In Light of Bessarion's Astronomical Manuscripts

A Global Microhistory of Science

Alberto Bardi

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Knowledge Hegemonies in the Early Modern World 4

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Contents

Pagina vuota 5

1 3PIntroduction 18

_Hlk172624854 20

1 9PAn Itinerant Quest for Knowledge 24

1 Trebizond 25

_Hlk172279301 26

_Hlk1093127931 27

2 Constantinople 28

_Hlk1093225631 31

3 Mistra 31

4 Bessarion and the Influence of Trebizond, Constantinople, and Mistra 34

2 21PBessarion’s Astronomical Apprenticeship in Constantinople and Mistra 36

_Hlk526206281 37

1 John Chortasmenos, Teacher of Bessarion in Astronomy and Mathematics 37

2 Bessarion and the Teachings of Chortasmenos 38

3 Philosophy, Astrology, and Mathematics in Mistra in the 1430s: At the School of Georgios. 40

_Hlk1728214331 41

4 Plethon’s Contributions to Mathematics 41

5 Between Orthodoxy and Plethon’s Reform Plans 42

3 29PBessarion’s Italian Years: Politics and Patronage of Arts and Sciences (1438-1472) 44

_Hlk1093298721 45

_Hlk1093307451 46

1 Bessarion’s Interest in Astronomy after Leaving Orthodox Christianity: the Friendship with. 46

2 Political Defence of Constantinople at a Distance 50

_Hlk1096463561 51

Contents (continued)

3 Bessarion’s Cultural and Symbolic Meaning 51
4 41PBessarion’s Astronomical Manuscripts 56
_Hlk1093325031 57
1 Hellenistic, Byzantine, and Arabo-Persian Astronomy in Bessarion’s Collection 57
2 The Coexistence of Hellenistic and Arabo-Persian Astronomy: Approach through Manuscri. 59
3 The Coexistence of Hellenistic and Arabo-Persian Astronomy: A Global Perspective 61
_Hlk1728224391 62
4 An Assessment of Bessarion’s Astronomical Culture 62
5 49PRethinking the Historiography of Western Science in Light of Bessarion’s Heritage 64
1 Bessarion’s Collection between Purity and Hybridisation 65
2 Deconstructing Purism and Historiographical Biases 65
3 Transmission and Hybridisation 67
4 Conclusions: A Global Microhistory 69
Appendix 72
_Hlk172469158 74
Bibliography 76
_Hlk109326521 76
_Hlk172722141 76
_Hlk109381235 77
_Hlk172724535 77
_Hlk109645194 79
_Hlk109655681 79
_Hlk109380653 80
_Hlk172725742 80
_Hlk172726099 80

Contents (continued)

_Hlk172727731 83

Pagina vuota 84

In Light of Bessarion's Astronomical Manuscripts

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4

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A Global Microhistory of Science

Alberto Bardi

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A Global Microhistory of Science
Alberto Bardi

Abstract

The heritage of Byzantine astronomical knowledge brought into the rest of Europe features the coexistence of Arabo-Persian and Hellenistic astronomy. This book shows how the Byzantine scientific inheritance can reshape our understanding of science in Renaissance Europe. In other words, it provides a new interpretation, different from the standard narrative on Western science in the fifteenth century, through a study of non-Western sources used by Byzantine scholars migrating to Latin Europe. More precisely, the second half of the fifteenth century has been described as a time of renewal for scientific and philosophical studies in Europe, notably those concerning the heavens. According to a prominent narrative, the fifteenth century saw intellectual enrichment thanks to the rebirth of Greek science, which was revivified through the unveiling of the pure sources of Greek authors after the dark period of the Middle Ages and was saved from the menace of the Ottoman Empire. This narrative is problematic for several reasons. First, it assumes the purity of Greek science, which must have remained uncontaminated through all those centuries, as if a disembodied entity, whereas science is a human activity which suffers the modifications and corruptions of the flux of history. The weakness of this narrative is also shown by the fact that it generated two sclerotised conceptions still adopted in the history of science. An examination of primary sources in Bessarion's collection shows that what is generally conceived of as Greek science was part of a heritage in which Arabo-Persian scientific works had been assimilated and merged with the Greek tradition thanks to the work of Byzantine scholars. Moreover, why would the Ottomans have rejected the Byzantine scientific heritage? This is likely part of a narrative constructed by some humanists, probably serving an anti-Islamic agenda. Was Bessarion part of this movement? This book provides a global microhistory of science. What significance does the existence of a global microhistory hold? Despite Bessarion's political views proving unsuccessful and his status as an émigré hindering full integration into the Church of Rome, he remains one of the important figures engaging in political and scientific patronage in Italy. His astronomical education embodied a fusion of cultures, and his support for astronomy reflected this cultural amalgamation. This is underscored by the global impact of the sources he bestowed upon Venice. It is worth noting that future astronomers would rely heavily on works in Bessarion's collection, such as the *Almagest* and the *Persian Tables*: Nicolaus Copernicus revisited the *Almagest*, while Ismael Boulliau and others utilised the *Persian Tables*.

Keywords Bessarion. Manuscripts. History of Astronomy. History of Science. Science Historiography. Global History. Microhistory. Middle Ages. Early Modernity. Renaissance.

Acknowledgments

It all started from a gift. On an early summer's day in the city of north-western Italy where Erasmus of Rotterdam graduated and Friedrich Nietzsche went mad, where the mathematicians Lagrange and Peano flourished, and where Fruttero & Lucentini described twentieth-century Italy with a unique sense of humor, a book on Bessarion was gifted to me by a group of friends who used to gather in front of a bookstall. Located under the porticoes of an avenue of the city centre, that bookstall had become an unofficial meeting point for students, academics, artists, and all sorts of minds inclined to discussion, criticism, and witty situations. There, between a pastry and a cup of coffee, I happened to listen to or participate in discussions over the broadest range of topics. Those meetings became my unofficial training in academic discussions. The book I received from those friends planted the first seeds towards the current publication. Those seeds were revitalised a few years later in a part of the world far away from the bookstall, in the land which had become famous thanks to John Steinbeck's *The Grapes of Wrath*. During a research stay at the History of Science Collections of the University of Oklahoma (OU) with an A.M. Mellon fellowship award, I encountered the work of Duane H.D. Roller (1920-1994) (Schofield, "Eloge: Duane Henry Dubose Roller, 14 March 1920-22 August 1994"), former professor of history of science at OU, rare books collector, and author of one of the earliest pieces acknowledging the relevance of Bessarion for the history of science (Roller, "Aristotle, Plato, and Gemisthos"). Later the geographical landscape radically changed again. Benefitting from a research grant of the German Centre of Venetian Studies (Deutsches Studienzentrum in Venedig/Centro Tedesco di Studi Veneziani), I stayed in Venice, hosted in one of those famous palaces on the Grand Canal, to examine Bessarion's manuscripts at the Biblioteca Nazionale Marciana (National Marciana Library). When not studying at that Library, and to avoid infernal hordes of tourists, I took the chance to share my ideas with local scholars at Ca' Foscari University, and I received useful feedback and encouragement in return. For scholarly reasons, I soon had to move again. The places and climates I happened to live in offered a great variety of languages and cultures, with their challenges and their doses of inspiration and obstacles (onset of the pandemic included) to scholarly activity. In sum, I preserved a good deal of chutzpah to keep on working at the current book, and my writing was able to progress thanks to new fellowships and research grants I received at Harvard University's Dumbarton Oaks research institute, at the Polonsky Academy for Advanced Study in the Humanities and Social Sciences at The Van Leer Jerusalem Institute, at Ca' Foscari University of Venice, and at Tsinghua University (School of Humanities, Department of the History of Science). The completion and publication of this book was made possible thanks to the grant 清华大学基础文科发展项目青年教师专项科研经费 (Special Research Grant for Young Teachers, under Tsinghua University Development Project on Basic Research in Humanities). I do wish to thank all the institutions mentioned above, as well as the staff at the libraries holding the manuscripts cited in the volume, and the anonymous reviewers of this book for their valuable suggestions. For useful and enjoyable discussions, I am grateful to several scholars, whom I cite in random order: Yin Cao, Pietro Daniel Omodeo, Sascha Freyberg, Federico Faroldi, Roberta Ricci, Avner Ben-Zaken, Andrea Bonfanti, and Nianshen Song.

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Table of Contents

Introduction 3

PART I

1 An Itinerant Quest for Knowledge 9

2 Bessarion's Astronomical Apprenticeship in Constantinople and Mistra 21

3 Bessarion's Italian Years: Politics and Patronage of Arts and Sciences (1438-1472) 29

PART II

4 Bessarion's Astronomical Manuscripts 41

5 Rethinking the Historiography of Western Science in Light of Bessarion's Heritage 49

Appendix 59

Bibliography 63

In Light of Bessarion's Astronomical Manuscripts
A Global Microhistory of Science

To Gabriela and the friends of the bookstall circle

Introduction

The latter half of the fifteenth century stands as a momentous period characterised by significant changes not only in trade routes (e.g. the famous discovery of Columbus) but also in scientific and philosophical inquiry throughout Europe, particularly in the realm of astronomical studies. These constituted the necessary premises for the cosmological novelties that transformed intellectual life of sixteenth-century Europe onwards, as well as their global implications. Traditional narratives often attribute the intellectual flourishing of fifteenth-century Europe to the so-called rebirth of Greek science, supposedly rejuvenated by the rediscovery of ancient Greek texts, following the obscurity of the Middle Ages, and shielded from the perceived threats posed by the Ottoman Empire.[1]

However, I consider this narrative problematic for several reasons and it warrants scrutiny on several fronts. First, it presupposes an idealised notion of Greek science as a pristine and immutable entity unaffected by the vicissitudes of historical context. Yet, as a human endeavour, science inevitably evolves and adapts within the currents of history. Moreover, this narrative has fostered entrenched misconceptions in the historiography of science, perpetuating the notions of Greek science's purity, preserved by Byzantine

1 Cf., among others, Taton, *Ancient and Medieval Science*, 180-242; Popper, *The Myth of the Framework*, 40-3; Russo, *The Forgotten Revolution*; Deming, *Science and Technology in World History*, 26-31.

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scholars emigrating to Western Europe, and its alleged revival in the fifteenth and sixteenth centuries.

A closer examination of primary sources, particularly within the collection of the Byzantine scholar Bessarion, reveals a more nuanced reality. Contrary to prevailing assumptions, Greek scientific knowledge was intricately intertwined with non-Byzantine contributions, transmitted and synthesised by Byzantine scholars over centuries. Bessarion's astronomical manuscripts, in particular, showcase a convergence of Arabo-Persian and Hellenistic astronomical traditions within the Byzantine scientific milieu.[2] Moreover, the narrative surrounding Bessarion's role in safeguarding Greek science from Ottoman encroachment warrants re-evaluation. How then should we shape our understanding of science in Renaissance Europe? Why would the Ottomans have rejected the Byzantine scientific heritage? This is likely part of a narrative constructed by some humanists, likely serving an anti-Islamic agenda. Was Bessarion part of that movement?

By answering these questions, this book provides a new interpretation, different from the standard narrative on Western science in the fifteenth century, through a study of non-Western primary sources used by Byzantine scholars and émigrés. Methodologically, the central emphasis of the present work extends beyond mere examination of sources to encompass the intricate interplay between these sources and the scholars who engaged with them, as well as the dissemination of knowledge facilitated by the analysis of the texts contained within these sources. Of particular relevance is the transmission of works between the Middle East and Europe, often via translation. These dynamics find vivid expression in the life and pursuits of Bessarion. Although a brilliant talent and an exponent of the Byzantine social stratum who had access to education, he belongs to a minority, or better two minorities: those Byzantine émigrés in Italy and those who believed in reconciliation between the Church of Constantinople and the Church of Rome. Consequently, this work positions Bessarion as the focal point of a microhistorical narrative, wherein his scholarly pursuits had a global impact, transcending both cultural and geographical confines. Through this lens, the book seeks to pursue a nuanced exploration of global microhistory. Therefore, Bessarion's life and scholarly endeavours, alongside his astronomical manuscripts, serve as a microcosm through which to examine the transition from the Middle Ages to Early Modernity within the sphere of scientific history. This perspective provides a rich context for an understanding of the broader shifts and developments during this pivotal period in intellectual history.

This book is not for readers seeking a monograph replete with primary sources and extensive quotations from unpublished materials, in which such sources would be expected to provide exhaustive evidence. It does not primarily engage in philological investigations or manuscript studies. Although it benefits from documented evidence and scholarship on primary sources, the research outlined in the forthcoming pages is grounded in the assumption that

> history is not only what is reflected in documents but also what was lost in the cracks between them. The role of the historian is not only to recover

2 Rigo, "Bessarione, Regiomontano"; Privitera, Accendere (a cura di), *Bessarione. La natura delibera*.

> sources and to synthesise them into a coherent narrative but also to take a bold step in attempting to recover what was lost in the cracks between the documents. Deductive logic and intelligent deductions fill in the cracks and bring about a thicker historical narrative.[3]

Knowledge of Bessarion's scientific and philosophical background is required to understand the relevance of Bessarion's astronomical manuscripts. On this account, this book is arranged in two parts. Part 1 consists in a series of Bessarion's significant biographical episodes (full biographical accounts exist, there is no need for an additional one). Chapter 1 concerns itself with Bessarion's life and education, focusing on the cultural climates he experienced in fifteenth-century Trebizond, Constantinople, and Mistra. Chapter 2 traces what Bessarion learned about astronomy from his teachers John Chortasmenos in Constantinople and Georgios Gemistos Plethon in Mistra; it focuses on some astronomical texts provided in a manuscript transcribed by Bessarion (*Marcianus graecus* Z. 333), testifying to his apprenticeship in astronomy in Constantinople and constituting a remarkable document to understand his education and his further interests in astronomy. Chapter 3 deals with Bessarion's political activity in Italy against the Ottomans and his patronage of the astronomer Regiomontanus. At that point, the reader will have acquired the tools to explore Bessarion's astronomical manuscripts more in detail.

Part 2 begins with the acknowledgment that achieving a completely objective perspective devoid of any form of positioning is an unattainable ideal. Nevertheless, striving towards an ideal of impartiality is deemed worthwhile. As articulated by Italian anthropologist Ernesto De Martino:

> An absolutely non-ethnocentric perspective is theoretically absurd and practically impossible, as it would mean stepping out of history in order to contemplate all of the cultures, including the western one. Thus, the only possibility I see is to employ western categories of interpretation in a non-dogmatic manner. This is a critical use, that is, it is controlled by the explicit awareness of the western historical genesis of those categories and the need to enlarge and recast their meaning through their comparison with other historical-cultural worlds.[4]

Acknowledging these epistemological constraints, Chapter 4 recognises that Bessarion's astronomical manuscripts have predominantly been scrutinised through the lenses of philology, codicology, and Byzantine studies. However, an exploration from the perspective of cross-cultural history can potentially reveal insights beyond those previously provided. The introduction of astronomical sources into Italy by Bessarion served as a conduit for intercultural exchange, necessitating an inquiry into how disparate cultural milieus responded to the knowledge encapsulated within these sources – a narrative not inherently evident within the texts themselves. In such instances, historians are tasked with employing imagination and discernment to speculate on the dynamics of knowledge dissemination. Through

3 Ben-Zaken, *Cross-Cultural Scientific Exchanges*, 6.

4 Transl. by Pietro D. Omodeo, in Omodeo, *Political Epistemology*, 38.

this lens, Bessarion's astronomical manuscripts emerge as pivotal components in the narrative of global history.

