics from Antiquity to the Renaissance," *Archive for History of Exact Sciences* 64 (2010): 75–112.

figure is drawn in a manner that privileges orthogonal relations and Euclidean regularity.

The result is elegant, but less tightly aligned with the specific geometric relations of Apollonius' construction (See Fig. 4).

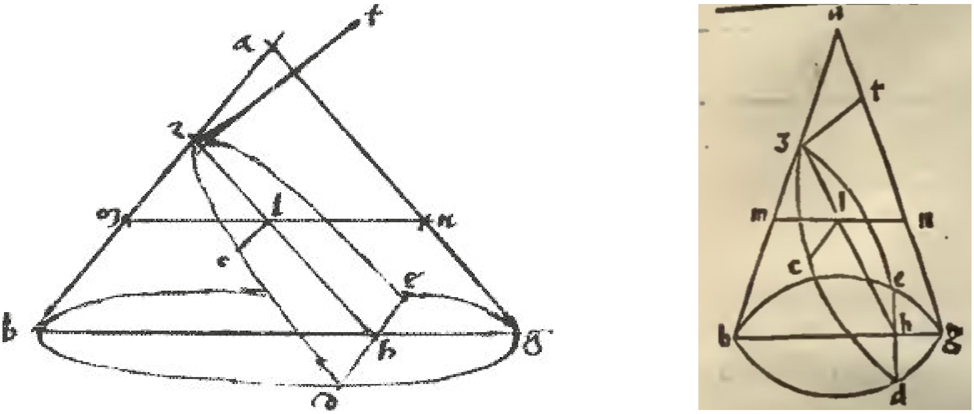


Fig. 3 – Diagrams of Proposition I.11: Maurolico (Escor. J.III.31) and Memmo (1537).

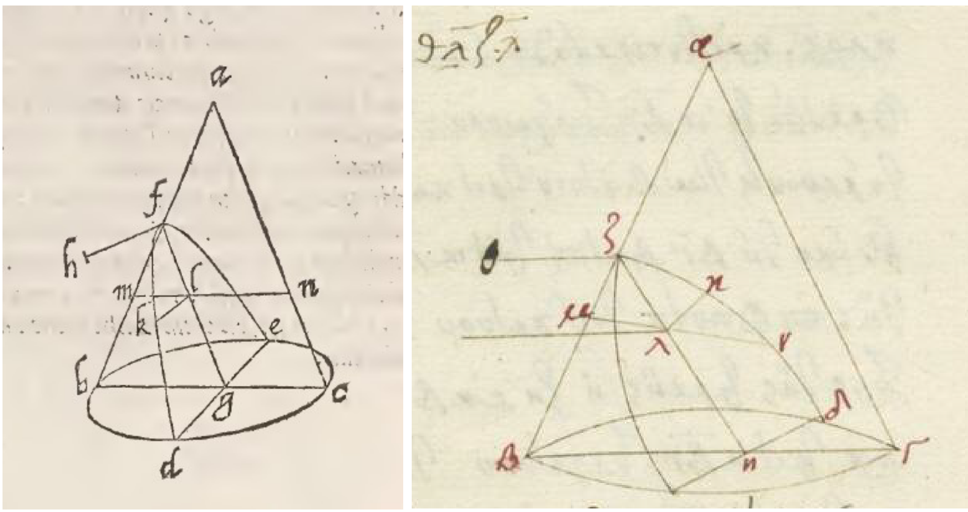


Fig. 4 – Diagram of the Proposition. I.11 parabola. Latin edition by Commandino (1566, 14r). In the diagram drawn by Commandino, **hf** is the *latus rectum*. On the right: diagram from the codex Vindobon. Suppl. Gr. 9, f. 10r.

The two solutions thus reflect two different editorial attitudes. Maurolico rewrites the inherited diagram to restore the geometry required by the proof; Commandino normalises the construction within a broader graphical method. Both reject the medieval schematic tradition – but they do so in opposite ways: Maurolico by recovering Apollonius' configuration, Commandino by embedding it in a more uniform constructive framework.

