2 Bessarion's Astronomical Apprenticeship in Constantinople and Mistra

Summary 1 John Chortasmenos, Teacher of Bessarion in Astronomy and Mathematics. – 2 Bessarion and the Teachings of Chortasmenos. – 3 Philosophy, Astrology, and Mathematics in Mistra in the 1430s: At the School of Georgios Gemistos Plethon. – 4 Plethon's Contributions to Mathematics. – 5 Between Orthodoxy and Plethon's Reform Plans.

Astronomy was one of the compulsory subjects of the Byzantine study programme at the Patriarchal School in the fifteenth century.[1] Accordingly, Bessarion's curriculum followed these schemes: rhetoric, grammar, and logic, and then a second, higher level of education, with arithmetic, music theory, geometry, and astronomical studies.[2] Beside the astronomical studies, Bessarion received a solid education in rhetoric, philosophy, and theology in Constantinople. According to the epistemological beliefs of the Middle Ages, astronomy was deemed essential and compulsory to tackle theological studies. The Greek rhetorical tradition, the philosophical tradition accepted by Eastern Church Fathers along with the translations into Greek of Latin Scholastic philosophy, and the hesychast background were fundamental in Bessarion's environment. In spite of the tension between the theologies of the Churches of Rome and Constantinople, Bessarion did not perceive Latin Scholastic philosophy as opposed to hesychasm and Palamite theology: he was not a radical hesychast and his encounter with scholasticism was mediated by Byzantine translations.[3]

What follows examines Bessarion's astronomical education in Constantinople and Mistra.

1 Bydén, *Theodore Metochites' Stoicheiosis astronomike*, 216-62. On scientific education in Byzantium, cf. Manolova, Pérez-Martin, "Science Teaching and Learning Methods in Byzantium".

2 Cacouros, "La philosophie et les sciences du *Trivium* et du *Quadrivium*"; Kastiampoura, "Faith or knowledge?".

3 Monfasani, *Bessarion scholasticus*.

DOI 10.30687/978-88-6969-856-9/002

1 John Chortasmenos, Teacher of Bessarion in Astronomy and Mathematics

A polymath with a keen interest in mathematics and astronomy, John Chortasmenos (ca. 1370-1431/1437) was one of Bessarion's teachers in Constantinople.[4] Bessarion owed to Chortasmenos his passion for mathematics and astronomy.

Chortasmenos taught at the Patriarchal School of Constantinople from 1397 until 1425.[5] His scientific interests are evident in his manuscripts.[6] For instance, manuscript *Matr. Bibl. Nat.* 4678 (Madrid, National Library) shows Chortasmenos's interest in Diophantus's *Arithmetica*. Notably, Chortasmenos's marginal note sends Diophantus's soul to the devil due to the difficulty of his theorems.[7] Noteworthy is the group of manuscripts *Vat. Urb. gr.* 80 (Vatican Apostolic Library), *Vinbob. suppl. gr.* 75 (Vienna, Austrian National Library) and *Vat. gr.* 1059 (Vatican Apostolic Library).[8]

A part of manuscript *Urb. gr.* 80[9] is transcribed by Chortasmenos and provides an excerpt of Theon of Alexandria's *Little Commentary on Ptolemy's Handy Tables*, part of Stephanus of Alexandria's *Commentary on Ptolemy's Handy Tables*, a treatise of Isaac Argyros on lunar and solar conjunctions, a treatise on geography based on Ptolemy's *Geography*, *Almagest* Book 1 alongside *scholia* taken from commentaries of Theodosius, Proclus, Theon, and Metochites,[10] as well as excerpts of mathematics and astronomical tables based on Ptolemy.[11]

Manuscript *Vindob. suppl. gr.* 75 contains Chortasmenos's transcription of the astronomical treatises of Isaac Argyros.[12]

Manuscript *Vat. gr.* 1059 is also penned by Chortasmenos and contains a remarkable number of scientific texts:[13] for instance, Proclus's *Exposition of Astronomical Hypotheses*, John Philoponus's treatise on the astrolabe, works by Argyros on the astrolabe and on astronomical tables for lunisolar cycles and Easter computus, Ptolemy's *Geography*, Theodorus Meliteniotes's *Three Books on Astronomy*, the Greek version of the Alphonsine Tables, passages from commentaries on the *Handy Tables* and on the *Almagest*, along with marginal notes and worked-out sample computations, and computations of

4 Tambrun-Krasker, "Bessarion", 7-15; Hunger, "Johannes Chortasmenos, ein byzantinischer Intellektueller der späten Palaiologenzeit"; Hunger, *Johannes Chortasmenons (ca. 1370-ca. 1436/37)*; Gamillscheg, "Johannes Chortasmenos als Restaurator des Wiener Dioskurides"; Schreiner, "Zum Tod des Johannes Chortasmenos"; Trapp, Walter, Beyer (eds), *Prosopographisches Lexikon der Palaiologenzeit*, vol. 12, item 30897. On Chortasmenos's interest in mathematics and astronomy: Caudano, "Le calcul"; Acerbi, "Why John Chortasmenos Sent Diophantus to the Devil".

