1 Introduction

Tycho Brahe did cosmology a great wrong.[1] Such was the opinion of Mendo Pacheco de Brito, who, in the middle of an impassioned controversy over the nature and location of the exceptionally bright comets that appeared above Portugal in late 1618, accused his opponent – the astronomer and physician Manuel Bocarro Francês – of seizing the ideas of the Lutheran astronomer Tycho Brahe.[2] According to Brito, these Tychonic theories were particularly pernicious as they risked jeopardising the long-established worldview born out of the consensus between Aristotelian philosophy and orthodox theology:

> We announce that the originator of these new ideas is Tycho Brahe, who was a heretic (*herege*) and intended, on every matter, to weaken Aristotle's doctrine so that his mistakes could be corroborated.[3]

Although not unusual, these religious arraignments have passed largely unnoticed by historians concerned with the so-called relationship between science and religion. While discussing the impact of ecclesiastic agency on science and scientific activity in early modern Europe, historians have focused mainly on formal processes of censorship. Accordingly, the inquisi-

1 This book develops the argument made in Carolino, "How Did a Lutheran Astronomer Get Converted into a Catholic Authority?".

2 On this controversy, see Carolino, "Disputando Pedro Nunes" and Camenietzki, Carolino, Leite, "A Disputa do Cometa".

3 de Brito, *Discurso em os Dous Phaenominos Aereos*, ff. 18*v*-19*r*: "Aduertimos tambem, que destas opiniões nouas, he inuentor Tycho Abrahe, o qual foy Herege, e em tudo pretende enfraquecer a doctrina de Aristoteles, pera com isso ficar mais em seus erros confirmado".

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torial trials of prominent individuals, such as Galileo Galilei, Giordano Bruno and Giambattista della Porta, have regularly been scrutinised, with the lists of prohibited books being increasingly dissected.[4] Undoubtedly, the direct effects that ecclesiastic censorship had on scientific activity in early modern Europe are hardly to be ignored. Nevertheless, statements such as that made by Brito, linking confessional identity to philosophical orthodoxy, suggest the existence of a more complex, indirect and subtle influence. In the aftermath of the Western Christian schism, the Catholic Church, with the support of increasingly centralised states, struggled to promote the religious conformity of doctrine and practices through censorship, religious propaganda and education. In this context, as the Counter-Reformation gained momentum, the confessional agenda exerted an increasing influence over the ongoing philosophical debates and science. Indeed, Brito's statement epitomises the cultural politics of the early Counter-Reformation Church. Striving to ensure their intellectual hegemony, the Catholic authorities established a close link between Aristotelian natural philosophy and metaphysics and orthodox theology. The interpretation of the doctrine of transubstantiation in Aristotelian-Thomist philosophical terms handed down by the Council of Trent represents a case in point. The conversion of the substance of bread and wine into the body and blood of Christ, while maintaining the constitution of the former substances, required an Aristotelian-Thomist understanding of the metaphysics of substance.[5] In this context, any attempt to put forward a theory that conflicted with the Aristotelian-Thomist theoretical framework was easily converted into an implicit attack on Catholicism and its truths of faith (the Eucharist) and science (geocentrism). Science became a confessional matter, as Brito was well aware.

What Brito ignored was how, even as he wrote those lines against Tycho Brahe, the Danish astronomer was in the process of being assimilated by the Society of Jesus authorities. The astronomical novelties revealed by the brand-new telescope rendered the traditional Ptolemaic system untenable. The geo-heliocentric system elaborated by Tycho Brahe stood out as a likely candidate for replacing it. After a distressing process of censorship, Giuseppe Biancani's *Sphaera Mundi* was finally published in 1620. Although Biancani's book was to a large extent just a traditional treatise on cosmography, it was nevertheless the first printed work by a Jesuit author to endorse the Tychonic planetary system.[6] For such a reason, it is regarded as a turning point in the science politics of the Jesuits, when the Jesuit authorities officially accepted Tychonic geo-heliocentrism. Soon after this foundational moment, Tycho Brahe emerged as an authority among Jesuit astronomers and philosophers.[7]

4 The production in this field of historical research has been abundant. Some of the most influential and recently published works are Baldini, Spruit, *Catholic Church and Modern Science*. Vol. 1, *Sixteenth-Century Documents*; Finocchiaro, *On Trial for Reason*; Gingras, *Science and Religion*.

5 Redondi, *Galileo Heretic*, 209-26; Dear, "The Church and the New Philosophy", 124.

6 Prior to this, the Tychonic system had already been taught in the Jesuit milieu by at least Otto Cattenius at the University of Mainz, in 1610-11, and Cristoforo Borri at the College of Brera (Milan), in 1612. Krayer, *Mathematik im Studienplan der Jesuiten*, 135-7; Carolino, "The Making of a Tychonic Cosmology".