8. *Maurolico and Commandino on the hyperbola* (Conics, *I.16*)

Whereas in Propositions I.11–14 the difficulty lay in rendering spatial constructions involving axial inclinations, the subsequent propositions are confined to planar configurations. Yet these remain far from straightforward: the use of generic diameters means that the lines drawn ordinatewise are not conceived as perpendicular to the diameter, and the diagrams must capture a combination of orthogonal and oblique directions within the plane.

A representative case is Proposition I.16, where Apollonius determines the pair of conjugate diameters of the opposite sections (i.e. the two–branched hyperbola).[46] Here the diagram must capture a subtle configuration: a *generic* diameter *cl* of the hyperbola, two lines drawn ordinatewise (*lt* and *ch*)that are not orthogonal to *cl*, and a *latus rectum ae* drawn perpendicularly to the transverse side *ab*. This mixture of non-orthogonal and orthogonal relations, characteristic of Apollonius' construction, is essential to the logic of the proposition.[47]

Maurolico represents this configuration with a striking degree of fidelity. In his diagram, the diameter is genuinely generic, not aligned with the axis of the hyperbola; the two ordinatewise lines meet the diameter obliquely, as Apollonius requires; and the *latus rectum* is drawn orthogonally to the transverse side. The figure thus expresses the precise interplay of relations on which the proof depends. Maurolico's drawing is freehand, yet it adheres closely to the Apollonian construction (See Fig. 5).

Commandino's solution reflects a different graphical philosophy. Applying his constructive method, he tends to align the diameter with the axis of the hyperbola and to regularise the configuration into an orthogonal framework. The resulting diagram is more symmetrical and metrically controlled, but it no longer reproduces the layout of lines required for Apollonius' determination of a conjugate diameter in the general case. In effect,

[46] For Apollonius, two diameters are *conjugate* when each bisects the lines drawn parallel to the other. His definition is explicit: "The two straight lines, each of which, being a diameter, bisects the straight lines parallel to the other, I call conjugate diameters of a curved line and of two curved lines." *Apollonius of Perga, Conics*, Books I–III, translated by R.C. Taliaferro (Santa Fe: Green Lion Press, 2000), 4.

[47] "If through the midpoint of the transverse side of the opposite sections a straight line be drawn parallel to a straight line drawn ordinatewise, it will be a diameter of the opposite section, conjugate to the diameter just mentioned." Ibid., 33.

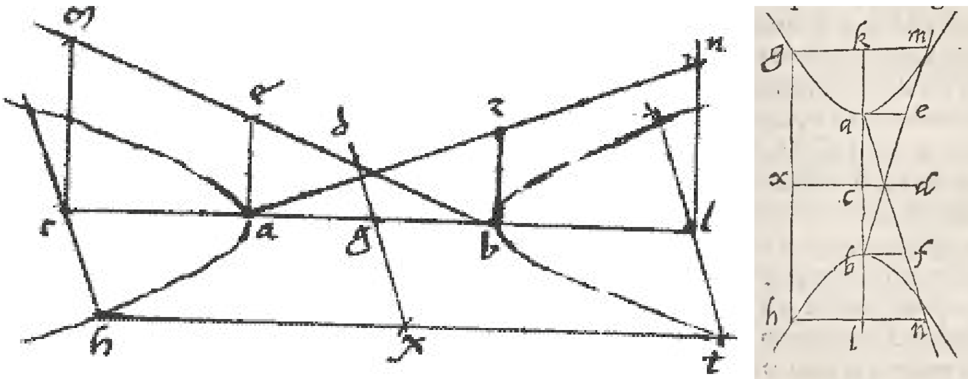


Fig. 5 – Diagram of Proposition I.16: Maurolico and Commandino.

Commandino assimilates the generic diameter of the hyperbola to the special case of the axis, thereby smoothing out a geometric distinction.