5 Cacouros, "Jean Chortasménos, 'katholikos didaskalos'".

6 Acerbi, "Byzantine Recensions of Greek Mathematical and Astronomical Texts", 190-1.

7 Acerbi, "John Chortasmenos". On Diophantus: Meskens, *Travelling mathematics*.

8 Canart, Prato, "Les recueils", 115-78.

9 Canart, Prato, "Les recueils", 132-45.

10 Ševčenko, *Études sur la polémique*, 281.

11 Tihon, *Petit Commentaire*, 126-7; Canart, Prato, "Les recueils", 132-46.

12 Canart-Prato, "Les recueils" 120-5.

13 Tihon, *Petit Commentaire*, 127-31; Canart, Prato, "Les recueils", 125-31.

eclipses and lunisolar conjunctions.[14] In addition to this, the *mise en page* of manuscript *Vat. gr.* 1059 is noteworthy.

The texts have been arranged in two columns, so that the astronomical treatises display their theoretical and practical parts in parallel, providing the reader easier fruition for both reading and learning experiences. Also, the organisation of the content is worthy of attention. The transcription of Theodorus Meliteniotes's *Three Books on Astronomy* (*Vat. gr.* 1059, ff. 228*r*-447*r*), a handbook on the use of Ptolemy's (book 1 and 2) and Arabo-Persian (book 3) astronomical tables,[15] is based on the manuscript *Vat. gr.* 792[16] and adds astronomical tables to it, as well as excerpts from Theon's *Little Commentary on Ptolemy's Handy Tables* in parallel with the corresponding topics of Meliteniotes.[17] Moreover, Chortasmenos arranged a synoptic outline in three columns for the method to find lunisolar conjunctions, placing a theoretical text alongside the computational methods by Meliteniotes and Chortasmenos in the next two columns.[18] The manuscript *Vat. gr.* 1059 was composed in Constantinople no later than 1413, in the years when Chortasmenos was professor at the Patriarchal School, and it was likely meant to serve as a textbook.[19]

To sum up, the comparative approach in establishing collections of scientific texts was a habit which Chortasmenos transmitted to Bessarion, who never gave it up.

2 Bessarion and the Teachings of Chortasmenos

During his sojourn in Constantinople, Bessarion engaged in scholarly pursuits that left an enduring legacy, as evidenced by the surviving manuscripts attributed to him. One notable example is Bessarion's transcription of the *Almagest*, a seminal work by Claudius Ptolemy, which remains preserved within the manuscript *Marcianus graecus* Z. 302 in Venice.

While the preservation of Ptolemaic texts may not come as a surprise, given their centrality to astronomical education in Byzantium, Bessarion's involvement in transcribing such foundational works speaks to his scholarly dedication and contribution to the dissemination of knowledge during this period.

Of particular significance to Bessarion's astronomical education was his meticulous compilation of a handbook on Arabo-Persian astronomical tables, contained within the manuscript *Marcianus graecus* Z. 333, dating to the 1420s. This handbook, crafted by Bessarion himself, represents a remarkable testament to his engagement with diverse astronomical traditions beyond the confines of Byzantine scholarship. By delving into Arabo-Persian astronomical tables, Bessarion demonstrated a keen intellectual

14 Caudano, "Le calcul".

15 Edition of Books 1 and 2 by Leurquin, *Théodore Méliténiote. Tribiblos Astronomique. Livre I*; Lerquin, *Théodore Méliténiote. Tribiblos Astronomique. Livre II*; Edition of Book 3 by Bardi, *Persische Astronomie in Byzanz*, 350-434.