In summary, the manuscripts suggest that Hellenistic and Arabo-Persian astronomy both relied on Ptolemy's principles, yet they diverged in their foundational approaches to scientific investigation. The intellectual environments of second-century Alexandria and thirteenth-century Maragha or Tabriz differed markedly, with the former emphasising astrology and philosophical reflection, the latter concentrating on the computation of prayer times and the development of calendars tailored to Islamic communities. These distinct motivations shaped the pursuits of Islamic astronomers, whose collective body of work is commonly known, for simplicity's sake, as Arabo-Persian astronomy.

Chapter 5 is an evaluation of the cultural significance of Bessarion's astronomical manuscripts through a novel framework. This framework diverges from the conventional interpretation that views these manuscripts solely as conduits for the preservation of 'Greek astronomy' among European intellectuals. Instead, it conceptualises them as agents facilitating the transmission of a hybrid astronomical culture into the Renaissance milieu. The notion of 'hybridity' is employed to denote the amalgamation of disparate forms of knowledge, resulting in the emergence of a novel and internally cohesive entity. In contrast, eclecticism is characterised by the accumulation of diverse knowledge forms that retain their distinctiveness without converging into a unified whole.

All in all, the present study reveals Bessarion's cultural politics and the consequences his views had in the subsequent historiography of science. Bessarion's cultural politics is connected to how historiography of science has been written until recently. Eurocentrism has been overemphasised, and Bessarion's microhistory allows us to rethink the transition from the Middle Ages to Modernity in global terms.

Part I

1 An Itinerant Quest for Knowledge

Summary 1 Trebizond. – 2 Constantinople. – 3 Mistra. – 4 Bessarion and the Influence of Trebizond, Constantinople, and Mistra.

The tumultuous period spanning the thirteenth to the fifteenth century saw the relentless expansion of various powers, including the Ottomans, Venetians, and other Italian lords, who gradually encroached upon the territories of the Byzantine Empire. This protracted process of territorial conquest was a central factor contributing to the depiction of the final epochs of the Byzantine Empire, characterised by pervasive crisis and decline. Concurrently, the population residing within the Byzantine domain, whether in the imperial capital of Constantinople or its peripheral regions, faced impoverishment and demographic decline. Nevertheless, amid the backdrop of this era fraught with socio-political upheaval, there emerged vibrant intellectual hubs, notably Constantinople, Mistra, Thessalonica, and Trebizond. It was within this rich cultural tapestry that Bessarion[1] lived his formative years, ultimately embarking on a transformative journey that culminated in his definitive relocation to Italy. The trajectory from Trebizond to Constantinople and onwards to Mistra delineated the path traversed by Bessarion prior to his choice to move to Italy, imprinting upon him the indelible marks of these diverse intellectual and urban landscapes.

The distinctive characteristics and intellectual vibrancy of these cities profoundly shaped Bessarion's *Weltanschauung*, encapsulating his intellectual persona within the nexus of cultural ferment and scholarly discourse.

1 Bessarion's original name was Basil. He changed his name to Bessarion upon becoming a monk in 1423. See biographical accounts mentioned in note 2.

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Thus, the subsequent exposition provides a comprehensive overview of the cultural milieus permeating these urban centres, intertwined with pivotal biographical facets of Bessarion's life. It is pertinent to note that the chapter refrains from offering a redundant biographical narrative of Bessarion, recognising the abundance of existing accounts documenting his life and contributions.[2]

1 Trebizond

Bessarion's birth in 1408 is traced to the city of Trebizond, nestled along the shores of the Black Sea.[3] This ancient city, renowned as the capital of the Empire of Trebizond from 1204 until 1461, epitomised a vibrant cosmopolitan hub teeming with intellectual vigour. Its cosmopolitan allure stemmed primarily from its strategic geographical location, important as a pivotal node along lucrative trading routes. Consequently, Trebizond emerged as a melting pot of diverse cultures, a captivating crossroads where European and Oriental influences mingled and intertwined.[4] For scholars and historians alike, Trebizond remains an enigmatic anomaly within the annals of the Eastern Mediterranean. Its unique character defies conventional categorisation, as succinctly articulated by Frederick Lauritzen: "Trebizond does not represent a simple and clear-cut legacy of the Greco-Roman world, but rather a continuation of those aspects of culture of the eastern Mediterranean which require the study of numerous languages and often unfamiliar contexts. The central and most striking problem remains the lack of sources".[5]

Situated at the crossroads of divergent and often conflicting powers, Trebizond emerged as a microcosm of resilience amid the tumultuous currents of history. The city, like many others of its kind, weathered the storms of political and economic upheaval with characteristic fortitude, adapting to rapid changes while navigating through the complexities of shifting alliances and rivalries.

During the thirteenth century, Trebizond was embroiled in a series of challenges exacerbated by external pressures. Sultan Kaykaus I's capture of the Black Sea port of Sinope in 1214 severed vital communication links between Trebizond, Byzantium, and Western harbours such as Venice and Genoa. This disruption to maritime trade routes dealt a significant blow to the city's economic stability, forcing it to recalibrate its strategies for survival amidst uncertainty. Furthermore, the encroachment of the Mongols in the 1220s and 1230s unleashed widespread devastation across the lands belonging to the Empire of Trebizond. The Mongol onslaught, marked by its ferocity and relentless expansionism, plunged the region into chaos, leaving

2 Cf., among others, Tambrun-Krasker, "Bessarion"; Zorzi, "La vita del Bessarione. Cronologia"; Mariev, "Bessarion, Cardinal"; Del Soldato, "Basil [Cardinal] Bessarion".

3 There are different theses about Bessarion's date of birth. I take as convincing the year 1408 as argued by John Monfasani, "Platina, Capranica, and Perotti"; cf. also Tambrun-Krasker, "Bessarion", 9. For a recent reassessment of the evidence about Bessarion's date of birth, cf. Kennedy, "Bessarion's date of birth", who proposes to set the birth in 1403.

4 Fallmerayer, *Original-Fragmente, Chroniken, Inschriften und anderes Materiale*; Karpov, *L'Impero di Trebisonda Venezia Genova e Roma 1204-1461*; Karpov, *История Трапезундской империи*; Eastmond (ed.), *Byzantium's Other Empire*.

5 Lauritzen, "Bessarion's Political Thought", 153.

behind a trail of destruction and disarray. Despite these relentless scourges and adversities, Trebizond steadfastly clung to its independence, forging a path towards prosperity through internal cohesion and resilience.

At the heart of Trebizond's social fabric lay its diverse population, a mosaic of cultures and ethnicities that lent richness and dynamism to its bustling markets and lively streets. The majority of Trebizond's inhabitants traced their lineage to the Greek diaspora, their presence infusing the city with a distinct Hellenic flavour. Alongside this predominant Greek core, Trebizond played host to a kaleidoscope of peoples, including Armenians, Georgians, Turks, and Italians, each contributing their unique traditions and customs to the vibrant tapestry of urban life. Of particular note were the Italian communities, whose presence in Trebizond bore testament to the city's role as a nexus of Mediterranean commerce. Genoa and Venice, in particular, established their own quarters within the city, leveraging their maritime prowess to forge lucrative trade agreements with local authorities. These enclaves served as bustling hubs of activity, where merchants from distant shores converged to engage in the bustling trade that characterised Trebizond's economic landscape.

Initially based on economic grounds, Trebizond's cosmopolitanism allowed the spontaneous and easy circulation of knowledge between different cultures. Outcomes of this situation can be seen in the artistic production and scientific works. On the one hand, the conjunction of different styles from East and West is reflected in the paintings and architecture of the Church of Hagia Sophia of Trebizond.[6] On the other hand, interactions with the Mongols brought new scientific knowledge to Trebizond, which made the city more cosmopolitan than Constantinople in terms of fourteenth-century astronomical studies.[7]

An intriguing artefact from the fourteenth century, an anonymous almanac pertaining to the city of Trebizond, has survived. Almanacs of this nature served as compendiums of essential data facilitating the organisation of societal affairs, encompassing all strata of Trapezuntine society. Within its pages lay a comprehensive array of information, from agricultural cycles to commercial endeavours, meticulously structured through computational tables detailing the celestial movements of the Sun, Moon, and planets throughout the year.

This almanac, covering the period from 12 March 1336 to 12 March 1337, is a testament to the sophisticated fusion of Greek and Islamic calendar systems. While its geographical accuracy regarding western regions is questionable, the almanac is generally reliable in its depictions of areas to the South and East. Beyond its practical utility, the significance of this document extends into two distinct realms. First, it illuminates the profound ties between celestial science and the organisation of societal structures. The meticulous recording of astrological data underscores the pivotal role played by the understanding of celestial movements in shaping daily life, from agricultural practices to commercial transactions. In essence, the almanac reveals the symbiotic relationship between celestial observation and societal order. Second, the almanac offers intriguing insights into the socio-economic and geopolitical dynamics of mid-fourteenth-century Trebizond.

6 Eastmond, *Byzantium's Other Empire*, 59-102.

7 Mercier, *An Almanac for Trebizond for the Year 1336*, 13-17.

Its emphasis on orienting economic activities and political relations towards Turkish and Persian spheres rather than Byzantine ones suggests a subtle yet significant shift in the city's strategic outlook. This departure from traditional Byzantine affiliations hints at broader transformations occurring within the region during this period, highlighting the dynamic interplay between political allegiances and economic imperatives.[8]

Trebizond combined its Christian and Hellenic core with the broader Arabic and Persian intellectual worlds. This attitude towards the Orient is exemplified by the activities of the Byzantine scholar Gregory Chioniades (1240/50-1320).[9] To cultivate his interests in astronomy and mathematics, Chioniades travelled from Constantinople to Persia with the support of Alexios II Komnenos, Emperor of Trebizond. He studied in Tabriz and fulfilled his duty as bishop in the meantime. When returning, he stopped in Trebizond, bringing with him a collection of astronomical manuscripts which he translated into Greek from Persian and Arabic. The strategic position of Trebizond likely facilitated such linguistic and intellectual exchanges in the fourteenth century, in parallel with its commercial and political trajectories, hence making Chioniades a non-exceptional case of cultural brokerage. Once back in Constantinople, Chioniades, allegedly on account of his long sojourn in the Muslim world, was asked to make a public profession of Orthodox faith. The text of his profession contains an exposition of all key articles of Orthodox Christianity in opposition to the beliefs of Chaldeans, Muslims, and Jews. The aim of this profession was also to define distinctions between Christianity and concurrent systems of belief.[10] This was likely a reaction to the religious syncretism that appears to have shaped Trebizond during the Komnenian era, a consequence of the frequent local contacts amongst Christians and Muslims at that time.[11]

All in all, Trebizond's cultural milieu during the fourteenth century intricately wove together influences from both Byzantine and distant Eastern and Western spheres. While the Byzantine legacy undoubtedly permeated Trebizond's cultural landscape, the city also maintained a keen awareness of developments beyond its immediate borders. Manuscripts and artistic endeavours from this period offer a fascinating glimpse into the dynamic interplay between Muslim and Christian traditions, illustrating a rich tapestry of cultural exchange and hybridity. This blend of influences is palpable in various facets of Trapezuntine society, shaping not only artistic expression but also social and religious practices. The synthesis of Muslim and Christian elements is evident in the diverse range of stylistic traits found in the arts, reflecting a nuanced fusion of aesthetic sensibilities. The study of astronomy serves as another illuminating example of this cultural amalgamation, with scholars drawing from both Byzantine and Islamic sources in their pursuit of astronomical knowledge. The juxtaposition of East and West within the cultural milieu of Trebizond engendered a subtle but palpable tension, one that likely left an indelible mark on individuals like Bessarion during their formative years. Indeed, the cultural crosscurrents of Trebizond provided fertile ground for the cultivation of intellectual curiosity

8 Peers, "Trebizond and its World through Manuscripts", 103-26.

9 Pingree, "Gregory Chioniades and Paleologan Astronomy".

10 Westerink, "La profession de foi de Grégoire Chioniadès".

11 Shukurov, "Between Peace and Hostility".

and eclectic interests. For Bessarion, in particular, this environment facilitated the germination of intellectual seeds that would later blossom into his mature scholarly pursuits.

Although Bessarion relocated to Constantinople in pursuit of better higher education, he left us with a eulogy of Trebizond which he likely composed around 1422.[12] This text, while adorned with rhetorical flourishes and not strictly a historical document, underscores the significant role played in his formative years by Trebizond's diverse and vibrant multicultural ambience. Bessarion extolled the cosmopolitan nature of Trebizond and highlighted the pivotal role of its harbour in facilitating commerce and cross-cultural interactions. He leveraged these themes to suggest Trebizond as a potential model for the future of the Byzantine Empire.

Due to his intellectual talent, Bessarion was sent to Constantinople by the metropolite of Trebizond, with the hope that he would cultivate his intellectual qualities and make a career. His formative studies took place from 1416 to 1431 in Constantinople, where he became a monk in 1423, then priest in 1430.

2 Constantinople

The impact on the Byzantine Empire of the Fourth Crusade in 1204 is widely acknowledged as one of the most dramatic events in its history, marking a profound turning point that reverberated for centuries to come. With the sacking of Constantinople, the heart of the Byzantine Empire, the political and cultural landscape of the region was irrevocably altered. Relocation of the imperial capital to Nicaea and subsequent efforts to reclaim Constantinople showed the resilience of the Byzantine spirit, yet the empire never fully regained its former stature.

For over half a century, the Byzantine Empire grappled with the aftermath of the Fourth Crusade, striving to restore its political and territorial integrity. The reconquest of Constantinople in 1261 was a symbolic triumph, signalling a brief resurgence of Byzantine power. However, this victory proved to be ephemeral, as the empire continued to face internal challenges and external threats.

Despite sporadic periods of stability and prosperity, the Byzantine Empire suffered a protracted decline in the centuries following the Fourth Crusade. Struggling to assert its authority amidst a shifting geopolitical landscape, the empire found itself increasingly marginalised on the world stage. While efforts were made to adapt to changing circumstances and preserve the legacy of Byzantine civilisation, the empire remained a shadow of its former glory. Ultimately, the once-mighty Byzantine Empire succumbed to the inexorable advance of the Ottoman forces in 1453. The fall of Constantinople marked the end of an era, bringing an end to nearly a millennium of Byzantine rule and fundamentally altering the course of history in the region.[13]

Unlike that of Trebizond, the environment of Constantinople had experienced a great loss in terms of cultural and economic capital so that its establishment could not view external cultural influences without some suspicion.