This was not due to a misunderstanding. In the diagrams he draws for Eutocius – in particular those accompanying Proposition I.16 in that commentary – Commandino clearly distinguishes between the axis and a generic diameter and accurately represents the diameter as non-axial. He was thus fully aware of the difference between the general and special cases, but in his edition of the *Conics* chose to favour a regularised and visually balanced construction over a faithful rendering of Apollonius' diagrammatic logic.

The difference, therefore, lies not in difficulty in representing two and three-dimensional visualisation, but in the interpretation of the configuration itself. Maurolico preserves Apollonius' use of a generic diameter and the associated non-orthogonal relations; Commandino normalises the figure by recasting it within his broader constructive method. The two diagrams reveal, with exceptional clarity, the divergent editorial strategies that guide their work: Maurolico reconstructs the configuration required by the proof, while Commandino regularises it according to a normative graphic procedure.

9. Two editorial philosophies of the diagram

The comparison of Propositions I.11 and I.16 reveals that the differences between Maurolico and Commandino are not merely graphical but reflect two distinct conceptions of what a mathematical diagram is and how it should function within a demonstration.

For Maurolico, the diagram is an essential component of the argument. It must express the configuration on which the proof depends and may be rewritten whenever the inherited tradition obscures or contradicts that structure. His drawings correct misalignments, restore missing relations, and adapt the visual layout to the internal logic of the demonstration. This approach reflects the broader character of his mathematical practice: text and figure are coextensive, and clarity in one demands clarity in the other. The diagram becomes an instrument of analysis and, in many cases, a means of reconstructing the reasoning that the damaged text no longer conveys.

Commandino's attitude is different. For him, the primary task of the editor is to transmit the text of Apollonius and the late–antique commentary in a philologically controlled form. The diagram serves as a regulated visual counterpart to the restored text. His figures are constructed according to a systematic Euclidean method, privileging axial symmetry, orthogonal relations, and metrical regularity. Even when Apollonius' construction implies a more generic configuration – as in the case of the conjugate diameters – Commandino tends to select the realisation that best fits within his normative graphical framework. The result is visual clarity anchored in textual fidelity, rather than in a reconstruction of the more complex geometric structure presupposed by the argument.

These two approaches should not be seen as opposing tendencies. Each reflects an attempt to recover Apollonius' geometry under different editorial priorities: Maurolico seeks to restore the operative structure of the arguments, while Commandino aims to preserve the textual and constitutive order of the ancient tradition. Their work thus offers two complementary ways of "rewriting" Apollonius: one mathematical, the other philological, both essential to the Renaissance reappropriation of the *Conics*.

10. Rewriting Apollonius

The comparison developed in this article shows that Maurolico and Commandino reopened access to Apollonius' *Conics* through two complementary strategies. Their work does not simply repair a damaged tradition: it reflects two coherent ways of making an ancient mathematical text intelligible, usable, and meaningful for sixteenth-century readership.

For Maurolico, recovering Apollonius meant reconstructing the operative structure of the arguments. His rewriting of proofs, his reorganisation of the material, and his deliberate redrawing of the diagrams all aim at restoring a mathematical text that could once again be *worked with*. Although his edition of the *Conics* remained unpublished until 1654 and therefore had no direct impact on the first phase of early modern geometry, the analytical attitude that shapes it circulated through other works – most notably the *De lineis horariis* – which influenced authors such as Clavius and, later, Borelli.

Commandino offered a different service to Renaissance mathematicians. His 1566 Latin edition stabilised the Greek text, integrated the late-antique commentary, and provided a regulated corpus of diagrams designed as a visual counterpart to the restored wording. For scholars, teachers, and students, it quickly became the standard gateway into Apollonius and shaped the reception of the *Conics* throughout the late sixteenth and seventeenth centuries.

Taken together, Maurolico and Commandino represent two distinct yet mutually reinforcing modes of Renaissance engagement with ancient mathematics: one oriented toward mathematical reconstruction, the other toward philological restitution. Their joint contribution made Apollonius available to two kinds of readers – those who wished to *work* with the *Conics* and those who wished to *study* them – and prepared the ground for the divergent appropriations of conic geometry in the seventeenth century.