16 Leurquin, "Un manuscrit autographe de la Tribiblos Astronomique".

17 Tihon, *Le Petit Commentaire*, 128-9.

18 Tihon, *Le Petit Commentaire*, 129.

19 Caudano, "Le calcul", 215-18.

curiosity and a willingness to explore alternative sources of knowledge, reflecting the cosmopolitan ethos of Constantinople as a hub of intellectual exchange.[20] Entitled *Instructions on the Persian astronomical tables* (henceforth just *Paradosis*),[21] the handbook's text was likely copied from another of Bessarion's manuscripts, *Marcianus graecus* Z. 323, and some additional sections were taken from Chortasmenos's version of that handbook in the manuscript *Vaticanus graecus* 1059.[22]

What is relevant to Bessarion's apprenticeship is that he undertook the transcription of that handbook under the supervision of John Chortasmenos. The accretions to the main text that Bessarion made in his version were copied from Chortasmenos's manuscript. This way of transcribing attests to the taste for comparisons and for getting multiple versions of one single work. In particular, Bessarion took from Chortasmenos an additional method to find lunisolar conjunctions and, accordingly, rewrote some computations in multiple, different ways.[23]

Bessarion's transcription, though not interesting in the mathematical content, is important because it bears witness both to his practice of learning and to the Byzantine circulation of Arabo-Persian astronomy, stemming from several Islamic authors, for example Nasir al-Din al-Tusi's *Ilkhanic Tables* alongside other astronomical tables.[24]

Another manuscript owned by Bessarion, *Marcianus gr.* Z. 323, is relevant to Bessarion's education in Constantinople. Bessarion likely used it as a model for his transcription of Arabo-Persian astronomy. It is an 'encyclopedic' volume,[25] providing different sets of astronomical tables and commentaries – a sort of *summa* of practical astronomy (use of tables and astrolabes and computations) for that age. More precisely, it is a fourteenth- to fifteenth-century codex providing Ptolemaic and Arabo-Persian astronomy and Greek mathematics and geometry.[26] The Arabo-Persian astronomy (ff. 71*r*-94*v*) is followed by a text-group of astronomy of the Hellenistic and Byzantine traditions: an anonymous introduction to the *Almagest* (ff. 166*r*-169*v*), Proclus's *Exposition of Astronomical Hypotheses* (ff. 171*r*-204*v*), some astronomical texts (ff. 205*r*-221*r*), Stephanus of Alexandria's *Commentary on Ptolemy's Handy Tables* (ff. 222*r*-263*r*), Theon's *Little Commentary on Ptolemy's Handy Tables*, Isaak Argyros's treatise on astronomical tables (ff. 287*v*-288*v*), Ptolemy's *Handy Tables* (ff. 289*r*-382*r*), John Philoponus's treatise on the astrolabe (ff. 384*r*-393*v*), Isaak Argyros's treatise on the astrolabe (ff. 394*r*-398*v*) and further texts of Ptolemaic astronomy.

20 Bardi, "Bessarione a lezione di astronomia da Cortasmeno".

21 Bardi, "The *Paradosis* of the Persian Tables"; Bardi, *Persische Astronomie in Byzanz*. The original Greek title is Παράδοσις εἰς τοὺς περσικοὺς κανόνας τῆς ἀστρονομίας.

22 Bardi, "Bessarione a lezione di astronomia da Cortasmeno".

23 For details, cf. Bardi "Bessarione a lezione di astronomia da Cortasmeno".

24 Mercier, "The Greek 'Persian Syntaxis' and the Zīj-i Īlkhānī"; Pingree, "Gregory Chioniades and Palaeologan Astronomy"; Pingree, "In Defence of Gregory Chioniades".

25 On Byzantine encyclopedism, better known as 'cultura della silloge', cf. Odorico, "La cultura della ΣΥΛΛΟΓΗ"; Odorico, "Du premier humanisme à l'encyclopédisme"; Manafis, *(Re)writing History in Byzantium*; Németh, *The* Excerpta Constantiniana *and the Byzantine Appropriation of the Past*.

26 Mioni, *Codices graeci manuscripti*, 38-44; Mondrain, "Les écritures dans les manuscrits byzantins", 166; Jarry, "Sur une recension du Traité de l'Astrolabe", 46.

John Chortasmenos advocated for Bessarion's relocation to Mistra in order to enhance his scientific education. While the precise motivations behind Chortasmenos's recommendation remain speculative, it is conceivable that it stemmed from the prevailing cultural milieu characterised by the dominance of hesychast ideals, potentially inhibiting the cultivation of scientific pursuits. Nevertheless, what can be discerned from Bessarion's extant transcriptions originating from his tenure in Constantinople is the confluence of Hellenistic and Arabo-Persian astronomical paradigms, a characteristic that significantly influenced his subsequent astronomical inclinations. These observations shed new light on Bessarion's intellectual status, which is in contrast to claims in past historiography about Bessarion as a promoter of purely Hellenistic/Ptolemaic astronomy.[27] More on this is in chapter 4.