7 On the Jesuit reception of Tycho Brahe's astronomical system, see Lerner, "L'entrée de Tycho Brahe"; Schofield, *Tychonic and Semi-Tychonic*, 277-89; Lattis, *Between Copernicus and Gal-*

However, the incorporation of Tycho Brahe into the pantheon of Jesuit authorities was anything but a straightforward process. The Tychonic astronomical system conflicted with several astronomical tenets long since taught at Jesuit colleges and universities, such as the existence of celestial spheres. It also contradicted the theories generally maintained by Jesuit natural philosophers in the cosmological domain. Furthermore, Tycho Brahe was publicly Lutheran. A quick reading of his *Epistolarum astronomicarum libri* (Uraniborg, 1596) would have left no Jesuit in any doubt about Tycho's confessional identity. This most likely explains why Jesuits seemed to be so cautious about explicitly crediting Tycho with *his* new astronomical system around 1620. As Christine Jones Schofield has already pointed out, in her pivotal book on the diffusion of the Tychonic system in early modern Europe, the Swiss Jesuit Johann Baptist Cysat, Professor of Astronomy at the University of Ingolstadt, despite using a diagram representing the Tychonic world system in his famous book on the comet of 1618 and praising Tycho's ability to determine the motions of the comets,[8] did not identify Tycho as the author of the new world system.[9] Needless to say, Cysat was most likely aware of Tycho's authorship of the geo-heliocentric system of which he availed himself. A couple of years earlier, in the academic year 1613-14, his Jesuit confrère, collaborator and predecessor in the teaching of astronomy at Ingolstadt, Christoph Scheiner, had already disclosed the Tychonic system to his students of cosmology at the University of Ingolstadt.[10] The same strategy of praising the astronomical abilities of Tycho Brahe in print while explicitly avoiding crediting the Danish astronomer with the 'Tychonic' system was followed by Giuseppe Biancani himself. In his *Sphaera Mundi* (mentioned above), while delving into *De Mundi Fabrica*, Biancani exposed the geo-heliocentrism of Tycho Brahe, but not a single word was said about its author.

By the time Cysat and Biancani published their books, a process of censorship of Tycho Brahe's *Astronomiae instauratae progymnasmata* was underway in Rome under the surveillance of Roberto Bellarmino. As one learns from the censure issued by the Roman Congregation of the Holy Office, it was not Brahe's scientific ideas that were at stake but his religious identity. Accordingly, it urged the Catholic reader to suppress the praises that Tycho Brahe addressed to Luther and his prominent worshippers from his book. The question was not about the (in)ability of Protestants to access the truth in science and philosophy[11] but was about establishing the intellectual hegemony of the Catholics over the Protestant scholars. Tycho Brahe's religious belief remained an issue for a few Jesuit astronomers until the mid-seventeenth century. As Michel-Pierre Lerner revealed, in his *Almagestum novum* (1651), Giambattista Riccioli addressed severe words to the "impi-

ileo, 205-16; Strano, Truffa, "Tycho Brahe Cosmologist", 89-93; Marcacci, *Cieli in contraddizione*; Carolino, "Astronomy, Cosmology, and Jesuit Discipline", 678-81.

8 Cysat, *Mathemata astronomica*, 57.

9 Schofield, *Tychonic and Semi-Tychonic*, 170-1. Schofield also referred to the case of the Jesuit theses of the College of Pont-à-Mousson (1622).

10 Scheiner, *Disquisitiones mathematicae*, 52-3. Scheiner taught mathematics (including astronomy) and Hebrew at the University of Ingolstadt between 1610 and 1616-17. Daxecker, *The Physicist and Astronomer*, 9-10. The *Disquisitiones mathematicae* stemmed from these mathematical classes at Ingolstadt.