In this sense, the two paths sketched in the introduction – an *imitatio* of the ancients that restores their words, and an *æmulatio* that rewrites their arguments as working mathematics – appear not as alternatives but as complementary forms of Renaissance engagement with Apollonius.

References

Acerbi, Fabio. "The mathematical *Scholia Vetera* to Almagest I.10-15. With a critical edition of the diagrams and an interpretation of their symmetry properties." *SCIAMVS* 18 (2017): 133–259.

Apollonii Pergaei Conicorum libri quattuor. Vna cum Pappi Alexandrini lemmatibus, et commentariis Eutocii Ascalonitae. Sereni Antinsensis philosophi libri duo nunc primum in lucem editi. Quae omnia nuper Federicus Commandinus mendis quamplurimis expurgata e Graeco conuertit, & commentariis illustrauit. Bononiae: Ex officina Alexandri Benatii, 1566.

Apollonii Pergaei quae graece exstant cum commentariis antiquis. Edidit et latine interpretatus est I.L. Heiberg, vol. I. Lipsiae: In Aedibus G.B. Teubneri 1891.

Apollonii Pergaei quae graece exstant cum commentariis antiquis. Edidit et latine interpretatus est I.L. Heiberg, vol. II. Lipsiae: In Aedibus G.B. Teubneri 1893.

Apollonii Pergei philosophi, mathematicique excellentissimi Opera per doctissimum philosophum Ioannem Baptistam Memum Patritium Venetum, mathematicharumque artium in Urbe Veneta lectorem publicum de Graeco in Latinum et noviter impressa. Venezia: 1537.

Apollonius de Perge, Coniques, Texte grec et arabe, établi, traduit et commenté, sous la direction de Roshdi Rashed, tome 1.2: *Livre I*. Édition et traduction du texte grec par Micheline Decorps-Foulquier et Michel Federspiel. Berlin, New York: Walter de Gruyter, «Scientia Graeco-Arabica», 2008.

Apollonius of Perga, Conics, Books I–III, translated by R.C. Taliaferro; Book IV translated by M. Fried, Diagrams by William H. Donahue. Santa Fe, Green Lion Press, 2013.

Baccetti, Fabrizio. *Origine e destino dei Conicorum Elementorum Quintus et Sextus*. Tesi di laurea (rel. Pier Daniele Napolitani, Università di Pisa, A.A. 2005–2006).

Brigaglia, Aldo. "La ricostruzione dei libri V e VI delle Coniche da parte di F. Maurolico." *Bollettino di storia delle scienze matematiche* 17, 2 (1997): 267–307.

Brigaglia, Aldo. "Maurolico's Reconstruction of the Fifth and Sixth Book of Apollonius' Conics." In *Medieval and Classical Traditions and the Renaissance of Physico-Mathematical Sciences in the XVIth Century*, Proceedings of the XXth International Congress of History of Science (Liège, 20–26 July 1997), 47–57. Turnhout: Brepols 2001. https://doi.org/10.1484/M.DDA-EB.5.113571

Castellani, Carlo. "Il Prestito dei codici manoscritti della Biblioteca di San Marco in Venezia ne' suoi primi tempi e le conseguenti perdite de' codici stessi." *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti* 55 (1896–1897): 350–351.

Ciocci, Argante. "Federico Commandino and the Latin Edition of Pappus' Collection." *Archive for History of Exact Sciences* 76, issue 2 (2022): 129–151. https://doi.org/10.1007/s00407-021-00284-1

Ciocci, Argante. "Federico Commandino and the Latin Edition of Apollonius's Conics (1566)." *Archive for History of Exact Sciences* 77, issue 4 (2023): 393–421. https://doi.org/10.1007/s00407-023-00307-z

Ciocci, Argante. *Federico Commandino: Umanesimo matematico e rivoluzione scientifica*. Urbino: Quaderni del Centro Urbino e la prospettiva, Urbino University Press, 2023.