12 Lauritzen, "Bessarion's Political Thought"; Kennedy, *Two Works on Trebizond*.

13 Nicol, *The Last Centuries of Byzantium, 1261-1453*.

Judging from the extant sources, education in Constantinople was still arranged as a system similar, but not exactly equal, to what in Latin-speaking Europe was known as *Trivium* and *Quadrivium*. This curriculum provided a first level with rhetoric, grammar, and logic (*Trivium*), then a second, higher level of education consisting of arithmetic, music theory, geometry, and astronomical studies (*Quadrivium*).[14]

Between 1261 and 1453, the Byzantine Empire grappled with a tumultuous period marked by political instability, internal strife, and external pressures, culminating in its eventual downfall. The era saw a series of civil wars among imperial families in Constantinople, exacerbating divisions within the empire and undermining political unity. Additionally, the emergence of charismatic figures further weakened the authority of emperors, contributing to a sense of uncertainty and unrest.

Despite facing deep-seated crises, the ruling class of Constantinople remained steadfast in their belief in the supremacy of the Byzantine Empire as the optimal form of governance. This unwavering commitment to imperial authority, coupled with a reluctance to separate the spheres of church and state, perpetuated a disconnect between the ruling elite and the broader population. The Byzantine Emperor, often referred to as the Emperor of the Romans, was revered as the sole legitimate ruler, further entrenching the hierarchical structures of power.

Yet, this entrenched political ideology ultimately proved detrimental to the empire's ability to address the growing discontent among its citizens. Increasing poverty, exacerbated by economic pressures and external threats from Latin and Ottoman forces, fuelled social unrest and popular discontent. Despite the resilience of the ruling class, their detachment from the everyday realities faced by the common people left them ill-equipped to quell the simmering tensions that pervaded Byzantine society. All this, along with never exhausted tendencies to isolationism and chauvinism, failed to reinforce the power of Constantinople in foreign policy,[15] but rather accentuated a proto-nationalistic movement that considered Byzantium the heir of the glorious Greek civilisation (Hellenism).[16]

The environment Bessarion encountered in Constantinople in the 1420s was dramatically influenced by the theological controversies and political struggles of the fourteenth century.[17] Those episodes had a strong impact on astronomical studies and sciences in general, so it is worth briefly recollecting them.[18] After the Council of Constantinople of 1351, the monastic, mystic movement originated at Mount Athos, known as hesychasm,[19] achieved cultural hegemony. The theology of Gregorius Palamas (1296-1359), supporting the hesychasts and condemning Latin theology as heretic, was

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

15 Nicol, *The Last Centuries of Byzantium, 1261-1453*.

16 Kaldellis, *Hellenism in Byzantium*.

17 Bardi, "The Relationships between Scientific and Theological Discourses".

18 Essential studies on this topic, to which I am indebted: Meyendorff, *Byzantine Hesychasm*; Sinkewicz, "Christian Theology and the Renewal of Philosophical and Scientific Studies".

19 Hesychasm stems from the Greek word *hesychia* 'quietness', 'peace of mind', 'silence', 'tranquillity'. For a good summary, cf. Russel, "The Hesychast Controversy". In-depth studies: Meyendorff, *Byzantine Hesychasm*; Rigo, *Monaci esicasti e monaci bogomili*.

proclaimed the official doctrine of the Orthodox Church of Constantinople. The theological controversy resolved in the Council of Constantinople in 1351 had developed throughout the first half of the fourteenth century. The concerns proved influential also in the approach to sciences and put an end to a complex period of intellectual controversies that shaped the intellectual humus Bessarion found at his arrival in Constantinople. The conflict started when the Greek monk from southern Italy Barlaam of Seminara (ca. 1290-1348) disputed with Palamas on the possibility of experiencing God by the hesychast monks. Palamas and Barlaam are crucial for an understanding of the consequences for astronomical studies after the decisions taken by Byzantine Orthodox authorities on the question of the *Filioque* at the Council of 1351.[20] That convention sanctioned the theological doctrine of Palamas on 'divine substance' and 'energies' as official for the Orthodox Church, thus irredeemably widening the divide between the Eastern and Western Churches.[21] The resolution of the theological controversy was a socio-historical turning point involving political factions of Byzantine society, namely the triumph of the hesychasts in their struggle for hegemony in the official Byzantine culture, splitting political and intellectual environments into *pro* and *contra* hesychasm. The debates on hesychasm coincided with the discussion whether ascetic practice and prayer are superior to natural knowledge and whether the latter is worth being pursued and to what extent.[22] The political success of pro-hesychasts resulted in an irreversible, negative view on what pertains to the inquiry into nature and the heavens as an access to the divine.

With regard to astronomical studies, traditionally considered a useful tool to achieve contemplation of God, the question dealt with which properties of the heavens and the celestial bodies allowed one to reach the contemplative state. The official hesychast and Palamite positions were expressed by Theodorus Meliteniotes (ca. 1320-1393),[23] Professor and Head of the Patriarchal School, in a work composed around 1352, *Three Books on Astronomy*: knowledge of the stars, according to him, had a subaltern role as *ancilla fidei*. It was permitted to study astronomy merely to learn how to compute celestial positions and eclipses, thus to investigate the motion of the planets by mathematical means. This guaranteed a high degree of certainty, but nothing rational could derive from investigation of the physical properties. Moreover, examining heavenly realms as causes of human affairs (that is astrology) was banned from the official curriculum as an activity that prevented the soul from achieving salvation. Although astrological works continued to be circulated they came to be seen as suspicious and unorthodox.

Radical hesychast positions claimed that one had to devote oneself to ascetism and reject other kinds of knowledge, for they do not lead to salvation and easily provide erroneous knowledge due to their unstable premises. Therefore, scholars looked for arguments to acknowledge the usefulness of secular knowledge. In the case of astronomy, Meliteniotes argued that

20 Demetracopoulos, "Barlaam of Calabria". See the bibliography mentioned there.

21 Bradshaw, *Aristotle East and West*; Siecienski, *The Filioque: History of a Doctrinal Controversy*.

22 Nicolaidis, *Science and Eastern Orthodoxy*, 93-117.

23 Tihon, "Meliteniotes, Theodore".

secular knowledge was useful inasmuch as it provided knowledge obtained through pure mathematics about the abstract properties of celestial bodies.

This approach was the outcome of a long debate between attempts to ban astrology from licit knowledge and attempts to defend it on the basis of Neoplatonic philosophy combined with Christian doctrine, such as the anonymous dialogue *Hermippus* (*On Astrology*).[24] Dating from the fourteenth century but perhaps composed earlier, it is a treatise on the beauty of astrology more than a defence against criticism, since it touches on all the possibilities granted to those who want to study astrology. The book explains the nature of the planets (which are endowed with souls) and the effects of their conjunctions on the world and human affairs, the nature of the human soul and its parts, and how they influence our decisions. The author even employed Neoplatonic concepts to describe the nature of Christian concepts, such as the Holy Trinity:

> I will plainly explain what's left, that is: reason (λόγος) is the vehicle of the intellect, the soul is the vehicle of reason, and the spirit is the vehicle of the soul. […] For this reason, when we are successfully and appropriately inspired – if we observe properly – we worship the three hypostases in God and the mystery of the triad [i.e. trinity] from which life begins and was revealed to us. That which is the intellect in us is the father in them [the hypostases], reason is the son, the soul is the [holy] spirit, and by them the spirit is uncreated and life-generating.[25]

What is striking is that the author claimed that astrology was necessary to achieve contemplation of God, implying that Scriptures, prayers, and ascetic practices alone would not be enough, something that prompted the strongest hesychast opposition.[26]

Bessarion's education was influenced by the outcomes of this climate of tension between ascetism and astrology. His astronomical education will be dealt with further, and in more detail, below (see chapter 2).

3 Mistra

Unlike the general state of confusion in the remnants of the Byzantine Empire from the thirteenth to the fifteenth century, the city of Mistra in the Peloponnese enjoyed a time of relative prosperity.[27] It was founded by Franks who devastated Constantinople in 1204. Located not far from the ancient Sparta, Mistra was conceived as a strategic point in warfare, not as a trading centre as Trebizond or Thessaloniki or Constantinople. Despite

24 The Greek text is edited in Kroll and Viereck, *Anonymi Christiani Hermippus De Astrologia Dialogus*. I am currently working on the English translation. There are two candidates for the text's authorship: John Catrarios and Nikephoros Gregoras, both of whom were active as scribes and composers of astronomical texts in fourteenth-century Byzantium. Cf. Jürss, *Studien zum spätbyzantinischen Dialog Hermippus De astrologia*. My study on *Hermippus* is reprised from my previous article: Bardi, "Hybrid Knowledge and the Historiography of Science".

25 Author's translation; original text in Kroll, Viereck, *Anonymi Christiani Hermippus De Astrologia Dialogus*, 21.

26 Magdalino, *L'Orthodoxie des astrologues*, 154-7.

27 Runciman, *Lost Capital of Byzantium*.

its non-Byzantine origins, it soon became the cradle of the rediscovery of Greek philosophy and the birth of Hellenic independence in the fourteenth and fifteenth centuries. In a similar manner to Trebizond, it became a cosmopolitan city and attracted not only Byzantines but also Franks, Catalans, Jews, Venetians, Genoese, and Florentines.

These encounters resulted in a climate of intellectual flourish: Mistra became a paradise for scholars, especially those seeking intellectual freedom, which was not guaranteed by the hesychast orthodoxy in Constantinople. Mistra, as an intellectual hub opposed to the capital Constantinople, has been effectively described by Niketas Siniossoglou: "The intellectual circle of Mistra was largely formed as a collateral result of the hegemony of Palamism in the main theological and political centres. Mistra provided shelter to intellectuals and *literati* forced by circumstances to leave Constantinople and Thessaloniki".[28]

Mistra reached its cultural apex due to the polymath Georgios Gemistos Plethon, the most renowned exponent of the intellectual milieu produced there.[29] He was Bessarion's teacher after he arrived.

Plethon was born in the 1360s and, like other eminent personalities of Mistra, was a descendant of an aristocratic family and was educated in Constantinople. He spent several years in Adrianople, the European capital of the Ottoman Sultanate, but then settled in the Peloponnese after 1409. Plethon's philosophy was quite eclectic, merging elements stemming from Platonism, Zoroastrianism, Chaldean Oracles, Kabalistic thought, Christianity, and Islam. He likely developed this unique background in Adrianople, where he studied under the Jewish philosopher Elisaeus, who was acquainted with Kabala, Zoroastrianism, and the Aristotelianism interpreted by Ibn-Rushd (or Averroes).

Plethon's move to Mistra was likely due to his expressions of non-Orthodox views, e.g. sympathies with Zoroastrianism, Islam, and Judaism, when he resided in Constantinople.[30] Even the Emperor of Byzantium, Manuel Palaeologus, recognised that his position was not in accordance with the hesychast-Palamite Church of Constantinople. Nevertheless, the Emperor acknowledged Plethon's exceptional intellectual talents and decided to send him to Mistra, where the Emperor had placed his son, Theodorus II, in charge of the despotate of the city. Plethon eventually found an ideal intellectual environment in Mistra. In that context, his philosophical inquiry led him to establish an original and innovative plan of political reform. In particular, he claimed that the decadence of the Byzantine Empire was due to lack of acknowledgment of the intellectual and historical heritage of the Greek civilisation. Thus, his political agenda promoted a rebirth of Greek knowledge alongside Greek myths and divinities, as opposed to Constantinople and Rome. The essential part of this agenda was to re-read the ancient classics. This aspect of re-reading classical sources makes him a figure anticipating the subsequent age of humanism.[31] Some scholars saw in

28 Siniossoglou, *Radical Platonism in Byzantium*, 122. Although a contested book, which generated some controversy (which I do not summarise here), I believe it is a valuable publication worthy of being consulted.

29 Masai, *Pletone e il platonismo di Mistrà*; Woodhouse, *George Gemistos Plethon*; Hladký, *The Philosophy of Gemistos Plethon*.

30 Masai, *Pletone e il platonismo*, 55-65.

31 Garin, *Lo zodiaco della vita*, 65-8; Levitin, *Ancient Wisdom in the Age of the New Science*, 36-8.

Plethon the precursor of Spinoza because of his reading of philosophical and historical sources with the lenses of a proto-historical-critical method; this method avoided the interpretation of Scriptures offered by rabbinical or ecclesiastic official institutions and, instead, employed what was later called *lumen naturale*. At any rate, Plethon's religious views were shaped by a rationalist spirit.[32]

Through his re-reading of Greek, Christian and Jewish traditions, Plethon strove to achieve metaphysical and moral reforms; therefore, he focused on reforming principles of philosophy and politics. Not accidentally, Plethon frequently dealt with the topic of principles in philosophy and mathematics (see chapter 2).

Plethon was the exponent of a long-standing tradition of Byzantine polymaths who had cultivated, at least from the eleventh century, a wide range of disciplines and attempted to reconcile Platonic philosophy with Christian doctrine, following the example of Michael Psellos (1018-1081).[33]

Plethon's theory of knowledge depended on the principle of causality (*ex uno unum*) and generated determinist views of reality, with no difference between spiritual and material beings. Human behaviour and divine behaviour were to be considered a rational chain of causes-effects, where one could know determined effects from determined causes. That is why astrology played a most significant role in Plethon's philosophy: astrology was the science that guaranteed knowledge of the chain of causes between God and humanity, the whole knowledge of everything. As Plethon's determinism took inspiration from non-Christian sources, such as Greek philosophers, Kabalistic thoughts and Islam, his dealing with pagan texts was not well received by the Church of Constantinople. However, his unorthodox methods were at least tolerated in Mistra.

One of Plethon's major works, *Laws*, was burnt as heretical by the Orthodox censorship of the Constantinopolitan Patriarch Gennadius Scholarios, although it has survived in fragments.[34] Moreover, Byzantium was conquered by the Ottomans and the Hellenistic legacies were not resurrected as he had expected. Nonetheless, Plethon's rationalistic spirit is traceable in the early modern developments of science and interpretations of texts free from religious censorship. Notably, his presence at the time of the Council of Florence was influential for the birth of Neoplatonic circles of the city.[35] Marsilio Ficino published his translation of the *Enneads* of Plotinus and named Plethon as "the second Plato". It was in Plethon's honour that Cosimo de' Medici founded the Academy at Florence.

In 1465, a Venetian army under the command of Sigismondo Pandolfo Malatesta of Rimini entered Mistra. Sigismondo took with him the body of Plethon and placed it in a noble sepulcher in Rimini, where the inscription reads: "The greatest philosopher of his time". The spirit of Plethon shaped the cultural and intellectual climate that Bessarion found in Mistra.

32 Siniossoglou, *Radical Platonism*, 418-26.

33 Siniossoglou, *Radical Platonism*, 49-92. On Psellos, cf. Barber, Jenkins, *Reading Michael Psellos*; Lauritzen, "L'ortodossia neoplatonica di Psello"; Kaldellis, Polemis, *Psellos and the Patriarchs*; Moore, *Iter Psellianum*; Jeffreys, Lauxtermann (eds), *The Letters of Psellos*; Lauritzen, *Bibliography – Michael Psellos, 2000-2020*.