11 On the question of establishing and making sense of truth among early modern Catholics, see Badea et al., *Making Truth*.

ous" Tycho Brahe,[12] accusing him of following Luther, Melanchthon and David Chytraeus, the "plague of the human race" (*humani generis pestes*) according to the Italian Jesuit.[13]

This book explores the complex process of integrating Tycho Brahe's astronomical theories into the Jesuit intellectual framework by focusing on a specific community of Jesuit scholars, the group of professors who taught mathematics at the College of Santo Antão, Lisbon, during the first half of the seventeenth century. Recent scholarship has emphasised the role that the Jesuit polyvalent information network played in the circulation of knowledge in the early modern period.[14] An analysis of the appropriation of Tycho Brahe's astronomical theories by the international community of Jesuit mathematicians active in Lisbon may also offer an appropriate occasion to investigate how the Jesuit network affected the production of knowledge process itself. Between 1615 and 1652, a series of foreign Jesuits, trained in different academic traditions from across Europe, taught the Tychonic system in the College of Santo Antão's Class on the Sphere (*Aula da Esfera*). The respective professors were (according to the order in which they taught) the Italian Giovanni Paolo Lembo (1570-1618, who taught in Lisbon from 1615 to 1617), who studied mathematics at the Collegio Romano under Christoph Clavius; the German Johann Chrysostomus Gall (1586-1643, t. 1620-27), who trained in astronomy at Ingolstadt University under Johann Lanz, Christoph Scheiner and Johann Baptist Cysat; the Italian Cristoforo Borri (1583-1632, t. 1627-28), who learned and taught mathematics at the College of Brera, in Milan, before departing to East Asia as a missionary; the English Ignace Stafford (1599-1642, t. 1630-36), a former student of the Royal English College of Valladolid, Spain; the Irish Simon Fallon (1604-1642, t. 1638-41), who studied at the College of Arts, Coimbra, and the University of Évora, Portugal;[15] and, finally, the English John Rishton (1615-56, t. 1651-52), a Jesuit who trained in Ghent and Liège before departing for Lisbon in the late 1640s.[16]

At the College of Santo Antão, these Jesuits of different European origins reflected on the astronomical and philosophical challenges raised by adopting Tycho Brahe. Since they were supposed to provide an introduction to astronomy (to the Sphere), Santo Antão's professors usually did not discuss the technical aspects involved in the astronomical debate. Even John Rishton, who examined the Copernican system in greater detail, did not consider technical details. The English Jesuit tackled the crucial arguments of the controversy, such as the parallax issue, but did not focus, for example, on the theory of the Sun or the movement of Mars.

The confessional issue nevertheless remained at the forefront of all concerns. The situation was especially tense because, as those professors unanimously realised, the celestial novelties of the late sixteenth and early

12 Lerner, "Tycho Brahe Censured", 95.

13 Riccioli, *Almagestum novum*, Pars prior, XLVI, col. b. Cf. Pars posterior, 74, col. b.

14 See, among many others, Findlen, "How Information Travels"; Romano, *Impressions de Chine*; Harris, "Mapping Jesuit Science".

15 Biographical details of these Jesuits can be found in Baldini, "L'insegnamento della matematica", 129-67, 142-4.

16 Baldini, "The Teaching of Mathematics", 386-7. To this list, we should add the English Jesuit Thomas Barton (c. 1615-?), who taught mathematics at the College of Santo Antão in 1648-49. However, I was unable to examine his lecture notes (*Tractado da Sphera*), which are in the possession of a private owner. On Barton and his lecture notes, see Bernardo, "O Tractado da Sphera".

seventeenth centuries had forced Jesuit mathematicians to work out an astronomical solution that enabled the replacement of the Ptolemaic traditional planetary system without yielding to the temptation of advocating the Copernican heliocentric system, which was rigorously forbidden in 1616.[17] The prohibition of endorsing the Copernican theory was regularly reinforced. In 1651, for example, the *Ordinatio Pro Studiis Superioribus*, issued during the short generalate of Francesco Piccolomini, excluded the teaching of any theses that, among many others, proclaimed the diurnal motion of the Earth.[18] It was against this complex background that this Jesuit community devised the Tychonic system as a solution and explicitly conceived it as a 'compromise' system. In doing so, they paved the way for the entrance of Tycho Brahe into the restricted selection of Jesuit authorities. Nevertheless, the Lutheran astronomer remained strictly confined to the realm of astronomy. The Jesuits soon recognised that Brahe's accurate observations and precise instruments made him an astronomical *auctoritas*. Nevertheless, they seemed much more cautious regarding the cosmological ideas that Tycho discussed in his works. As this book will demonstrate, they assimilated Tycho's and his correspondents' ideas on celestial matter and fluidity while avoiding any recognition of their authorship. Inspired by the Tridentine instructions, Jesuits instead endeavoured to attribute the source of those cosmological ideas to the early Church Fathers. Thus, while Tycho Brahe entered the pantheon of 'Jesuit' luminaries, he nonetheless was not granted the full status of an authority. This complex and intricate process through which Tycho Brahe was integrated into the Jesuit intellectual framework thus demonstrates that the impact of confessionalisation reached well beyond the formal censorship of science. Confessionalisation correspondingly shaped the very formation of early modern scientific culture.

