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RESEARCH ARTICLE

How did a Lutheran astronomer get converted into a Catholic authority? The Jesuits and their reception of Tycho Brahe in Portugal

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Abstract

This article explores the complex process of integrating Tycho Brahe's theories into the Jesuit intellectual framework through focusing on the international community of professors who taught mathematics at the College of Saint Anthony (Colégio de Santo Antão), Lisbon, during the first half of the seventeenth century. Historians have conceived the reception of the Tychonic system as a straightforward process motivated by the developments of early modern astronomy. Nevertheless, this paper argues that the cultural politics of the Counter-Reformation Church curbed the reception of Tycho Brahe within the Jesuit milieu. Despite supporting the Tychonic geo-heliocentric system, which they explicitly conceived of as a 'compromise' between the ancient Ptolemy and the modern Copernicus, and making recourse to some of the cosmological ideas produced in Tycho's Protestant milieu, the Jesuits strove to confine the authority of the Lutheran astronomer to the domain of mathematics. Philosophy was expected to remain the realm of Catholic orthodoxy. Thus, while Tycho Brahe entered the pantheon of 'Jesuit' authorities, he nonetheless was not granted the absolute status of intellectual authority. This case demonstrates how the impact of confessionalization reached well beyond the formal processes of science censorship.

Introduction

Tycho Brahe did cosmology a great wrong. 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 on the ideas of the Lutheran astronomer Tycho Brahe.[1] According to Brito, these Tychonic theories were particularly pernicious as they risked jeopardizing the long-established world view 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

[1] On this controversy see Luís Miguel Carolino, 'Disputando Pedro Nunes: Mendo Pacheco de Brito "versus" Manuel Bocarro Francês numa Controvérsia Matemática de inícios do Século XVII', *Anais da Universidade de Évora* (2002) 12, pp. 87–108; and Carlos Ziller Camenietzki, Luís Miguel Carolino and Bruno Martins Boto Leite, 'A Disputa do Cometa: Matemática e Filosofia na controvérsia entre Manuel Bocarro Francês e Mendo Pacheco de Brito acerca do cometa de 1618', *Revista Brasileira de História da Matemática* (2004) 4(7), pp. 3–18.

his mistakes could be corroborated.'[2] 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 upon science and scientific activity in early modern Europe, historians have focused mainly on formal processes of censorship. Accordingly, the Inquisitorial trials of prominent individuals, such as Galileo Galilei, Giordano Bruno and Giambattista della Porta, have been regularly scrutinized with the lists of prohibited books increasingly dissected.[3] Undoubtedly, the direct effects that ecclesiastic censorship had upon scientific activity in early modern Europe is 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 centralized 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 did exert an increasing influence over the ongoing philosophical debates and science. Indeed, Brito's statement epitomizes 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 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 still maintaining the constitution of the former substances, required an Aristotelian understanding of the metaphysics of substance.[4] In this context, any attempt to put forward a theory that conflicted with the Aristotelian theoretical framework was easily converted into an implicit attack on Catholicism, and on its truths of faith (the Eucharist) and science (geocentrism). Science became a confessional matter, as Brito was well aware.

What Brito did ignore 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 did render 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.[5] For such reason, it has become regarded as a turning point in the science politics of the Jesuits, the point in time when the Jesuit authorities officially accepted the

[2] Mendo Pacheco de Brito, *Discurso em os Dous Phaenominos Aereos do Anno de Mil e Seiscentos e Dezoito*, Lisbon: Pedro Craesbeck, 1619, fols. 18v–19r.

[3] Production in this field of historical research has been abundant. To quote some of the most influential and recently published works: Ugo Baldini and Leen Spruit (eds.), *Catholic Church and Modern Science*, vol. 1: *Sixteenth-Century Documents*, Rome: Libreria Editrice Vaticana, 2009; Maurice A. Finocchiaro, *On Trial for Reason: Science, Religion, and Culture in the Galileo Affair*, Oxford: Oxford University Press, 2019; Yves Gingras, *Science and Religion: An Impossible Dialogue*, Cambridge: Polity Press, 2017.