34 George Gemistos Plethon, *Traité des lois ou recueil des fragments*.

35 Garin, *Lo zodiaco della vita*, 63-92.

4 Bessarion and the Influence of Trebizond, Constantinople, and Mistra

Bessarion first experienced a multicultural context in his native city of Trebizond, and after that the context of two opposed poles, i.e. the radical hesychast Constantinople and the anti-hesychast, rationalistic Mistra. Especially in the latter city, thanks to Plethon, Bessarion turned his attention to the astronomical sciences as a tool to explore divine realms and the relations between heavens and earth; he did not disdain investigation of the physical properties of the celestial bodies, which could shed light on their influence in human realms. This view would later be reflected in Bessarion's patronage of astronomy in Italy (see chapter 3).

From Trebizond, Bessarion absorbed a Byzantine heritage which had happily integrated oriental influences, notably Arabic and Persian cultures, as well as Islamic astronomy from the Mongols. In Constantinople, he encountered the post-hesychasm phase, where this movement had hegemonised institutional education. Bessarion attended the Patriarchal school of Constantinople but then moved to Mistra and absorbed non-orthodox ideas of necessity, causalism, determinism, and reform of the whole society promoted by Plethon. Remarkably, the philosophy one could develop in Mistra did not view inquiry into the domains of natural philosophy with suspicion. This aspect is essential to understand Bessarion's later efforts to foster astronomical studies in Italy.

In sum, Trebizond, Constantinople and Mistra (and the peculiarities of their intellectual environments) were the three key factors of Bessarion's formation. In his youth, Bessarion could experience opposite poles concerning philosophy and science. Trebizond and Mistra were rather 'open-minded' and tolerant compared to the radicalism of Constantinople. All of this influenced Bessarion's choices in preserving astronomical manuscripts (see chapter 4).

Two main periods shaped Bessarion's life. The years in the area of the late Byzantine Empire, as an Orthodox Christian, and the expatriation to Italy after 1438 and his conversion to Catholicism. What follows is arranged accordingly. Chapter 2 is devoted to Bessarion's astronomical apprenticeship in Constantinople and Mistra, while chapter 3 deals with his Italian period.

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*.

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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.

3 Bessarion's Italian Years: Politics and Patronage of Arts and Sciences (1438-1472)

Summary 1 Bessarion's Interest in Astronomy after Leaving Orthodox Christianity: the Friendship with Regiomontanus. – 2 Political Defence of Constantinople at a Distance. – 3 Bessarion's Cultural and Symbolic Meaning.

Bessarion's first important experience in an Italian context was the Council of Ferrara-Florence (1437-39), in which both he and Plethon took an active part. Unlike Plethon, who contrasted the reconciliation between Rome and Constantinople, Bessarion acted as a promoter of union between the Catholic and Orthodox Churches. The final decree of the Council in 1439 marked not only the resolution of the *Filioque* question, with the success of Latin theology, but also a reaffirmation of papal supremacy over all Christians. However, most of the Byzantines, along with the claims of forgery of the original text of the *Filioque*, perceived the decree about the union as an act of humiliation. Hence, most of the members of the Byzantine delegation withdrew their agreement to the union once they left Florence. Nonetheless, the union was officially proclaimed in Constantinople in 1452 and not rejected officially until the Orthodox Synod of 1484.[1]

All in all, the Council of Ferrara-Florence intensified intellectual exchanges between East and West. Indeed, the so-called renaissance of Platonism in Florence owed some debts to Neoplatonic thinkers who came to the city.

As the union was just an ephemeral outcome, it eventually generated more discrepancy between the two worlds, alongside disappointment among those Orthodox exponents who adhered to the union cause: Bessarion, for instance. Due to the inconveniences of the Council and other theological concerns, and his will to unify the Churches, Bessarion decided to join the

1 Gill, *The Council of Florence*.

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Church of Rome. In 1439, he was proclaimed a cardinal of the Catholic Church, and expatriated definitively to Italy. His ecclesiastic career reached its apex in 1455, the year in which he was nominated as a candidate for the papal throne.[2] In the meantime, he devoted his efforts to philosophical and theological issues, as well as politics. He struggled – following his teacher Plethon – to compare and reconcile the philosophy of Plato with that of Aristotle and to evaluate their compatibility with Christian doctrine. Bessarion, as mentioned, entered a controversy over this issue with another Byzantine expatriate, George of Trebizond.[3] Moreover, Bessarion worked intensively in politics to defend Europe against the menace of the Ottoman Turks. Yet, amid these various activities, astronomy remained Bessarion's special topic of interest, and this found concrete expression in Bessarion's patronage of the most brilliant astronomer of the fifteenth century, Regiomontanus.[4]

Bessarion's Italian years cemented his historical-political significance, especially that of being a defender of Christians in Europe against the attacks of the Muslim Ottoman Turks and of being a major protagonist in the saving of manuscripts so as to preserve the written witnesses of Greek cultural heritage. Although the project of 'saving manuscripts' began in earnest after the fall of Constantinople (1453) to the Ottoman Turks, Bessarion had been collecting manuscripts even in his youth. He became renowned for these activities in his own lifetime and was quite often regarded as a bibliophile among his contemporaries.[5]

John Monfasani has offered convincing and thought-provoking words on Bessarion's Italian years:

> Bessarion adapted brilliantly to Latin culture, but he did not internalise it. His intellectual reactions, instincts, and erudition always remained profoundly Greek. Bessarion was neither the most Latin among the Greeks nor the most Greek among the Latins. Rather he was the most influential of the Greeks in the Latin West, the *potentissimus Graecorum inter Latinos*. He wished to use that position politically to rescue Greece, religiously to unite Greek Orthodoxy with Latin Catholicism, and culturally to salvage Greek culture from the rubble of the Byzantine Empire. He failed in the first two goals, but succeeded in the third. By his patronage, writings, and library he did more than any individual in the fifteenth century to advance the Hellenisation of the Latin West.[6]

The so-called process of Hellenisation of the Latin West involved many fields of knowledge. Concerning astronomy, this process requires attention, because it is inextricably linked to what kind of astronomical knowledge Bessarion was bringing to Italy. As anticipated, his astronomical background was marked by the coexistence of Hellenistic astronomy (Ptolemy) and Arabo-Persian handbooks and tables. While Bessarion's activity in Italy was focused on politics, theology, and philosophy, his astronomical interests were

2 Mohler, *Kardinal Bessarion*, 1: 267-8.

3 Monfasani, "Bessarion's 1469 *In Calumniatorem Platonis*"; Monfasani, "A tale of two books"; Monfasani, *George of Trebizond*; Monfasani, *Collectanea Trapezuntiana*.

4 Zinner, *Leben und Wirken*.

5 Mioni, "Bessarione bibliofilo e filologo".

6 Monfasani, "Cardinal Bessarion and the Latins", 17.

reflected in the activity of his best protégé, Regiomontanus (see section 1). Was the latter benefitting from Bessarion's astronomical culture? Was he taking sides in favour of Ptolemy and against Arabo-Persian astronomy?

Bessarion's attempt to save Byzantium and Trebizond from the Ottomans involved the rhetorical tool of depicting the Ottomans as barbarians and enemies of Greek culture. Were the Ottomans really against such a heritage? Especially, were they ready to get rid of the Byzantine astronomical heritage, with its Hellenistic and Arabo-Persian elements, after conquering Constantinople? What follows cannot claim to provide a comprehensive answer, but it certainly explores several aspects crucial to approaching these questions, each of which merits a dedicated study in its own right.

1 Bessarion's Interest in Astronomy after Leaving Orthodox Christianity: the Friendship with Regiomontanus

After settling definitively on Italian soil, Bessarion, now a cardinal of the Catholic Church, was sent in 1460 to Vienna as papal legate to organise a crusade against the Turks.[7] On that occasion, he met the astronomer Georg Peuerbach (1423-1461) and his pupil, Regiomontanus. The most conspicuous evidence for Bessarion's interest in astronomy after migrating to Italy and joining the Church of Rome is his patronage of Regiomontanus.[8] The relationship between them was so intense that the mathematician dedicated some works to his patron and built an astrolabe with a dedication.[9]

From Peuerbach, Bessarion acquired a copy of a very successful textbook of astronomy, *Theoricae novae planetarum*, and he tasked Peuerbach with the preparation of a new commented translation of the *Almagest* from Greek into Latin. After Peuerbach's premature death in 1461, Bessarion charged Peuerbach's pupil, Regiomontanus, who became his protégé, with completing that task.[10] At that time, Ptolemy's *Almagest* was known in the West through the Latin translation (mediated by Arabic intermediaries) by Gerardus of Cremona and the more recent translation by George of Trebizond, redacted from the Greek.[11] Bessarion's interest in the *Almagest* notably intensified following the controversy with George of Trebizond, who accused Bessarion of incompetency in understanding the Greek of the *Almagest* after Bessarion had criticised some points of his translation. An examination of Bessarion's manuscripts preserved in the Biblioteca Marciana has revealed that Bessarion repeatedly assisted Regiomontanus in understanding the Greek terminology of the *Almagest*. For instance, Bessarion's manuscript *Marcianus latinus* 329 bears witness to his comparison between the works of Peuerbach, Regiomontanus and al-Battani with the Greek text of the *Almagest* contained in his manuscript *Marcianus graecus* 310 in order to assist Regiomontanus in his new version of the *Almagest*, which would

7 Märtl, "Kardinal Bessarion als Legat im Deutschen Reich".

8 Shank, "Regiomontanus and Astronomical Controversy". On Regiomontanus, cf. Zinner, *Leben und Wirken*; Hamann (ed.), *Regiomontanus-Studien*; Malpangotto, *Regiomontano*.

9 Rigo, "Bessarione, Giovanni Regiomontano", 76-7; King, L'Estrange Turner, "The astrolabe dedicated to Cardinal Bessarion".

10 Rigo "Bessarione, Giovanni Regiomontano", 50.

11 Rose, *The Italian Renaissance of Mathematics*, 39-44.

result in the *Epytoma*.[12] Moreover, the manuscript *Marc. lat.* 329 contains a copy of Menelaus's treatise on spherical trigonometry which was extensively annotated by Bessarion with references from the Greek of the *Almagest*.[13] In addition, Bessarion donated a Greek copy of Theon of Alexandria's *Commentary on the Almagest* to Regiomontanus, who later attempted to translate it into Latin.[14]

Because of his focus on the *Almagest*, Bessarion has been considered a purist of Ptolemaic astronomy.[15] Yet such purism apparently stands in opposition to a current of Byzantine scholars who preferred Arabo-Persian astronomy (originally stemming from Islamic authors) over Ptolemy.[16] These assessments are influenced by a tendency within recent scholarship to consider two separate currents in the Byzantine astronomical world of the thirteenth- to fifteenth-century, namely the purists of Ptolemy and those who favoured non-Greek astronomy, mediated by Persian authors.[17] This view finds some support from scholars such as the Byzantine Theodoros Metochites (1300), who suggested a preference for Greek astronomy rather than other traditions.[18] However, it has been shown that some Byzantine astronomical texts of the first half of the fifteenth century provided a mixture of Ptolemaic and Arabo-Persian methods. The distinction between the two currents was rather ideological and did not mirror the actual scientific practice.[19] As seen, Bessarion's astronomical education saw a combination of Ptolemaic and Arabo-Persian works. Moreover, Plethon had integrated his astronomical works with Arabo-Persian and Hebrew astronomical tables. Bessarion was educated in environments which were quite eclectic in the selection of astronomical sources, and such an eclectic approach is detectable also in Regiomontanus.

Beside his work on the translation of the *Almagest*, Regiomontanus's lecture of 1464[20] at the University of Padua can be read as a source on Bessarion's view on sciences; indeed, since he praised Bessarion as his patron, it can hardly be considered a document providing views contrary to Bessarion's. In his lecture, Regiomontanus provided a brief history of mathematical sciences, and, remarkably, praised astrology as the queen of mathematical sciences because it granted human beings access to knowledge of divine realms and the links between them and human realms.[21] This is more than telling in light of the culture Bessarion experienced in

12 Rigo, "Bessarione, Giovanni Regiomontano", 86-90.

13 Rigo, "Bessarione, Giovanni Regiomontano", 81-2.

14 Zinner, *Leben und Wirken*, 328-9.

15 Rigo, "Bessarione, Giovanni Regiomontano"

16 Rigo, "Bessarione, Giovanni Regiomontano", 98-9.

17 Pingree, "Gregory Chioniades and Palaeologan Astronomy".

18 Rigo, "Bessarione", 99. On Metochites see Paschos, Simelidis, *Introduction to Astronomy*.

19 Caudano, "Le calcul".

20 Original title: *Oratio Johannis de Monteregio, habita Patavij in praelectione Alfragani*. First printed in *Rudimenta astronomica Alfragrani* (Johannes Petreius: Nuremberg, 1537). On Regiomontanus's lecture, cf. Swerdlow, "An Inaugural Oration by Johannes Regiomontanu", 131-68; Byrne. "A Humanist History of Mathematics?", 41-61; Malpangotto, *Regiomontano,* 133-46; Goulding, *Defending Hypatia*, 8-10; Omodeo, "Johannes Regiomontanus and Erasmus Reinhold", 165-86.

21 See chapter 2, note 41.

Constantinople and of the high praise that Plethon had for astrology in his reform plans (see chapter 1 and 2).

Bessarion's patronage and will to re-translate the *Almagest* suggests that he internalised a wish to reform astronomical studies, and this could not have been reconciled with the expectations of the Byzantine Orthodoxy in Constantinople. Bessarion's wish likely found an ideal ground for growth in Plethon's Mistra, and this wish is attested to in his patronage of Regiomontanus.

In light of the close intellectual relationship between Bessarion and Regiomontanus, it is reasonable to see in the Paduan lecture a reflection of the aims of a scientific agenda shared with Bessarion. As evinced by the 1464 lecture, Regiomontanus had privileged access to Bessarion's manuscripts, which included works on not only mathematical astronomy but also philosophy of astronomy, such as Proclus's *Exposition of Astronomical Hypotheses*, as well as works of a rather astrological character by Ptolemy, Vettius Valens and Hermes Trismegistos.[22] Regiomontanus also single-handedly copied some astrological texts from Bessarion's manuscripts and there is evidence of Regiomontanus having had access to astrological materials in Bessarion's manuscripts to study astrology and learn Greek.[23]

It is likely that Bessarion's move to Italy was not only motivated by religious or political reasons, but also by his disappointment with the decisions of Byzantine officials after the failure of the 1439 Council of Florence and their positioning against union with the Church of Rome – something that could have been life-saving in the fight with the Muslim Ottoman Turks about to conquer Constantinople. For Bessarion, the passage to the West also offered a golden opportunity to conduct a broader investigation of astronomical studies including astrology, a path that had been denied him in his homeland due to the political-theological choices of his compatriots.