I develop this argument in a dozen short chapters. The book starts with a brief introduction to the College of Santo Antão's Class on the Sphere, the institutional setting in which the geo-heliocentric controversies took place (chapter 2). There was a strong link between the Lisbon mathematics class and the Collegio Romano, the Jesuit key institution of mathematical teaching at the turn of the seventeenth century. Alongside several professors who, having been trained in Rome, travelled to Lisbon, an Aristotelian-Ptolemaic orthodox cosmological view inspired by the work of the influential mathematics professor of the Roman college Christoph Clavius made its way into the Lisbon institution. This cosmological view was based on a few conventional cornerstones, such as the notions of the incorruptibility and the solidity of the celestial region. Nevertheless, the appearance of comets and new stars in the late sixteenth and early seventeenth centuries radically challenged these cornerstones. Chapter 3 analyses the telescope observations of these celestial novelties carried out by the Lisbon community of Jesuit astronomers. This analysis corroborates the existence of a close interconnection between the Collegio Romano's and the Santo Antão College's astronomical agenda at the beginning of the seventeenth century.

17 On the 1616 ban on Copernicus, see particularly Frajese, "Il decreto anticopernicano" and Fabbri, Favino, *Copernicus Banned*. For a seminal insight into the complex reception of and reaction against Copernicus in the sixteenth and seventeenth centuries, see Omodeo, *Copernicus in the Cultural Debates*.

18 "Ordinatio Pro Studiis Superioribus", 92. On the complex process that would result in the publication of this Ordination, see in particular Hellyer, "The Construction of the *Ordinatio*".

Since the astronomical novelties revealed by the brand-new telescope rendered the traditional Ptolemaic system untenable, the Jesuit astronomers struggled to devise astronomical solutions. In the following chapters, I discuss the Jesuit refutation of Copernicus based on astronomical, physical and biblical arguments (chapter 4), the development of an alternative geo-heliocentric model of Capellan inspiration, which came to terms with the celestial novelties while simultaneously retaining intact the foundations of traditional cosmology (chapter 5), and finally the reception of Tycho Brahe's geo-heliocentric system (chapter 7). However, a complex process of censorship preceded the reception of the Tychonic astronomical system and ideas, focusing not so much on scientific questions but above all on confessional issues. This is the theme of chapter 6.

Chapters 7 and 8 focus on the intricate process of integrating Tycho Brahe into the framework of the Jesuit authorities. In the early stage of this process, Jesuits strove to confine Tycho Brahe's influence to the realm of mathematics (chapter 7), but, as the seventeenth century progressed and Jesuit mathematicians became increasingly involved in the physical discussion of the structure and composition of the cosmos, they started to make use of Tychonic ideas on topics such as the celestial matter and fluidity. Nevertheless, as chapter 8 shows, they still explicitly avoided crediting Tycho Brahe and his correspondents with these new notions. Aligned with the Catholic Church's guidelines, issued by the Council of Trent, Jesuits strove to credit the early Church Fathers as the source of their theories.

Although deeply influenced by Tychonic cosmology and astronomy, chapter 9 shows nevertheless that Jesuit astronomers worked out a coherent cosmological view that, on the one hand, was fully consistent with the Catholic theology and, on the other hand, addressed some topics left unsolved by the Danish astronomer. This cosmological view proved quite influential not only among the mathematician community but also among the Jesuit philosophers. While historians have tended to emphasise the existence of strict disciplinary distinctions and different scholarly practices within the Jesuit Order, chapter 10 proves that, despite operating in different institutional settings, there was no divide between mathematicians and philosophers at the Lisbon College of Santo Antão.

The book finishes with a brief discussion of the impact that the ecclesiastic ban on Copernicanism had on Jesuit cosmological teaching (chapter 11). While Santo Antão's mathematics professors initially insisted that the Copernican system was mathematically sophisticated and useful but physically incongruent and potentially heretical in religious terms, by the middle of the seventeenth century, they did not avoid stating that "the system of Copernicus is not physically impossible".[19] Nevertheless, the ban on Copernicanism by the authorities of the Catholic Church remained an obstacle to elaborating further on heliocentric cosmologies as models that described the world.

Except for chapter 6, each chapter is followed by the transcription and translation of a relevant primary source discussed in the chapter. In part because these sources were written in Portuguese (for reasons discussed in chapter 2, the College of Santo Antão's mathematical class had the peculiarity of being taught in the Portuguese language), they have passed large-

19 Rishton, Curso de Mathematica, BNP, PBA. 54, f. 140*v*.

ly unnoticed in the mainstream historiography of early modern science. All the translations from Portuguese and Latin are my own.