Clagett, Marshall. *Archimedes in the Middle Ages, I. The Arabo-Latin tradition.* Madison: The University of Wisconsin Press, 1964; *II. The translations from the Greek by William of*

Moerbeke. Philadelphia: The American Philosophical Society, 1976; *III. The fate of the medieval Archimedes, 1300 to 1565*. Philadelphia: The American Philosophical Society, 1978; *IV. A supplement on the medieval Latin traditions of conic sections (1150-1156)*. Philadelphia: The American Philosophical Society, 1980; *V. Quasi-Archimedean geometry in the thirteenth century*. Philadelphia: The American Philosophical Society, 1984.

Clavius, Christoph. *Gnomonices libri octo*. Roma, Francesco Zannetti, 1581.

Clavius, Christoph. *Corrispondenza*, edited by Ugo Baldini and Pier Daniele Napolitani. Pisa: Dipartimento di Matematica, 1992.

D'Alessandro, Paolo, and Napolitani, Pier Daniele. *Archimede Latino/Archimedes Latinus. Iacopo da San Cassiano e il corpus archimedeo alla metà del Quattrocento con edizione della Circuli dimensio e della Quadratura parabolae*. Paris: Les Belles Lettres, 2012.

Decorps-Foulquier, Micheline. *Recherches sur les Coniques d'Apollonios de Pergé et leurs commentateurs grecs: histoire de la transmission des livres I-IV*. Paris: Klincksieck, 2000. https://doi.org/10.3406/rht.2003.1506

Decorps-Foulquier, Micheline. "La tradition manuscrite du texte grec des Coniques d'Apollonios de Pergé (livres I-IV)." *Revue d'histoire des textes* 31 (2001): 61–116.

Del Centina, Andrea and Fiocca, Alessandra. "Gli Elementa conica di G. A. Borelli, un'opera dimenticata tra tradizione e innovazione." *Bollettino di storia delle scienze matematiche* 43, 1 (2023): 61–104.

Eutocius d'Ascalon, *Commentaire sur les Livres I-IV des Coniques d'Apollonius de Perge, Fragmenta, Lemmes de Pappus aux Coniques I-IV.* Texte grec, établi, traduit et commenté par Micheline Decorps-Foulquier et Michel Federspiel. Berlin–New York: Walter de Gruyter, «Scientia Graeco-Arabica», 2014.

Francisci Maurolyci Messanensis, Emendatio et Restitutio Conicorum Apollonii Pergaei. Messina: 1654.

Francisci Mavrolyci Optica. Edizione Nazionale dell'opera matematica di Francesco Maurolico, edited by Riccardo Bellé and Ken'ichi Takahashi. Pisa–Roma: Fabrizio Serra Editore, 2017.

Francisci Mavrolyci Archimedea. Edizione Nazionale dell'opera matematica di Francesco Maurolico, edited by Riccardo Bellé, Pier Daniele Napolitani, Beatrice Sisana. Pisa–Roma: Fabrizio Serra Editore, 2022.

Fried, Michael N. and Unguru, Sabetai. *Apollonius Of Perga's Conica. Text, Context, Subtext*. Leiden–Boston–Köln: Brill, 2001.

Heath, Thomas L. *Apollonius of Perga: Treatise on Conic Sections*. Cambridge: Cambridge University Press, 1896.

Knorr, Wilbur. "The Hyperbola-Construction in the *Conics*, Book II: Ancient Variations on a Theorem of Apollonius." *Centaurus* 25, 4 (1982): 253–291. https://doi.org/10.1111/j.1600-0498.1981.tb00647.x

Malpangotto, Michela. "Graphical Choices and Geometrical Thought in the Transmission of Theodosius' Spherics from Antiquity to the Renaissance." *Archive for History of Exact Sciences* 64 (2010): 75–112. https://doi.org/10.1007/s00407-009-0054-1

Moscheo, Rosario. *I Gesuiti e le matematiche nel secolo XVI. Maurolico, Clavio e l'esperienza siciliana*. Messina: Società Messinese di Storia Patria, 1998.