Regiomontanus's claims about the highest degree of certitude granted by mathematical sciences, especially his praise of astrology to reach divine realms, without any mention of theology, might lead one to consider him an anti-Scholastic thinker. Of course, this cannot be said with certainty, but to be sure this was a non-orthodox Scholastic approach, and it remains to be determined whether this approach might have been influenced by Bessarion. Before moving to Italy and converting to Catholicism, Bessarion had not perceived his commitment to Orthodoxy and to Thomism as contradictory. His reception of the works of Thomas Aquinas was mediated by Greek translations of *Summa contra Gentiles* and *Summa Theologiae* by Demetrios Cydones. It is certainly an exaggeration to view Bessarion as an anti-Scholastic philosopher *tout court*. The world of Catholic theology in his time was the one before the Council of Trent, and thus it did not have Thomism institutionalised; it was rather open to experimentation with different forms of theology, such that Bessarion could find in it a suitable hub for his predilection for Platonic philosophy.[24] His manuscripts collection reflects some

22 Shank, "Regiomontanus and Astronomical Controversy", 91.

23 Rigo, "Bessarione, Giovanni Regiomontano", 74-5.

24 For an overview of theology and philosophy in the Catholic world before the Council of Trent, cf. Gilson, *The Spirit of Medieval Philosophy*, esp. 364-426.

interest in the works of Aquinas, but after moving to Italy he did not use Thomism to tackle the theological and scientific issues he was dealing with.[25]

Although certainly sharing Regiomontanus's view on the high dignity of the mathematical sciences, Bessarion was a man of faith, and as such he very likely distinguished between the truths provided by mathematical sciences and those truths not mathematically provable. It is difficult to believe that he would have allowed his protégé to state that mathematics was superior to theology. Not only was he a churchman, but his collection of manuscripts testifies to a strong interest in theological and philosophical questions, making a thesis on the superiority of mathematics to theology historically incongruous and misleading. The same applies to Regiomontanus. The question of the certitude provided by mathematical sciences is detectable in the backgrounds of both Regiomontanus and Bessarion. The former likely stressed that concept under the influence of the anti-Scholastic philosophers with whom he was in contact, whereas Bessarion's familiarity with the idea hailed from Byzantium. The certitude of mathematics as guaranteeing the superiority of astronomy to the other sciences was common knowledge during his years of study in Constantinople in the 1420s, and had its origins in Ptolemy.[26] In Padua, in contrast to other university contexts such as Paris, the teaching of theology was not superior to the arts, medicine, or law. This made Padua the perfect place for a pupil of Plethon and his protégé.

The significance of Bessarion's patronage of Regiomontanus and his fostering of study of the *Almagest* in Italy lies in his being heir to a lineage of scholars, especially Plethon, unaligned with Orthodox views on astronomical studies without astrology after the Council of 1351. On this account, Bessarion saw in Regiomontanus the possibility to propound non-Orthodox views and reform astronomical studies. He stressed the importance of having Regiomontanus teach at the University of Padua, because he saw in that institution the ideal framework for the type of study of the heavens that did not proscribe investigation of the physical properties of the heavens, both in the form of celestial physics and for astrological purposes.

As demonstrated by Michael Shank, in his *Defensio Theonis* Regiomontanus made significant claims pertaining to the physical properties of the heavens, advocating the physical reality of the geometric models astronomers used to account for the motions of the heavens.[27] Alongside Regiomontanus's unquestionable talent, Bessarion's patronage and his intellectual background might have supported the creation of an ideal framework for this programme to unfold. It was not only the opportunity provided by the patronage but also the intellectual heritage Bessarion transmitted to his mentee that allowed Regiomontanus to conceive of astronomy as physical and not just a problem of modeling and computation.[28]

Regiomontanus's inaugural lecture reflected his enthusiasm for the Greek and Arabic scientific literature he had accessed thanks to his patron.[29] Regi-

25 Monfasani, *Bessarion Scholasticus*, 61-81.

26 For an overview on the discussions about the certainty of mathematics, cf. Omodeo, Renn, *Science in Court Society*, 79-82.

27 Shank, "Regiomontanus as a Physical Astronomer".

28 Shank, "Regiomontanus on Ptolemy".

29 Rose, *The Italian Renaissance*, 98-9.

omontanus emphasised the Greek origins of mathematics and acknowledged the Arabic advancements in astronomy. Therefore, if he and Bessarion had set out to pursue an anti-Arabic humanist agenda, they would not have bestowed such lavish praise on Arabic astronomy – such praise would have been counterproductive. While some exponents of humanism had worked for the suppression of Arabic science in Europe and had constructed a purist vision of society with Greek science and Christian faith,[30] Regiomontanus and Bessarion were not part of those groups.

2 Political Defence of Constantinople at a Distance

Bessarion's main task in foreign policy during his life in Italy was the defence of Constantinople against conquest by the Ottomans, the menace of Islamisation of the Christian Empire of Byzantium. After the fall of Constantinople (1453), Bessarion tried to convince the Church of Rome to organise a crusade against the Ottoman Turks.[31] After his native city, Trebizond, fell under the attacks of the Ottomans in 1461, Bessarion's activity in preserving Greek manuscripts and transferring them to Italy likely became more urgent.

Bessarion's foreign policy had already started at the time of the Council of Florence. In an oration there, he suggested a correlation between the weakness generated by the division of the Churches and the successful warfare the Ottomans were waging in Byzantium.[32] It is at that time that the Byzantines in Italy started to shape a propaganda about themselves as heirs of the glorious Greek civilisation, and soon they depicted the Ottomans as barbarians. Bessarion, once he realised that the conquest of Constantinople was inevitable, assumed the responsibility of preserving the Greek *paideia* (education, civilisation), and thus Greek culture, science, and philosophy, which would have been destroyed by the despicable crudity of the Ottomans.[33] Still, there was no consensus among Byzantine expatriates on foreign policy. For instance, Bessarion's prominent opponent, George of Trebizond, was a supporter of the Ottoman sultan Mehmed II. Therefore, the controversy over the *Almagest* and over Plato also had an important political dimension.

It is important to note that, in the context of his struggle against George, Bessarion played the role of an anti-Islam exponent; yet, regarding sciences, he was the patron of a scholar who lectured on an Islamic author, al-Farghani (ninth century), and he acknowledged the scientific advancements in Islamicate contexts.

Bessarion's foreign policy did not succeed in persuading the Latins to launch a crusade, but his political mindset still remained focused on stressing the Greek heritage. This generated a pervasive bias in Italian intellectual circles: the Ottomans as barbarians, who would have sent culture and science into oblivion. This view breaks down upon closer inspection, for

30 Hasse, *Success and Suppression*.

31 Kourniakos, *Die Kreuzzugslegation Kardinal Bessarions in Venedig*.

32 Bisaha, *Creating East and West*, 109.

33 Accendere, "Scriptorium Bessarionis".

sciences, especially astronomy, were cultivated and fostered at the Ottoman court by the sultan Mehmed II and they also flourished later on.[34] Notably, Mehmed II's court was a hub for people willing to cultivate arts and sciences and he himself did not disdain scholarly disputes. His cultural politics viewed the conquest of Constantinople as the chance to establish a new imperial capital of a multi-confessional empire.[35] Accordingly, after 1453, Mehmed's centralisation policies in administration made Constantinople attractive for many scholars, artists, and literati from East to West, even Byzantines. Remarkably, the Byzantine scholar Georgios Amiroutzes (1400-1470), a native of Trebizond like Bessarion, became an advisor of Mehmed, who consulted him on issues concerning Christian theology and Greek philosophy. Amiroutzes praised Mehmed's patronage of Greek and Arabic sciences and philosophy.[36] Among the most important astronomers at Mehmed's court was Ali Qushji (1403-1474), one of the major innovators of Ptolemy's models and, to some historians, a possible inspiration for the Copernican theory.[37]

3 Bessarion's Cultural and Symbolic Meaning

Travelling to Italy was decisive for Bessarion, as if he was anticipating the future generations of intellectuals who went to Italy to accomplish the *grand tour*. The Council of Ferrara-Florence triggered Bessarion's eventual decision to definitively expatriate. Italy became the venue of the *floruit* of his main political and scientific work, which he had begun to develop in his apprenticeship years in Constantinople and Mistra: the comparison between Plato and Aristotle, the development and reform of astronomical studies, the union of the Churches, and the fight against Islam to restore Constantinople and Trebizond.

Bessarion's foreign policy failed, as Mehmed II conquered both Byzantium and Trebizond, but the idea of the Byzantines as heirs of Greek civilisation was successfully transmitted into the West. This aspect is worthy of attention. In fact, there is a distinction between Bessarion's political discourse against the Ottomans and his mindset towards scientific discourse. In the former he portrayed the Islamic civilisation, personified by the Ottomans, as barbarians neglectful of sciences and philosophy, while he himself had been educated on astronomical sources stemming from Islamic authors and he encouraged Regiomontanus to give a course on al-Farghani and acknowledged Arabic contributions to sciences.

The discrepancy between the political discourse and the views on science reveals Bessarion's cultural politics, and this likely underlies Bessarion's depiction as the champion of Greek astronomy in the West. Actually,

34 Küçük. *Science without leisure*; Shefer-Mossensohn, *Science among the Ottomans*; Şen, "Reading the Stars at the Ottoman Court"; Balıkçıoğlu, *Verifying the Truth on Their Own Terms*.

35 Necipoğlu, *Byzantium between the Ottomans and the Latins*; Necipoğlu, "From Byzantine Constantinople to Ottoman Kostantiniyye"; İnalcık, "The Policy of Mehmed II"; Bryer, Lowry, *Continuity and Change*; Akasoy, "A Baghdad Court in Constantinople/Istanbul".

36 Monfasani, *George Amiroutzes*.

37 Although the similarities between the models employed by Copernicus and Ali Qushji are striking, there is no evidence that Copernicus copied from him or other Islamic astronomers. Cf., for instance, Ragep, "Ali Qushji and Regiomontanus".

Bessarion assumed a cultural and symbolic meaning owing to such commitment. The symbolic meaning, perfectly exemplified by Lorenzo Valla's motto about Bessarion *inter Graecos latinissimus inter Latinos graecissimus* (the most Latin among the Greeks, the most Greek among the Latins), was due to his political activity *pro* Latins and *contra* Ottomans as well as his being *de facto* a native Greek speaker, educated in Greek philosophy but operating among the Latins. Bessarion's cultural meaning was the role that his efforts of preserving the 'Greek heritage' actually accomplished: for instance, concerning astronomical sciences, Bessarion's heritage was the outcome of the comparison and merging of different traditions, the Hellenistic and the Arabo-Persian, thus stemming from both Christian and Islamic contexts.

Bessarion's symbolic meaning likely contributed to the formation of the notion of purism concerning Greek sciences and philosophy and thus affected their cultural value during their transmission into Latin Europe. In the long run, Bessarion's and Byzantine expatriates' propaganda has been influential also on recent views concerning the purism of Greek science. In fact, the notion of purism was still alive among twentieth-century historians of science, among whom Alexandre Koyré.[38] Although closer examination of Bessarion's patronage of Regiomontanus suggests that the former's views on sciences were not purist at all, and also Bessarion's background in astronomy was all but purist (see chapters 1 and 2), the relevance of Bessarion's symbolic meaning has shaped the historiographical current which has considered Greek science as a pure product preserved by Byzantines and reborn in Latin Europe (see chapter 5). The distinction between Bessarion's symbolic meaning and his cultural meaning will cause this narrative to break down, but first a deeper examination of Bessarion's astronomical manuscripts will further enrich our knowledge of the scientific Byzantine heritage.

38 Among others, cf. Koyré, *From the Closed World to the Infinite Universe*.

Part II

4 Bessarion's Astronomical Manuscripts

Summary 1 Hellenistic, Byzantine, and Arabo-Persian Astronomy in Bessarion's Collection. – 2 The Coexistence of Hellenistic and Arabo-Persian Astronomy: Approach through Manuscripts. – 3 The Coexistence of Hellenistic and Arabo-Persian Astronomy: A Global Perspective. – 4 An Assessment of Bessarion's Astronomical Culture.

As articulated by Pietro Daniel Omodeo in *Political Epistemology*, reprising Italian anthropologist Ernesto De Martino,

> An absolutely non-ethnocentric perspective is theoretically absurd and practically impossible, as it would mean stepping out of history in order to contemplate all of the cultures, including the western one. Thus, the only possibility I see is to employ western categories of interpretation in a non-dogmatic manner. This is a critical use, that is, it is controlled by the explicit awareness of the western historical genesis of those categories and the need to enlarge and recast their meaning through their comparison with other historical-cultural worlds.[1]

Acknowledging these epistemological constraints is the basis for the following study of Bessarion's astronomical manuscripts. Certainly they have predominantly been scrutinised through the lenses of philology, codicology, and Byzantine studies. However, an exploration from the perspective of cross-cultural history can potentially reveal insights beyond those previously provided. The introduction of astronomical sources into Italy by Bessarion served as a conduit for intercultural exchange, necessitating an inquiry into how disparate cultural milieus responded to the knowledge encapsulated within these sources – a narrative not inherently evident within the texts

1 Transl. by Pietro D. Omodeo, in Omodeo, *Political Epistemology*, 38

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themselves. In such instances, historians are tasked with employing imagination and discernment to speculate on the dynamics of knowledge dissemination. Through this lens, Bessarion's astronomical manuscripts emerge as pivotal components in the narrative of global history.

The relevance of Bessarion's manuscripts for the history of science has already been explored, but there is still a lot to examine and assess.[2]

Bessarion's lifetime activity of preserving manuscripts intensified after the conquest of Constantinople. While in Italy, Bessarion found in Venice the ideal place to house his collection, and he decided to donate his manuscripts to the Republic of Venice in 1468, with the intention to build a library and make his materials accessible to the public. He died in 1472 and it took some time before his manuscripts were accessible to a large audience.[3] Nowadays most of Bessarion's collection is still in Venice, held at the Biblioteca Nazionale Marciana (Marciana National Library), but some of his codices are scattered throughout Europe.[4] Several works concerning the sciences of the stars and the heavens – astrology, astronomy, cosmology; the contemporary distinction of these branches is obviously not pertinent to the distant past – are preserved within Bessarion's collection.[5] The complete list is provided in the Appendix.

The focus on manuscripts is not due to an erudite or antiquarian motivation. It is an attempt to study the elements that they convey which would illuminate the manuscripts collection beyond the individual texts. In other words, taken as a whole, they reveal a wider circulation of astronomical knowledge, in which Bessarion participated as a key actor.

1 Hellenistic, Byzantine, and Arabo-Persian Astronomy in Bessarion's Collection

Within Bessarion's collection, works dealing with Ptolemy concern the mathematical foundations of astronomy (e.g. *Almagest*), the physical foundations of astronomy (e.g. *Planetary Hypotheses*) and astronomical tables (e.g. *Handy Tables*), alongside handbooks on how to use them. For the sake of simplicity, let us group them henceforth under the label 'Hellenistic astronomy'. Authors such as Argyros, Gregoras and Barlaam represent the Byzantine astronomical tradition. In the first half of the fourteenth century, Gregoras and Barlaam engaged in a controversy over astronomy, ending in a competition on the calculation of eclipses. That field saw the emergence of the use of both Ptolemaic and Arabo-Persian tables.[6]

The two manuscripts of Regiomontanus's *Epytoma in Almagest* are perhaps the most notable examples of the later Hellenistic astronomical tradition mediated and improved through the Latin astronomical literature.

2 Rigo, "Bessarione, Giovanni Regiomontano"; Bardi, "Islamic Astronomy in Fifteenth-Century Christian Environments"; Acerbi, "I codici matematici di Bessarione"; Nicolaidis, Malpangotto (éds), *Fécondité des échanges culturels*.