[4] Pietro Redondi, *Galileo Heretic*, London: Allen Lane and The Penguin Press, 1988, pp. 209–26; Peter Dear, 'The Church and the new philosophy', in Stephen Pumfrey, Paolo Rossi and Maurice Slawinski (eds.), *Science, Culture and Popular Belief in Renaissance Europe*, Manchester and New York: Manchester University Press, 1991, pp. 119–39, 124

[5] Prior to this, the Tychonic system had already been taught in the Jesuit milieu by at least Otto Cattenius in the University of Mainz in 1610/11, and by Cristoforo Borri at the College of Brera (Milan) in 1612. Albert Krayer, *Mathematik im Studienplan der Jesuiten: Die Vorlesung von Otto Cattenius an der Universität Mainz (1610/11)*, Stuttgart: Franz Steiner Verlag, 1991, pp. 135–7; Luís Miguel Carolino, 'The making of a Tychonic cosmology: Cristoforo

Tychonic geo-heliocentrism. After this foundational moment, Tycho Brahe soon emerged as an authority among Jesuit astronomers and philosophers.[6]

Yet 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 traditionally long since taught in 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 the reason Jesuits seemed so cautious to explicitly credit 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, did not identify Tycho as the author of the new world system.[7] 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 of 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.[8] The same strategy of praising the astronomical abilities of the Tycho Brahe in print, while explicitly evading 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 exposes 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 under way in Rome under the surveillance of Robert Bellarmine. 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 in his book. The

Borry and the development of Tycho Brahe's astronomical system', *Journal for the History of Astronomy* (2008) 39, pp. 313–44.

[6] On the Jesuit reception of Tycho Brahe's astronomical system see Michel-Pierre Lerner, 'L'entrée de Tycho Brahe chez les jésuites ou le chant du cygne de Clavius', in Luce Giard (ed.), *Les Jésuites à la Renaissance: Système éducatif et production du savoir*, Paris: Presses Unversitaires de France, 1995, pp. 145–85; Christine Jones Schofield, *Tychonic and Semi-Tychonic World Systems*, New York: Arno Press, 1981, pp. 277–89; James M. Lattis, *Between Copernicus and Galileo: Christoph Clavius and the Collapse of Ptolemaic Cosmology*, Chicago and London: The University of Chicago Press, 1994, pp. 205–16; Giorgio Strano and Giancarlo Truffa, 'Tycho Brahe cosmologist: an overview on the genesis, development and fortune of the geo-heliocentric world-system', in Massimo Bucciantini, Michele Camerota and Sophie Roux (eds.), *Mechanics and Cosmology in the Medieval and Early Modern Period*, Florence: Leo. S. Olschki, 2007, pp. 73–93, 89–93; Flavia Marcacci, *Cieli in contraddizione: Giovanni Battista Riccioli e il terzo sistema del mondo*, Perugia: Aguaplano, 2018; Luís Miguel Carolino, 'Astronomy, cosmology, and Jesuit discipline, 1540–1758' in Ines G. Županov (ed.), *The Oxford Handbook of the Jesuits*, New York: Oxford University Press, 2019, pp. 670–707, 678–81; Ivana Gambaro, 'Geo-heliocentric models and the Society of Jesus: from Clavius's resistance to Dechales's *Mathesis Regia*', *Annals of Science* (2021), 78(3), pp. 265–94.

[7] Johann Baptista Cysat, *Mathemata astronomica de loco, motu, magnitude et causis de cometae qui sub finem anni 1618 et initium anni 1619 in coelo fulsit*, Ingolstat: ex Typographeo Ederiano, 1619, p. 57. Schofield, op. cit. (6), pp. 170–1. Schofield also refers the case of the Jesuit theses of the College of Pont-à-Mousson (1622).

[8] Christoph Scheiner, *Disquisitiones mathematicae de controversiis et novitatibus astronomicis*, Ingolstadt: ex Typographeo Ederiano apud Elisabetham Angermariam, 1614, pp. 52–3.

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question was not about the (in)ability of Protestants to access the truth in science and philosophy, but about establishing the intellectual hegemony of the Catholic over the Protestant scholars.[9] Tycho Brahe's religious belief remained an issue for a few Jesuit astronomers until the mid-seventeenth century. As Michel-Pierre Lerner has revealed, in his *Almagestum novum* (1651) Giambattista Riccioli addressed severe words to the 'impious' Tycho Brahe.[10] He accused him of following Luther, Melanchthon and David Chytraeus, the 'plague of human race' (*humani generis pestes*) according to the Italian Jesuit.[11]