3 Philosophy, Astrology, and Mathematics in Mistra in the 1430s: At the School of Georgios Gemistos Plethon

As anticipated above, Georgios Gemistos Plethon played a significant role in Bessarion's education. Plethon influenced Bessarion in how to cope with the philosophies of Plato and Aristotle in a comparative framework. Moreover, Plethon's interest in the sciences is particularly evident in his inquiry into the celestial realms, broadly conceived as an approach to astronomical studies in which the physical properties and effects of celestial bodies were not be rejected – that which is known in the vulgate as 'astrology'. Such an approach was at odds with the radical anti-astrological attitude adopted in Constantinople by the intellectuals and hesychasm promoters in the headquarters of Byzantine Orthodoxy.[28] But Plethon's scientific and philosophical interests were headed towards a sort of *vita activa*. He was planning a reform to solve all aspects of the crisis of his age (cultural, religious, economic, ethical). His reform would get rid of the religions of his age and promote a return to Greek gods, the Chaldean Oracles, the use of astrology as a science, and a historical-critical approach to sources.[29] In Plethon's view, restoring Greek culture involved embracing pagan religious elements.[30]

Plethon was keen on mathematical astronomy *tout court*. Notably, he authored one of the most important works of Byzantine astronomy, a handbook on the computation of syzygies and planetary positions; he relied on a Hebrew translation of al-Battani, arranging the data on Hellenic chronological systems, different from the Julian calendar in use in Constantinople and based on a lunisolar system.[31] The tables of Plethon's handbook were computed for the year 1433. Bessarion was in Mistra when Plethon accomplished that task.[32]

Attention to astronomical studies was part of Plethon's attempt to revive the so-called Hellenic wisdom. Plethon was convinced that the salvation of

27 Rigo, "Bessarione, Giovanni Regiomontano".

28 Magdalino, *L'Orthodoxie des astrologues*.

29 On Plethon's reformism and paganism, cf. Garin, *Lo zodiaco della vita*, 63-8.

30 Siniossoglou, *Radical Platonism*.

31 Mercier, Tihon, *Georges Gémiste Pléthon. Manuel d'astronomie*, 118-27.

32 Tambrun-Krasker, "Bessarion", 16.

the Byzantines depended on the success of a political and spiritual renewal and argued in favour of a return to the roots of Greek (Hellenic) wisdom. His sources, however, were taken from several traditions. Part of this programme was to study the heavens in order to explain the causes of human events and to acknowledge the deterministic nature of the world. Knowledge of events was obtainable by an accurate knowledge of astrology, which pertained to examinations of the links between divine and human realms through the relationships between the celestial bodies at given times.

Another part of his attempt at reform was a novel approach to the comparison between Aristotelian and Platonic philosophy, which is another distinctive trait that Bessarion inherited from his teacher in Mistra. Plethon's approach was inspired by a method that interpreted sources without the mediation of Christian thought. In his *On the Differences between Plato and Aristotle* (from 1439, when Bessarion was still in Mistra), Plethon critically compared Plato and Aristotle and evaluated their reconcilability with Christian thought. In that work, he mounted a violent attack on Aristotle, demonstrating the superiority of Plato and his suitability for Christian doctrine over Aristotle.

The composition of *On the Differences* started a controversy over the respective merits of Platonic and Aristotelian philosophy, a controversy that continued both in the Byzantine East and in the Latin West for over thirty years. Once in Italy, Bessarion took the testimony of that polemic and engaged himself in that field in the context of a debate over Platonic philosophy against George of Trebizond, a promoter of the superiority of Aristotle over Plato. This scenario is especially evident in Bessarion's *In calumniatorem Platonis* (Against the Slanderer of Plato).[33]

4 Plethon's Contributions to Mathematics

Examination of Bessarion's manuscripts reveals that Plethon was the author of an important intervention to the text of Euclid's *Elements*, which influenced the reception of that work in early modern Europe till the nineteenth century. The manuscript *Marcianus graecus* Z. 301, from Bessarion's collection, was once owned by Plethon, and it includes an important intervention: Plethon put postulates 4 and 5 among the common notions (axioms) by substituting a *bifolium* into a preexisting group of quires of the manuscript and rewriting the syntax of the two assumptions.[34] Apparently a restoration, this was an intervention of great relevance for the philosophy of mathematics and the debates on mathematical principles. Plethon's choice put him into a long-standing debate on the nature of the postulates and the foundations of mathematics, and, by considering postulates 4 and 5 as common notions/axioms, he took side with the thought of Proclus and Geminus.[35] The reason for this replacement was due to the nature of principles that distinguished postulates and common notions (or axioms), to which the discussion traced back to Proclus's *Commentary on the First Book of Euclid*, in which he referred to Geminus. Briefly, postulates 4 and 5 did not warrant constructions