3 Labowsky, *Bessarion's Library*; Coggiola, "Il prestito di manoscritti della Marciana"; Volpati, "Per la storia e il prestito di codici".

4 Labowsky, *Bessarion's Library*.

5 For a full description of each manuscript, cf. Mioni, *Codices*, except where a footnote is provided.

6 Manolova, "Astronomy as Battlefield?".

The copy in manuscript *Marc. lat.* 328 is a prestigious one, and the manuscript also includes Menelaus's treatise on spherical astronomy. This manuscript was donated by Regiomontanus to Bessarion. Manuscript *Marc. lat.* 329 was the draft for the prestigious copy in *Marc. lat.* 328. Interestingly, Menelaus's treatise was extensively annotated by Bessarion with references from the Greek of the *Almagest*.[7] All this attests to the collaboration between Bessarion and Regiomontanus for the re-translation of the *Almagest* and shows Bessarion's will to keep learning astronomy during his busy time in Italy.

Examples of Arabo-Persian astronomy are works in Greek (but one in Latin) dealing with knowledge stemming from the Islamic tradition, written originally in Arabic or Persian. For instance, *Paradosis* and *Syntax* drew from astronomical works (*zījes*) written first in Persian and then in Arabic.[8] While Hellenistic astronomy in Bessarion's collection deals with both the theoretical and practical sides of astronomy, the Arabo-Persian works deal only with the latter category, consisting of structured sets of astronomical tables and handbooks on how to use them; the exception is the treatise on the astrolabe by Shams (*Marc. gr.* 309), which however does not pertain to the mathematical foundations of astronomy.[9] Tables and handbooks never deal with foundational aspects of astronomy, because they treat mathematical astronomy without explaining the theory. As such, we have to bear in mind the distinction between theoretical and practical categories of astronomical works when trying to determine the relevance of Hellenistic, Byzantine, and Arabo-Persian works in Bessarion's heritage. In this regard, the objects to be compared with the Arabo-Persian materials consist of Ptolemy's *Handy Tables* and the handbooks on them by Theon of Alexandria and by Stephanus of Alexandria.

The handbook of Arabo-Persian tables entitled *Paradosis* is extant in manuscripts *Marc. gr.* 323, 326, 327, 328, 333, 336, and a Latin version in *Marc. lat.* VIII. 31.[10] A similar handbook, authored by the Byzantine scholar George Chrysokokkes, is entitled *Persian Syntax* and is included in manuscripts *Marc. gr.* 309 and 327. The corresponding category of Hellenistic and Byzantine astronomy includes Ptolemy's *Psephophoria* (*Marc. gr.* 314), Theon's *Little Commentary on Ptolemy's Handy Tables* (*Marc. gr.* 315, 323), and Stephanus's *Commentary on Ptolemy's Handy Tables* (*Marc. gr.* 323, 325). The result is eight manuscripts of Arabo-Persian handbooks to four of Hellenistic ones. By taking a closer look at the content, we have Arabo-Persian sets of tables in manuscripts *Marc. gr.* 309, 323, 326, 327, 333, 336, *Marc. lat.* VIII. 31, alongside Ptolemy's *Handy Tables* (*Marc. gr.* 315, 323, 325, 331). In sum, concerning structured sets of tables, we have seven manuscripts of Arabo-Persian astronomy versus four copies of tables of Hellenistic astronomy.

Texts on the construction and use of astrolabes feature authors from both late Byzantium, such as Gregoras and Argyros, and early Byzantium, such as Philoponus. The only author of non-Greek tradition is the Persian Shams.

7 Valentinelli, *Bibliotheca manuscripta*, 3: 218; Rigo, 'Bessarione, Giovanni Regiomontano', 81-2.

8 Mercier, "The Greek 'Persian Syntaxis'". On Arabo-Persian sources, cf. Kennedy, "A Survey on Islamic Astronomical Tables", 125, 161-2.

9 Ragep, "New light on Shams"; Tihon, "Traités byzantins sur l'astrolabe", 333-5.

10 Bardi, "Scientific interactions".

Interestingly, the sole extant Byzantine astrolabe contains some notable features that strongly suggest the influence of Arabo-Persian astronomy. The maker himself was of Persian origin.[11]

The massive presence of handbooks is due to the fact that one did not need to know the theory to practice astronomy, such as computing planetary positions. Moreover, practical knowledge of how to use tables was needed to cast horoscopes, i.e. to practice astrology, which at the time of Bessarion was a widespread practice, at a personal level but also at military and political ones. This is also attested to in Bessarion's collection by the unsurprising presence of astrological works, such as Ptolemy's *Tetrabiblos* and Vettius Valens's *Anthologiae*.

2 The Coexistence of Hellenistic and Arabo-Persian Astronomy: Approach through Manuscripts

To explore the coexistence of Hellenistic, Byzantine, and Arabo-Persian astronomy in Bessarion's library, let us begin by describing some emblematic manuscripts. First, *Marcianus graecus* Z. 333 (644), because it was entirely transcribed by Bessarion himself. It is a fifteenth-century miscellaneous manuscript containing mathematical and astronomical texts.[12] The first unit of this manuscript provides texts of Greek mathematics and music: (ff. 26*r*-31*v*) Isaak Argyros on the square root; (ff. 34*r*-38*v*) John Pediasimos on music; (ff. 39*r*-83*r*) Nicomachos of Gerasa's *Introduction to Arithmetic*; (ff. 83*v*-86*r*) a commentary on the fifth book of Euclid's *Elements*; (ff. 86*v*-88*r*) a commentary on the tenth book of Euclid's *Elements*. A further group of texts deals with Hellenistic, Byzantine, and Arabo-Persian astronomy: (ff. 91*r*-142*r*) Cleomedes on the planetary motions (book 1 and 2); (ff. 143*r*-144*r*) Barlaam of Seminara on the Easter computus; (ff. 146*r*-176*v*) an anonymous handbook on Arabo-Persian astronomical tables; (ff. 176*v*-187*v*) a treatise by Isaak Argyros on solar and lunar cycles; (ff. 188*r*-191*v*) a method to detect the motions of the stars according to single years; (ff. 193*r*-199*r*) notes on conjunctions of celestial bodies; (ff. 200*r*-266*v*) a structured set of Arabo-Persian astronomical tables stemming from Persian, based on Naṣīr al-Dīn al-Ṭūsī's *Zīj Īlḫānī*; (ff. 267*r*-269*r*) a method for the use of the astrolabe; (ff. 269*v*-270*r*) a text on the astrological aspects of the moon; (ff. 272*r*-274*r*) Nikephoros Gregoras's treatise on the construction of the astrolabe; (ff. 275*r*-280*v*) John Philoponus's treatise on the astrolabe; (ff. 281*r*-286*r*) astrological texts.

The anonymous handbook on Arabo-Persian tables is an instruction manual on how to use the set of tables provided in the same manuscript *Marc. gr.* 333 at ff. 200*r*-266*v* (the original set of tables, the aforementioned *Zīj Īlḫānī*, was written in Persian,[13] which is why the Byzantines referred to it as the Persian tables). It is a text from the mid-fifteenth century, entitled *Instructions on the Persian Tables of Astronomy*,[14] better known as *Paradosis*, and it is handed down in five other manuscripts in Bessarion's collection,

11 Dalton "The Byzantine astrolabe at Brescia".

12 Mioni, *Codices*, 61-6.

13 Kennedy, "A Survey on Islamic Astronomical Tables", 125, 161-2.

14 Cf. Bardi, "The Paradosis of the Persian Tables"; Bardi, *Persische Astronomie in Byzanz*.

namely *Marcianus graecus* Z. 323, *Marc. gr.* Z. 326, *Marc. gr.* Z. 328, *Marc. gr.* Z. 336, and *Marc. lat.* VIII. 31.

Further manuscripts attest to the coexistence of different astronomical traditions. *Marc. gr.* Z. 323 is a fourteenth- to fifteenth-century codex covering Hellenistic, Byzantine and Arabo-Persian astronomy, and Greek mathematics and geometry.[15] *Paradosis* is provided at ff. 71-94*v*. After this, there is a text on the determination of lunar and solar conjunctions (f. 95*r*) and then (ff. 95*r*-165*v*) the set of planetary tables, which is commented on in *Paradosis*. The Islamic astronomy is followed by a text-group of Ptolemaic astronomy: 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 of Alexandria'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.

Marc. gr. Z. 328 is a fifteenth-century codex, prepared by an unknown scribe.[16] It includes *Paradosis* (ff. 30*r*-60*v*) along with the planetary tables on which it is supposed to comment (ff. 61*v*-122*r*). The rest of the content comprises Ptolemaic astronomy of Byzantine authors, such as astronomical treatises by Isaak Argyros and Nicephoros Gregoras.

Marc. gr. Z. 336 is a fourteenth- to fifteenth-century codex, compiled before 1436 by several scribes.[17] In addition to *Paradosis* (ff. 11*v*-30*v*) and the related Arabo-Persian tables (31*v*-132*r*), it contains Ptolemaic astronomy and astrology, Greek geometry, and treatises on astrolabes.

The set of planetary tables commented on in *Paradosis* is also provided by *Marc. gr.* Z. 326 at ff. 55*r*-179*v*, after a fragmentary witness to *Paradosis* (ff. 29*r*-54*v*).[18] Interestingly, the tables follow *Book of Six Wings*, a handbook of Hebrew astronomy on the computation of eclipses, which was translated into Greek by Michael Chrysokokkes (ff. 21*r*-54*v*).[19] Copies of both Gregoras's and Philoponus's treatises on the astrolabe are also handed down in the same manuscript.

In addition, the Arabo-Persian set of planetary tables of *Paradosis* is commented on by another Byzantine handbook, transmitted by two other manuscripts in Bessarion's collection. This is George Chrysokokkes's *Persian Syntax*, a mid-fifteenth-century Byzantine handbook on Arabo-Persian tables, composed around 1347, hence earlier than *Paradosis* (ca. 1352).[20] *Marc. gr.* Z. 309 (fourteenth century) contains *Persian Syntax*.[21] The Arabo-Persian tables are extant in the same manuscript (ff. 74*r*-114*v*). In addition to the tables, the manuscript provides a treatise on the astrolabe by Shams the

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

16 Mioni, *Codices*, 54-6.

17 Mioni, *Codices*, 77-83.

18 Mioni, *Codices*, 50-2. *Paradosis* was not previously recognised in that manuscript.

19 Solon, "The Six Wings".

20 Mercier, "The Greek 'Persian Syntaxis'".

21 Mioni, *Codices*, 17-20.

Persian (who remains unidentified but could be Shams a-Dīn al-Buḫārī).[22] *Persian Syntax*, alongside its tables, is also handed down in *Marc. gr.* Z. 327, a fifteenth-century astronomical miscellany of Arabo-Persian and Hellenistic astronomy.[23] A Latin version of *Paradosis* is also present in Bessarion's collection. This text is preserved in *Marcianus latinus* VIII 31, a fifteenth-century codex devoted to *Paradosis*, its tables, and to Hebrew tables of chronology and eclipses. It was composed in the first half of the fifteenth century in Crete.[24]

Bessarion himself transcribed other scientific texts or parts of them in the collection, such as Euclid's *Elements*, *Prolegomena ad Euclidis Data* by Marinus of Neapolis, Euclid's *Data*, books 1 to 3 of Theodosius's *Sphaerica*, Euclid's *Phaenomena*, Barlaam's *Logistics*, and Ptolemy's *Almagest* in the manuscript *Marc. gr.* Z. 302. In *Marc. gr.* Z. 310, Bessarion copied the commentary of Nicolaus Cabasilas on the third book of the *Almagest* and Barlaam's *Treatise on the Solar Eclipses of 1333 CE and 1337 CE*. Notes on scientific texts penned by Bessarion are provided in *Marc. gr.* Z. 304, *Marc. gr.* Z. 312, and *Marc. gr.* Z. 316. These transcriptions and notes show Bessarion's interest in Ptolemaic astronomy and Greek mathematics.

Bessarion's autograph transcriptions in the manuscripts *Marc.gr.* 302, 310, 312, 333 show that in his Constantinopolitan and Mistra years he was trained not only in the *Almagest* and Greek astronomy but also in Arabo-Persian tables.[25]

3 The Coexistence of Hellenistic and Arabo-Persian Astronomy: A Global Perspective

The coexistence of Hellenistic and Arabo-Persian astronomy, when viewed from a global perspective, reveals a rich scenario of intellectual exchanges between diverse cultural and geographical spheres. The contributions from the School of Maragha and Tabriz were the original works from which the Byzantine cultural brokers, such as Chioniades, established their Greek translations, which ended up in Bessarion's manuscripts. They served as pivotal catalysts for dissemination of astronomical knowledge beyond the confines of their origins. This diffusion found resonance in various regions, not only in Byzantium, but also in the Yuan and Ming dynasties in China, where the reception of these teachings is evident from historical records and the establishment of institutions to study Arabo-Persian astronomy.[26]

While Ptolemy's works served as the foundational bedrock for both Hellenistic and Arabo-Persian traditions, the underlying methodologies and motivations diverged significantly. The Arabo-Persian tradition, characterised by its meticulous observational practices within observatories under the Caliphs' patronage, stood in contrast to the Christian world view prevalent in Byzantium, focused on contemplation and astrological practice oriented towards politics and warfare. However, pragmatic considerations eventually

22 Ragep, "New light on Shams"; Tihon, "Traités byzantins sur l'astrolabe", 333-5.

23 Mioni, *Codices*, 52-3.

24 Bardi, "Scientific interactions".

25 This confirms the claims of chapter 2.

26 Weil, "The Fourteenth-Century Transformation".

outweighed religious reservations, as Byzantine scholars recognised the efficacy of Arabo-Persian astronomical tables for computational purposes.

The transmission of these astronomical insights further extended into Europe, with works such as Ismael Boulliau's *Astronomia Philolaica* and Jacob Christmann's chronological study on the utilisation of calendars, showcasing the integration of Arabo-Persian influences into European astronomical discourse. A Byzantine version of Arabo-Persian tables, similar to those found in Bessarion's manuscripts, was published by Boulliau in his *Astronomia Philolaica*. Moreover, Boulliau incorporated Chrysokokkes's preface to the Persian tables, detailing Chioniades's journey from Constantinople to Tabriz and his astronomical investigations during his time there.[27] Boulliau's chapter on Chrysokokkes would later be reprinted in the third volume of *Geographiae veteris scriptores graeci minores* (printed in Oxford in 1712).

Christmann made a translation of the work on chronology and astronomy of the Arab astronomer Al-Farghani and printed it in 1590 (reprinted in 1618) in Frankfurt am Main (*Muhamedis Alfragani arabis, Chronologica et astronomica elementa et palatinae bibliothecae veteribus libris versa expleta et scholiis expolita*). This *opus* contains a detailed appendix on ancient calendars, among others the Persian one, taken from a Byzantine manuscript similar to those owned by Bessarion (according to the Yazdegerd era, which corresponds to the starting date 16 June 632 CE).