This article explores the complex process of integrating Tycho Brahe's astronomical theories into the Jesuit intellectual framework through focusing on a specific community of Jesuit scholars, the group of professors who taught mathematics at Lisbon's College of Saint Anthony (Colégio de Santo Antão) during the first half of the seventeenth century. Recent scholarship has emphasized the role that the Jesuit polyvalent information network played in the circulation of knowledge in the early modern period.[12] 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 analyse 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 College of Saint Anthony's Class on the Sphere (Aula da Esfera).[13] The respective professors were (according to the order by which they taught) the Italian Giovanni Paolo Lembo (1570–1618, taught in Lisbon from 1615 to 1617), who studied mathematics in Collegio Romano under Christoph Clavius; the German Johann Chrysostomus Gall (1586–1643, t. 1620–7), trained in astronomy at Ingolstadt University under Johann Lanz, Christoph Scheiner and Johannes Baptista Cysat; the Italian Cristoforo Borri (1583–1632, t. 1627–8), 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. 1630–6), a former student of the Royal English College of Valladolid, Spain; the Irish Simon Fallon (1604–42, t. 1638–41), who studied in the College of Arts, Coimbra, and the University of Évora, Portugal; and finally

[9] On the question of establishing and making sense of truth among early modern Catholics see Andreea Badea, Bruno Boute, Marco Cavarzere and Steven Vanden Broecke (eds.), *Making Truth in Early Modern Catholicism*, Amsterdam: Amsterdam University Press, 2021.

[10] Michel-Pierre Lerner, 'Tycho Brahe censured', in John R. Christianson, Alena Hadravová, Petr Hadrava and Martin Šolc (eds.), *Tycho Brahe and Prague: Crossroads of European Science*, Frankfurt am Main: Verlag Harri Deutsch, 2002, pp. 95–101, 95.

[11] Giambattista Riccioli, *Almagestum novum astronomiam veterem novamque complectens*, Bologna: ex Typographia Haeredis Victorij Benatij, 1651, Pars prior, p. xlvi, col. b. Cf. Pars posterior, p. 74, col. b.

[12] See, among many others, Paula Findlen, 'How information travels: Jesuit networks, scientific knowledge, and the early modern Republic of Letters, 1540–1640', in Findlen (ed.), *Empires of Knowledge: Scientific Networks in the Early Modern World*, London and New York: Routledge, 2019, pp. 57–105; Antonella Romano, *Impressions de Chine: L'Europe et l'englobement du monde (XVIe–XVIIe siècle)*, Paris: Fayard, 2016; Steven J. Harris, 'Mapping Jesuit science: the role of travel in the geography of knowledge', in John W. O'Malley, Gauvin A. Bailey, Steven J. Harris and T. Frank Kennedy (eds.), *The Jesuits: Cultures, Sciences, and Arts, 1540–1773*, Toronto: University of Toronto Press, 1999, pp. 212–40.

[13] The Class on the Sphere (Aula da Esfera) provided a public course in mathematics devoted mainly to nautical science. It covered topics such as cosmography, navigation, construction and the applications of nautical and astronomical instruments. This class was established in around 1590, most likely following an order from by King Sebastião. As the course addressed nautical personnel not familiar with Latin, it was taught in Portuguese. Analysis of the context in which mathematics was taught in early modern Portugal can be found in Henrique Leitão, 'Jesuit mathematical practice in Portugal, 1540–1759', in Mordechai Feingold (ed.), *The New Science and Jesuit Science: Seventeenth Century Perspectives*, Dordrecht: Kluwer Academic Publishers, 2003, pp. 229–47.

the English John Rishton (1615–56, t. 1651–2), a Jesuit who trained in Ghent and Liège before departing for Lisbon in the late 1640s.[14]

Despite embodying different academic cultures, these Jesuits were chosen to teach in Lisbon because of their mathematical expertise. Two of them (Gall and Borri) were in transit to or from the Asian missions, whereas the remainder were apparently sent to Lisbon specifically to teach at the Class on the Sphere. This class provided a public course in mathematics devoted mainly to cosmography and was established around 1590, most likely following an order from King Sebastião.[15] Struggling to ensure a sound nautical education, an issue of key importance in a country whose income increasingly depended upon colonial revenues, King Sebastião requested that the Jesuits establish a class on cosmography at the College of Saint Anthony, an institution launched with royal support. Nevertheless, due to the lack of expert mathematicians in Portugal, the Jesuit authorities led a group of foreign experts to Lisbon.[16] As this article will demonstrate, these professors shared the same cosmological tenets and, above all, the same concerns. Even though they probably did not cross paths in the College of Saint Anthony, they were most likely aware of the scientific content of their predecessors' teaching. Cristoforo Borri, for example, in a letter sent to the General of the Jesuits, Mutio Vitelleschi, reveals that, once he landed in Lisbon, he learned that Gall, who was then the professor of astronomy in Lisbon, was already teaching the theory of celestial fluidity, which he had defended at the College of Brera in 1612.[17] From this point of view, they constituted a scholarly community.