Napolitani, Pier Daniele. "Le edizioni dei Classici: Commandino e Maurolico." In *Torquato Tasso e l'Università*, 119–141 Firenze: Olschki, 1997.

Napolitani, Pier Daniele. "Maurolico e Commandino." In *Il meridione e le scienze. Secoli 16°-19°*. Atti del convegno di Palermo, 14–16 maggio 1985, ed. by Pietro Nastasi, 281–316. Palermo: Istituto Gramsci Siciliano – Istituto italiano per gli studi filosofici, 1988.

Netz, Reviel. *The Shaping of Deduction in Greek Mathematics: A Study in Cognitive History*. Cambridge: Cambridge University Press, 1999. https://doi.org/10.1017/CBO9780511543296

Netz, Reviel. "Why Were Greek Mathematical Diagrams Schematic?" *Nuncius* 35 (2020): 506–535. https://doi.org/10.1163/18253911-03503017

Pappi Alexandrini Collectionis quæ supersunt e libris manu scriptis edidit latina interpretatione et commentariis instruxit Fridericus Hultsch. Volumen I, Insunt librorum II, III, IV, V reliquiae Berolini, apud Weidmannos, MDCCCLXXVI; Volumen II, *Insunt librorum VI et VII reliquiae,* Berolini, apud Weidmannos, MDCCCLXXVII. Volumen III, *Insunt liber VIII reliquiae Supplementa in Pappi Collectionem,* Berolini, apud Weidmannos, MDCCCLXXVIII.

Rose, Paul Lawrence. *The Italian Renaissance of Mathematics*. Genève: Droz, 1975.

Saito, Ken and Sidoli, Nathan Camillo. "Diagrams and arguments in ancient Greek mathematics: lessons drawn from comparisons of the manuscript diagrams with those in modern critical editions." In *The History of Mathematical Proof in Ancient Traditions*, ed by Karine Chemla, 135–162. Cambridge: Cambridge University Press, 2012.

Saito, Ken. "Quelques observations sur l'édition des Coniques d'Apollonius de F. Maurolico." *Bollettino di Storia delle Scienze matematiche* 14, 2 (1994).

Saito, Ken. "Francesco Maurolico's edition of the *Conics*." In *Medieval and Classical Traditions and the Renaissance of Physico-Mathematical Sciences in the 16th Century*. Proceedings of the XXth International Congress of History of Science (Liége, 20–26 July 1997), 41–46. Turnhout: Brepols, 2001. https://doi.org/10.1484/M.DDA-EB.5.113570

Saito, Ken. "A Preliminary Study in the Critical Assessment of Diagrams in Greek Mathematical Works." *SCIAMVS* 7 (2006): 81–144.

Sidoli, Nathan Camillo. "The manuscript diagrams of Theodosios' *Spherics*." *Journal for the History of Astronomy* 55, 4 (2024): 454–489. https://doi.org/10.1177/00218286241248639

Sisana, Beatrice. "Tempi, luoghi e contenuti della corrispondenza tra Federico Commandino e Francesco Maurolico." *Bollettino di Storia delle Scienze matematiche* 51, 2 (2021): 277–314.

Tassora, Roberta. "I Sereni Cylindricorum libelli duo di F. Maurolico e un trattato sconosciuto sulle sezioni coniche." *Bollettino di Storia delle Scienze matematiche* 15, 2 (1995): 135–264.

Toomer, Gerald J. "Eutocius of Ascalon." In *Dictionary of Scientific Biography*, vol. 4 (1971): 497–505.

Treweek, Athanasius P. "Pappus of Alexandria. The Manuscript Tradition of the Collectio Mathematica." *Scriptorium* 11 (1957): 195–233. https://doi.org/10.3406/scrip.1957.2937