Although direct utilisation of Bessarion's manuscripts by early modern astronomers and chronologers may not have been feasible, scholars such as Boulliau and Christmann demonstrate use of the textual content preserved in them. Hence, the simultaneous presence of Hellenistic and Arabo-Persian astronomical sources within the intellectual legacy of figures like Bessarion serves to underscore the intricate interconnectedness characterising the dissemination of knowledge across geographical and cultural areas. This phenomenon illuminates the dynamic exchange of ideas prevalent during the medieval period, highlighting the enduring impact of cross-cultural interactions on the evolution of astronomical thought and practice.

4 An Assessment of Bessarion's Astronomical Culture

The coexistence of Hellenistic and Arabo-Persian sources in Bessarion's heritage serves as a witness to the expansive dissemination of knowledge across Islamic and Christian domains. This reconsideration under the lens of global history contains an observation that underscores the cross-cultural nature of scientific knowledge, which can transgress and almost transcends religious and geographical confines. Such an assertion prompts a reconsideration of conventional narratives surrounding the resurgence of Greek science during the Renaissance, urging scholars to adopt a more inclusive and nuanced perspective that acknowledges the multifaceted influences shaping the trajectory of scientific development. More on this is in chapter 5.

Examination of Bessarion's astronomical manuscripts shows that what he preserved is the result of a lifetime labour and reflects the education he received before expatriating to Italy. The works of Hellenistic, Byzantine, Arabo-Persian, and Hebrew astronomy are all part of his background. This solid

27 Bullialdus, *Astronomia Philolaica*, 211-14.

astronomical interest laid the foundations for further interests in Latin astronomy, such as that by Bianchini and Sacrobosco, whose works he owned.[28]

It is noteworthy that the Arabo-Persian astronomical literature, imported from the Islamic world, lacks texts that delve into the realm of physical astronomy, instead emphasising mathematical aspects. The motivations behind this particular emphasis remain subject to speculation, inviting scholarly inquiry into the underlying reasons. Indeed, while the conceptualisation of celestial phenomena in Byzantium continued to be anchored in Aristotelian philosophical frameworks and interpretations drawn from scriptural sources, the prevailing influence of the hesychast culture during the late Constantinopolitan era may have played a significant role in shaping the prevailing attitudes towards the study of astronomy. This suggests the possibility of a nuanced interplay between philosophical, religious, and cultural factors in shaping the trajectory of astronomical inquiry within Byzantine society.[29]

The presence of astrological texts, though not surprising, testifies to Bessarion's favourable views on the investigation of celestial bodies as bearers of physical properties, and, as seen for Bessarion and Regiomontanus's views, subsequent astronomical studies would take them into consideration for further developments.

The claims about Bessarion as a purist of Ptolemaic astronomy are by no means applicable to the astronomical culture that he brought to Latin Europe. In the light of his manuscripts collection, I propose to view Bessarion's astronomical culture as a hybrid one. The notion of hybridity is appropriate to describe what one finds in the study of Bessarion's education and his manuscripts, embracing the several cultural influences and the spirit of comparison and reform of astronomy that I have described thus far.

28 See Appendix.

29 Bardi, "The Relationships between Scientific and Theological Discourses".

5 Rethinking the Historiography of Western Science in Light of Bessarion's Heritage

Summary 1 Bessarion's Collection between Purity and Hybridisation. – 2 Deconstructing Purism and Historiographical Biases. – 3 Transmission and Hybridisation. – 4 Conclusions: A Global Microhistory.

The coexistence of Arabo-Persian and Hellenistic astronomy within the Byzantine scientific legacy warrants a nuanced re-evaluation of the narrative surrounding the development of science during the Renaissance. Traditionally, the flourish of science in the Renaissance has been attributed to the 'rebirth' of Greek science, brought into Italy by Byzantine expatriates fleeing the fall of Constantinople. This myth was later fuelled by purist approaches to mathematics, notably by the so-called Commandino School.[1] However, this narrative oversimplifies the complex interplay of cultural influences that shaped scientific thought during this period. The notion of 'purity', i.e. Greek science as a pristine and unadulterated body of knowledge, fails to account for the dynamic nature of scientific inquiry, which is inherently shaped by the historical context in which it unfolds. Science, as a human endeavour, is subject to the vicissitudes of history, undergoing modifications and adaptations as it encounters new cultural, social, and intellectual currents. A closer examination of primary sources within Bessarion's collection has revealed a more complex picture of the Byzantine scientific heritage. Rather than a monolithic tradition derived solely from Greek sources, Byzantine scholars actively assimilated and integrated Arabo-Persian and Hebrew scientific works into their intellectual framework. This synthesis of diverse cultural influences enriched the Byzantine scientific tradition, resulting in a hybrid body of knowledge that defies simplistic categorisation.

1 Rose, *The Italian Renaissance of Mathematics*; Omodeo, Renn, *Science in Court Society*, 7-11.

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In light of these findings, it is imperative to reassess our understanding of the historiography of science in Renaissance Europe. Rather than viewing Greek science as the sole progenitor of scientific progress, we must recognise the contributions of other cultural traditions incorporated into the intellectual milieu of the time. This reframing of the narrative invites a more inclusive and comprehensive approach to the study of scientific thought during the Renaissance, one that acknowledges the multiplicity of influences that shaped the development of science in Europe.

1 Bessarion's Collection between Purity and Hybridisation

To contrast a narrative based on the notion of 'purity' I will use the term 'hybrid' and its relatives. For this idea I am benefitting from my previous study[2] and some influential achievements in the field of intellectual history, especially the notion of hybridisation in knowledge as "an admixture of information drawn from diverse sources drawn together to make something new".[3]

Hybridity characterised Bessarion's years of education and apprenticeship. The astronomical scene Bessarion experienced both in Constantinople and Mistra mixed the *Almagest* with *zijes* and Hebrew astronomical tables, and this was not perceived as 'suspicious' or 'incorrect' in the 1420s and 1430s. This hybridity in the approach to astronomy accompanied Bessarion for the rest of his life. The notion of purism is present in Bessarion's political discourse, a tool he used to contrast the Ottomans in his homeland, but his views on science remained unaffected by that. In fact, hybridity is attested to in the renowned Paduan lecture by Regiomontanus, which drew heavily upon Bessarion's manuscripts.

Examination of Bessarion's manuscripts collection reveals that he himself was taught Arabo-Persian astronomical tables and that he took care to preserve those copies. This astronomical education was common in the second half of the fifteenth century in Byzantine scholarly circles. Therefore, the astronomical culture of late Byzantium can well be described as the result of a process of hybridisation, and this is what was transmitted into Europe by the Byzantines.

2 Deconstructing Purism and Historiographical Biases

Upon examination of Bessarion's heritage, the narrative of the rebirth of science proves not to be consistent. Hence, the question of transmission of science through the Middle Ages to the Renaissance opens up the problem about the decline of science due to the rise of Christianity. This decline thesis usually goes as follows. Science was created by the ancient Greek philosophers around the sixth century BCE by means of freeing philosophical inquiry into nature from religious and mythological elements in order to find only rational explanations for natural phenomena. Science then died

2 Bardi, "Hybrid knowledge and the historiography of science".

3 Winterbottom, *Hybrid Knowledge and the Early East India Company*, 2. I am also indebted to Burke, *Cultural Hybridity*; Burke, *Hybrid Renaissance*; Stockhammer (ed.), *Conceptualizing Cultural Hybridization*; Stross, "The Hybrid Metaphor"; Shapin, *A Social History of Truth*; Shapin, *Never Pure*.

during the Middle Ages due to the rise of Christianity and Islam, but eventually the humanists rediscovered Greek science and thanks to them it experienced a rebirth.

This narrative has often been used till recently in the historiography of science,[4] but it was never unanimously accepted.[5] Criticism of such a historiographical approach has pointed out that this narrative reflects a projection of a progressivist view of science alongside modern categories applied to the history of ancient philosophy. First, ancient Greek philosophers did not avoid employing their myths and gods in their philosophical inquiries. Second, the transmission of science from Antiquity to the Renaissance as a direct link proves to be problematic, for there were scholars who cultivated and worked on Greek science in a timespan lasting more than a thousand years after Antiquity and before the so-called Renaissance.

The case of Bessarion teaches that what can be considered 'Greek science' is a hybrid product mediated by Christian scholars (especially the Byzantines) through their re-reading of Greek sources and comparing them with other traditions. Therefore, Bessarion's scientific interests, his patronage of arts and sciences in Italy, and his manuscripts collection constitute an important gateway to deal with the historiographical questions that the aforementioned narrative of the rebirth of Greek science has brought to the fore.

Some historiographical accounts are in favour of a continuity, instead of a decline, between the Greek knowledge cultivated by Byzantines and the humanists in Italy, and thus they reject a decline of science during the Middle Ages. The point shared by continuity theses and decline theses is consideration of Thales of Miletus (d. 546 BCE) as the founding father of science because of his struggle to search for rational explanations of natural phenomena and unitary principles of nature and the world.[6] Examination of Bessarion's manuscripts certainly points towards a continuity.

It is also useful to consider the material aspects in the transmission and transformation of science. Science was transmitted through the transcription of papyri and manuscripts, which – unlike the photocopies and digitisation tools used in our era – is extremely energy-consuming and characterised by several kinds of mistakes and modification processes. On this account, a direct link between ancient Greeks and Renaissance scholars must remove (intentionally) the so-called Middle Ages (both in the Western Latin world and Byzantium) from historiographical consideration.

Research in historical epistemology has compellingly demonstrated that science is inherently intertwined with ideologies and political agendas, challenging the notion of scientific neutrality and objectivity. The notion that scientific inquiry occurs in a vacuum, divorced from social, cultural, and political influences, is debunked by historical analysis. Instead, historical epistemology reveals that scientific knowledge production is shaped by broader socio-political contexts, with scientists often operating within frameworks influenced by prevailing ideologies and agendas. This recognition underscores the importance of critically examining the historical and societal contexts in which scientific knowledge is produced and

4 Taton, *Ancient and Medieval Science*, 180-242; Popper, "The Myth of the Framework" 40-3; Russo, *The Forgotten Revolution*; Deming, *Science and Technology in World History*, 2: 26-31.

5 Among others, Ben-Zaken, *Reading Ḥayy Ibn-Yaqẓān*; Poskett, *Horizons*; Harrison, *The Territories of Science and Religion*, 22-5.

6 For instance, cf. Roller, "Aristotle, Plato, and Gemisthos".

disseminated, acknowledging the inherent biases and power dynamics that can influence scientific discourse and decision-making processes.[7] Similarly, studies on the reception of Arabic science in Renaissance Europe have shown that the notion of purity of Greek science is a consequence of a process of constructivism of the Western tradition as essentially Greek, Roman, and Christian.[8] Indeed, the notion of purity of Greek knowledge is anything but a modern construction. It was already emphasised by those Byzantine scholars finding refuge in Italy. They used, albeit unsuccessfully, the prestige of Greek knowledge as a diplomatic tool to persuade the Latins to help them reconquer Byzantium. This propaganda was likely what generated a common perception that Greek science, and Greek heritage more in general, was in peril due to the Muslim enemies.

To sum up, there are three notions of purism involved in discourses about the reception of Greek science in Renaissance Europe:

- The purity underlying the rebirth after the decline due to Christianity.
- The purity of Greek science as opposed to an enemy (the Ottomans) of the Byzantine expatriates in Italy.
- The purity of Greek science as opposed to Arabic knowledge in the Renaissance.

After examining Bessarion's manuscripts, one can reply with the following working questions.

- If Christianity neglected science, where was it kept and how could it be preserved as pure as it was when cultivated by the ancient Greeks?
- To what extent is the notion of purism detected in Bessarion's manuscripts collection and his patronage of arts and sciences?
- Did Bessarion adhere to anti-Arabic humanist programmes?

The next section addresses these points.

3 Transmission and Hybridisation

It is obviously false that Christianity was not interested in science during the Middle Ages or even worked to suppress it due to lack of accordance with its own agenda. Upon examination of Bessarion's manuscripts and efforts to preserve sciences, as well as the claims about science by Regiomontanus (and also many other collections of European libraries), one finds thousands of medieval manuscripts with scientific content. Moreover, the labour of transcribing scientific materials was undertaken chiefly by monks who were, if not prestigious churchmen, at least Christian scholars. Before the age of writing machines and computers, transcription of texts was an

7 Omodeo, *Political Epistemology*.

8 Hasse, *Success and Suppression*, 314.

extremely energy-consuming task, similar to a heavy physically demanding job nowadays. What led the scribes and monks to undertake such an effort if they were not interested in science?

Although Western Christianity knew Greek science chiefly due to translations into Latin mediated through Arabic, the Eastern Roman Empire, cradle of Orthodox Christianity, had Greek (Attic Greek) as an official language of the ruling class, and kept cultivating and transcribing scientific manuscripts in Greek.

Being extremely demanding, the transcription of manuscripts was a process of selection of content and assignment of labour capital. In the Byzantine Empire this occurred in monasteries, led by churchmen, and in environments related to the imperial administration.[9] It is true that Byzantium selected and shaped the canon of Greek classics in all genres, but, most importantly, it was the most direct point of contact with ancient Greek thought, thus essential to an understanding of the transmission of Greek science.

The study of Bessarion's astronomical manuscripts suggests that the canonical Greek works of astronomy, first of all Ptolemy, were combined with Arabo-Persian and Hebrew sources. The process of hybridisation attested in the manuscripts was undertaken to have easier computations and to pursue astrological goals, such as casting horoscopes. Even before the age of Copernicus, scholars knew that Ptolemy needed to be reformed. Some sought a solution by comparing Ptolemaic sources with other traditions, and others tried to re-translate the *Almagest* from Greek into Latin (Bessarion's task assigned to Regiomontanus) to get rid of the errors that had accumulated during the textual transmission.

No notion of purism is detectable in Bessarion's activity of preserving scientific manuscripts. He collected sources from Islamic authors and well acknowledged advancements in sciences by Arabic mathematicians in Islamicate territories. The notion of purism pertains to the political domain, when he engaged in a diplomatic fight against the Ottomans, depicting them as barbarians, because he was promoting a union between the two Churches. In spite of being an opponent of the Ottoman conquest, Bessarion was not part of a humanist anti-Arabic agenda. He never worked to suppress the Arabo-Persian materials he had collected in his manuscripts, and he never regretted having been educated on them. In other words, the transmission of astronomical knowledge in Bessarion's manuscripts shows a process of hybridisation begun in Byzantium and continued in Italy by scholars like Regiomontanus. Bessarion never worked against this.

In our exploration of the influence of Bessarion's manuscripts on the trajectory of science in Italy and Europe, we find ourselves confronted with a multitude of complexities and nuances that characterise the intricate tapestry of intellectual exchange during the medieval era. While our inquiry has shed light on the potential significance of Bessarion's manuscripts in shaping scientific thought, we must acknowledge the challenges inherent in tracing their precise impact. Navigating the labyrinth of manuscripts and printed texts has revealed both the richness of the historical record and the gaps that compel historians to draw upon imaginative reconstruction. Indeed, the very absence of certain historical artefacts or narratives

9 Manolova, Pérez-Martin, "Science Teaching and Learning Methods in Byzantium".

serves as a catalyst for deeper inquiry, prompting us to uncover overlooked dimensions of the past.