33 Mariev, "Neoplatonic Philosophy in Byzantium".

34 Acerbi, Martinelli Tempesta, Vitrac, "Gli interventi".

35 Acerbi, "Two Approaches to Foundations in Greek Mathematics", 175-6.

as did the first three postulates, but rather expressed assumptions similar to the other common notions, according to the distinction given by Proclus as follows: "But a postulate prescribes that we construct or provide some simple or easily grasped object for the exhibition of a character, while an axiom asserts some inherent attribute that is known at once to one's auditor".[36]

Plethon's intervention influenced the first printed edition of Euclid, and thus the reception of the Greek text of Euclid in Europe at large. The arrangement of the three postulates plus postulates 4 and 5 as common notions, as seen in *Marc. gr.* Z. 301, was influential, because it was the manuscript taken by Simon Grynaeus as the basis for the printed Basel 1533 edition of *Elements*,[37] and it remained the reference text till the edition of François Peyrard of 1814-18.[38]

Plethon's intervention bestows on him a prominent place in the history of epistemology of mathematics. His reasoning regarding the difference between postulate and common notion referred to the general philosophical inquiry into the nature of principles, which shaped more generally his philosophical works. The importance of the thinking on common notions in the works of Plethon is indeed an important trait,[39] as it would be later received by Western European philosophers, for instance Baruch Spinoza with his *more geometrico* ordered ethics.

5 Between Orthodoxy and Plethon's Reform Plans

From the sources one can establish in general what Bessarion owed to Chortasmenos and the Constantinopolitan period, but one cannot precisely point out to what extent Plethon influenced Bessarion in astronomy. However, the role Plethon ascribed to astrology in his Platonic reform was certainly significant for Bessarion's education. It was conceived as a broad field of speculation to detect the causalism behind events and decisions. It is likely that Bessarion did not share this view *in toto*, but merely to a certain extent, for instance concerning the possibility that astrology provided insights that bridged human and divine realms, as expressed in the inaugural lecture of the astronomer Regiomontanus[40] (1436-1476) at the University of Padua in 1464.[41] This claim though was not written by Bessarion himself but by his best protégé, Regiomontanus (see chapter 3).

36 Translation; Morrow, *Proclus*, 142.

37 De Risi, "The development of Euclidean axiomatics"; Oosterhoff, "The Fabrist Origins of Erasmian Science".

38 Acerbi, Martinelli Tempesta, Vitrac, "Gli interventi", 412; Shabel, *Mathematics in Kant's Critical Philosophy*, 44-9.

39 Masai, *Pletone*, 107-30.

40 Regiomontanus is the Latinised name of his birthplace, Königsberg, in southern Germany (not the same as Kant's birthplace).

41 "*Te igitur divinum astrologiae numen appello, tuis velim aspires praeconiis, beneficia tua immense mortalibus demonstratura venias. Tu es procul dubio fidelissima immortalis Dei nuncia, quae secretis suis interpretandis legem praebes, cuius gratia coelos constituere decrevit omnipotens, quibus passim ignes sidereos, monimenta futurorum impressit.* […] *Per hanc disciplinam angelicam non minus immortali deo propinqui reddimur, quam per caeteras arte a belvis segregamur*". Regiomontanus in Schmeidler, *Johanni Regiomontani Opera Collectanea*, 51-2; Rutkin, *Sapientia Astrologica*, xx, 371-3.

Bessarion must have received a very broad astronomical education; it was not limited to the mathematical properties but also included the investigation of physical properties and causality, with astronomical implications, in order to study the chain of causes linking human realms to divine ones. The non-hesychast, non-orthodox character of Bessarion's apprenticeship was shared not only by Plethon but also by Chortasmenos, to whom Bessarion owed the habit of comparing different astronomical traditions and putting them together into a single manuscript.

Parallel with the comparison between Plato and Aristotle, the comparison between Ptolemy and his Arabo-Persian counterpart was essential in Bessarion's intellectual formation. A closer examination of his manuscripts will reveal more of this (see chapter 4). Bessarion was therefore educated in a milieu that encouraged comparative views about astronomical knowledge. This heritage was likely common both in the radical ambience of Orthodoxy in Constantinople and in less radical environments, such as Mistra.