The keen interest exhibited by non-Byzantine scholars in Arabo-Persian sources underscores the significance of this intellectual exchange in shaping European scientific discourse. As we reflect on the intersections of Byzantine and other European intellectual traditions, our inquiry prompts us to reconsider conventional narratives and embrace a more nuanced understanding of the evolution of scientific thought. While the precise extent of the influence of Bessarion's manuscripts may remain elusive, our exploration has enriched our understanding of the complex interplay between culture, politics, and science in medieval Europe. By situating Bessarion's manuscripts within the broader context of global intellectual networks, we have gained deeper insights into the diverse influences that shaped the scientific landscape of the time.

4 Conclusions: A Global Microhistory

An exploration of Bessarion's life and intellectual formation has been the starting point to approach the study of his astronomical manuscripts. The cultural ambience of Trebizond contained *in nuce* some of the elements that culminated in Bessarion's astronomical interests and in his intellectual curiosity for philosophy and science at large (chapter 1). Trebizond endowed him with a cultural heritage which had happily integrated oriental influences with Byzantine and Western aspects. Later, Bessarion encountered the post-hesychasm phase in Constantinople, in which hesychasts hegemonised the institutions and education. Bessarion started his apprenticeship in astronomy there but then moved to Mistra, which, for many circumstances, was the opposite of Constantinople, with its unique unorthodox figures like Georgios Gemistos Plethon. Thanks to him, Bessarion encountered in Mistra notions of necessity, causalism and determinism, aimed at a reform of society through a political model inspired by Platonic philosophy, Zoroaster, and the Chaldean Oracles, in which astrology was the most important mathematical science. At the opposite pole, Constantinople was the fortress of conservativism and orthodoxy, to the point of violence and intolerance. Between these two poles, the approach to astronomy was decisive and essential for Bessarion's future career. In fact, the intellectual activity in Mistra, contrary to the radical hesychast Constantinople, did not view inquiry into the domains of natural philosophy with suspicion. This aspect was the key for Bessarion's future efforts to foster astronomical studies.

Therefore, the influential background of the three cities in which Bessarion lived before expatriating was important for his entire life. Trebizond, Constantinople and Mistra (and their peculiarities) were the three key factors of Bessarion's education in light of their cultural backgrounds: Trebizond for astronomical studies and cross-cultural influences, Constantinople because of the controversies about hesychasm and Palamas, and Mistra for Plethon and his desire to reform astronomical studies and society at large. All of this generated tension between Greek vs non-Greek astronomy and religious knowledge vs secular knowledge, which was absorbed by the young Bessarion and resolved in his comparative approach to philosophy and sciences. This allowed him to easily engage in controversies over several issues and become a patron of arts and sciences.

Two main periods shaped Bessarion's life. The years in the area of the late Byzantine Empire, as a Christian Orthodox, and the expatriation to Italy after 1438 and his conversion to Catholicism: the former shaped his hybrid approach to astronomical studies thanks to Chortasmenos and Plethon (chapter 2), the latter was the phase in which he could create propaganda by stressing the Greekness of the Byzantines and their culture, while the scientific heritage they were bringing to the rest of Europe was hybrid (chapter 4). The hybridity in Byzantine science is reflected in Regiomontanus's lecture (chapter 3).

Bessarion was trying to save the sovereignty of Byzantium by an alliance with the Italians. The *topos* of Greek purity as something imperilled by the Ottoman threat, used only at the political level, became a bias which has influenced later historiography (chapter 5). All these facets form a complex scenario in which the evidence of the coexistence of Greek and Arabo-Persian astronomy is at odds with the notion of purism of Greek science. On this account, some historiographical myths linked to notions of purism in Greek science could be deconstructed and replaced by a notion of hybridity, which permeated the scientific culture Bessarion had assimilated and was promoted by him and through his protégé Regiomontanus.

If the Renaissance might still be seen as the rebirth of Greek science after the decline of the Middle Ages or the neglect by Christianity, the rebirth of Greek astronomy is undoubtedly characterised by the re-reading and comparison of astronomical sources in order to obtain better results (think of Copernicus), in other words, all the attitudes Bessarion and Regiomontanus employed in their astronomical activity. Regiomontanus, notably one of the major inspirations of Copernicus, owes much to Bessarion and his manuscripts. Ultimately, unless we wish to remove the hybrid astronomical culture that Bessarion brought into Latin Europe from historiographical discourse, Regiomontanus can well be seen as one of the major promoters of the spirit of that tradition.

What significance does the existence of a global microhistory hold? Despite Bessarion's political views proving unsuccessful and his status as an émigré hindering full integration into the Church of Rome, he remains an important figure in the Italian landscape, where he engaged in political and scientific patronage. Nonetheless, his astronomical education embodies a comparative spirit mixing several traditions, and his support for astronomy reflects this cultural hybridity. This is underscored by the global impact of the sources he bestowed upon Venice. It is worth noting that future astronomers heavily relied on works such as the *Almagest* and the *Persian Tables*: needless to say, Copernicus emulated the *Almagest*, while Boulliau and others utilised the data provided by the *Persian Tables*.

Appendix

The following list provides the astronomical texts* contained in Bessarion's manuscript collection.

Achmet, *Astrology*: *Marc. gr.* Z. 324 (end 14 c.)
Anonymous, Arabo-Persian astronomical tables: *Marc. gr.* Z. 309 (1350 ca.), 323 (14-15 c.), 326 (15 c.), 327 (15 c.), 328 (15 c.), 333 (15 c.), 336 (13-14 c.)
Anonymous, *On the astrolabe*: *Marc. gr.* Z. 303 (13-14 c.), 308 (13-14 c.), 330 (14 c.), 333 (15 c.)
Anonymous, *Paradosis of the Persian Tables*: *Marc. gr.* Z. 323 (14-15 c.), 326 (15 c.), 328 (15 c.), 333 (15 c.), 336 (13-14 c.); *Marc. lat.* VIII. 31[1] (Latin translation)
Anonymous, *Prolegomena ad Almagestum*: *Marc. gr.* Z. 303 (13-14 c.), 310 (1350 ca.), 311 (13-14 c.), 313 (9-10 c.), 314 (9-10 c.); *Ambrosianus* A 168 sup. # (15 c.)[2]
Aratus, *Phaenomena*: *Marc. gr.* Z. 317 (14 c.)
Argyros, astronomical tables: *Marc. gr.* Z. 323 (14-15 c.), 328 (15 c.)
Argyros, *On the astrolabe*: *Marc. gr.* Z. 323 (14-15 c.), 324 (end 14 c.), 328 (15 c.), 336 (13-14 c.)
Argyros, *On solar and lunar cycles*: *Marc. gr.* Z. 328 (15 c.), 333 (15 c.)
Aristarchus, *On the Sizes and Distances of the Sun and the Moon*: *Marc. gr.* Z. 304 (15 c.)
Autolycus of Pitane, *On the moving sphere*, *On risings and settings*: *Marc. gr.* Z. 304 (15 c.)
Barlaam of Seminara, *Treatise on the solar eclipses of 1333 and 1337*: *Marc. gr.* Z. 310 (1350 ca.), 332 (14 c.)

* For a full description of each manuscript, cf. Mioni, *Codices*, except where a footnote is provided.

1 Valentinelli, *Bibliotheca*, 3: 256-7; Bardi, "Scientific interactions in colonial, multilinguistic, and interreligious contexts".

2 Labowsky, *Bessarion's Library*, 118; Martini, Bassi, *Catalogus codicum graecorum Bibliothecae Ambrosianae*, 1: 75-6.

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Barlaam of Seminara, *On the Easter computus*: *Marc. gr.* Z. 332 (14 c.)
Bianchini, *Astronomical Tables*: *Marc. lat.* 341 (15 c.)[3]
Cabasilas, *Commentary on the third book of the Almagest*: *Marc. gr.* Z. 310 (1350 ca.)
Chrysokokkes (George), *Persian Syntax*: *Marc. gr.* Z. 309 (1350 ca.), 327 (15 c.)
Chrysokokkes (Michael), *Book of Six Wings* (treatise on eclipses): *Marc. gr.* Z. 326 (15 c.)
Cleomedes, *On the motions of celestial bodies*: *Marc. gr.* Z. 308 (13-14 c.) alongside Pediasimos's commentary, 309 (1350 ca.), 317 (14 c.), 333 (15 c.) alongside Pediasimos's commentary; *Vaticanus graecus* 222 (14-15 c.) alongside Pediasimos's commentary[4]
Ephestion of Thebes, *Epitome of Apotelesmatics*: *Marc. gr.* Z. 324 (end 14 c.), 336 (13-14 c.)
Euclid, *Phaenomena*: *Marc. gr.* Z. 301, 302 (before 1450)
Geminos, *Introduction to astronomy* (*Isagoge*): *Marc. gr.* Z. 323 (14-15 c.)
Gregoras, *On the Easter computus*: *Marc. gr.* Z. 336 (13-14 c.)
Gregoras, *On the eclipses of the Sun*: *Marc. gr.* Z. 325 (1450 ca.)
Gregoras, *On the astrolabe*: *Marc. gr.* Z. 325 (1450 ca.), 326 (15 c.), 333 (15 c.)
Heliodorus, *Commentary on Stephanus's Apotelesmatics*: *Marc. gr.* Z. 324 (end 14 c.), 336 (13-14 c.); *Ambrosianus* A 168 sup. # (15 c.)[5]
Hypsicles, *Anaphoricus*: *Marc. gr.* Z. 304 (15 c.)
Menelaus, *Spherics* (Latin translation): *Marc. lat.* 328 (15 c.),[6] 329 (15 c.)[7]
Metochites, *Introduction to Astronomy*: *Marc. gr.* Z. 329 (14 c.), 330 (14 c.)
Pappus of Alexandria, *Commentary on the Almagest*: *Marc. gr.* Z. 303 (13-14 c.), 310 (1350 ca.)
Paul of Alexandria, *Apotelesmatica*: *Marc. gr.* Z. 303 (13-14 c.)
Peuerbach, eclipse tables: *Marc. lat.* 342[8]
Peuerbach, *Theoricae novae planetarum*: *Ariminensis*, Biblioteca Civica Gambalunga 27 (*olim* 4.A.II.5)[9]
Philoponus, *On the astrolabe*: *Marc. gr.* Z. 303 (13-14 c.), 323 (14-15 c.), 324 (end 14 c.), 326 (15 c.), 333 (15 c.), 336 (13-14 c.) *Marc. gr.* Z. 336 (13-14 c.)
Proclus, *Commentary on Ptolemy's Tetrabiblos*: *Marc. gr.* Z. 303 (13-14c.)
Proclus, *Exposition of Astronomical Hypotheses*: *Marc. gr.* Z. 303 (13-14 c.), 323 (14-15 c.)
Pseudo-Aristoteles, *On the Universe*: *Marc. gr.* Z. 308 (13-14 c.)
Ptolemy, *Almagest*: *Marc. gr.* Z. 302 (before 1450), 303 (13-14 c.), 310 (1350 ca.), 311 (13-14 c.), 312 (1250 ca.), 313 (-10 c.)
Ptolemy, *Handy Tables*: *Marc. gr.* Z. 315 (14 c.), 323 (14-15 c.), 325 (1450 ca.), 331 (9 c.)
Ptolemy, *Planetary Hypothesis* (book 1): *Marc. gr.* Z. 314 (14 c.), 323 (14-15 c.), 324 (end 14 c.)
Ptolemy, *Psephophoria*: *Marc. gr.* Z. 314 (14 c.)
Ptolemy, *Tetrabiblos*: *Marc. gr.* Z. 314 (14 c.) alongside commentaries on *Tetrabiblos* by Porphyrius, Demophilus, and an anonymous author; *Marc. gr.* Z. 323 (14-15 c.), 324 (end 14 c.)
Regiomontanus, *Epytoma in Almagestum*: *Marc. lat.* 328 (15 c.),[10] 329 (15 c.)[11]
Rhetorius, *Astrological Problems*: *Marc. gr.* Z. 324 (end 14 c.), 336 (13-14 c.)
Sacrobosco, *De Sphaera*: *Marc. lat.* 338 (14 c.)[12]

3 Valentinelli, *Bibliotheca*, 3: 255.

4 Mercati, Franchi de' Cavalieri, *Codices vaticani graeci*, 1: 289-90.

5 Labowsky, *Bessarion's Library*, 118; Martini, Bassi, *Catalogus codicum graecorum Bibliothecae Ambrosianae*, 1: 75-6.

6 Valentinelli, *Bibliotheca*, 3: 249-51; Rigo "Bessarione", 80-1.

7 Valentinelli, *Bibliotheca*, 3: 218; Rigo "Bessarione", 81-2.

8 Valentinelli, *Bibliotheca*, 3: 265-6.

9 Fiaccadori, *Bessarione e l'Umanesimo*, 470, item 83 (by Antonio Rigo). The manuscript was listed as no. 799 in the inventory of 1474, cf. Labowsky, *Bessarion's Library*, 120.

10 Valentinelli, *Bibliotheca*, 3: 249-51; Rigo, "Bessarione, Giovanni Regiomontano", 80-1.

11 Valentinelli, *Bibliotheca*, 3: 218; Rigo, "Bessarione, Giovanni Regiomontano", 81-2.

12 Valentinelli, *Bibliotheca*, 3: 266.

Serenus, *Fragmentum astronomicum*: *Marc. gr.* Z. 303 (13-14 c.)
Shams, *On the astrolabe*: *Marc. gr.* Z. 309 (1350 ca.)
Stephanus of Alexandria, *Commentary on Ptolemy's Handy Tables*: *Marc. gr.* Z. 323 (14-15 c.), 325 (1450 ca.)
Theodosius, *Sphaerics*: *Marc. gr.* Z. 301, 302 (before 1450)
Theodosius, *On days and nights*: *Marc. gr.* Z. 304 (15 c.)
Theon of Alexandria, *Commentary on the Almagest*: *Marc. gr.* Z. 303 (13-14 c.), 310 (1350 ca.)
Theon of Alexandria, *Little Commentary on Ptolemy's Handy Tables*: *Marc. gr.* Z. 315 (14 c.), 323 (14-15 c.)
Theon of Smyrna, *Treatise on mathematics useful for the understanding of Plato:*[13] *Marc. gr.* Z. 303 (13-14 c.), 307 (12 c.; with Bessarion's notes)
Vettius Valens, *Anthologiae*: *Marc.gr.* Z. 314 (14 c.)

13 The second book is on astronomy.

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This book challenges the narrative of the revival of Greek science during the early modern age and offers a global microhistory of the cross-cultural legacy between the Arabo-Persian and Hellenistic astronomical traditions, which converged through the efforts of Byzantine émigrés such as Bessarion. An examination of Bessarion's life and manuscripts demonstrates that Byzantine astronomical texts were part of a rich hybrid culture that emerged from the encounter of these two traditions. This work intends to illustrate the global significance of this coexistence in light of Bessarion's activities and their symbolic and cultural meanings, and aims to reshape our understanding of science in the transition from the Middle Ages to Modernity.

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