At the College of Saint Anthony, these Jesuits of different European origins reflected on the astronomical and philosophical challenges raised by adopting Tycho Brahe. The confessional issue nevertheless remained at the forefront of all concerns. The situation was especially tense because, as those professors unanimously realized, the celestial novelties of the late sixteenth and early 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 strictly forbidden in 1616.[18] It was against this complex background that this Jesuit community devised the Tychonic system as a

[14] Biography details of these Jesuits can be found in Ugo Baldini, 'L'insegnamento della matematica nel collegio di S. Antão a Lisbona (1590–1640)', in Baldini, *Saggi sulla cultura della Compagnia di Gesù (secoli XVI–XVIII)*, Padua: CLEUP Editrice, 2000, pp. 129–67, 142–4; and Baldini, 'The teaching of mathematics in the Jesuit Colleges of Portugal, from 1640 to Pombal', in Luís Saraiva and Henrique Leitão (eds.), *The Practice of Mathematics in Portugal*, Coimbra: por ordem da Universidade, 2004, pp. 293–465, 386–7. To this list we should add the English Jesuit Thomas Barton (*c.*1615–?), who taught mathematics at the College of Saint Anthony in 1648–9. However, I was unable to examine his lecture notes (*Tractado da Sphera*), in the possession of a private owner. On Barton and his lecture notes see Luís Miguel Bernardo, 'O Tractado da Sphera de Thomas Bretono', *Mare Liberum* (2000) 18–19, pp. 179–91.

[15] As the course addressed nautical personnel, not familiar with Latin, it was taught in Portuguese. Cfr. Luís de Albuquerque, *A 'aula da esfera' do Colégio de Santo Anthony no século XVII*, Coimbra: Agrupamento de Estudos de Cartografia Antiga, 1972; Baldini, op. cit. (14); Henrique Leitão, *A Ciência na «Aula da Esfera» no Colégio de Santo Antão, 1590-1759*, Lisbon: Comissariado Geral das Comemorações do V Centenário do Nascimento de S. Francisco Xavier, 2007.

[16] Analysis of the context in which mathematics was taught in early modern Portugal can be found in Henrique Leitão, 'Jesuit mathematical practice in Portugal, 1540–1759', in Feingold, op. cit. (13), pp. 229–47.

[17] Cf. Cristoforo Borri, *Al molto Reu: Pre. Generale. Christoforo Borri sopra il libro che ho composto per stampare delli tre Cieli*, Arquivo Nacional da Torre do Tombo, Lisbon, Armário dos Jesuítas, vol. 19, fol. 315r.

[18] On the 1616 ban on Copernicus see particularly Vittorio Frajese, 'Il decreto anticopernicano del 5 marzo 1616', in Massimo Bucciantini, Michele Camerota and Franco Giudice (eds.), *Il Caso Galileo: Una rilettura storica, filosofica, teologica,* Florence: Leo. S. Olschki, 2011, pp. 75–89; Natacha Fabbri and Federica Favino (eds.), *Copernicus Banned: The Entangled Matter of the Anti-Copernican Decree of 1616*, Florence: Leo. S. Olschki, 2018. For a seminal insight into the complex reception of and reaction against Copernicus in the sixteenth and seventeenth centuries

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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 recognized that Brahe's accurate observations and precise instruments made him an astronomical *auctoritas*. Nevertheless, they seemed much more cautious as regards the cosmological ideas Tycho discussed in his works. As this paper 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 confessionalization reached well beyond the formal censorship of science. Confessionalization correspondingly shaped the very formation of early modern scientific culture.

Tycho Brahe censored

Religious censorship was not the exclusive concern of theologians and philosophers; it was also a matter for mathematicians, as one learns from the copy of Tycho Brahe's *Astronomiae instauratae progymnasmata* (1610) that belonged to the mathematics library of the College of Saint Anthony.[19] This book contains Tycho's investigations into the new star of 1572 as well as his solar theory, research on the lunar theory and a comprehensive catalogue of stars.[20] Nevertheless, it was not the scientific contents that distressed the Saint Anthony Jesuit mathematicians but rather the religion.

The Jesuit copy of Tycho's *Astronomiae instauratae progymnasmata* includes two sorts of censorship that both deal with religious issues. First and foremost, the erasures included in the typescript were intended to suppress sympathetic references to the religious beliefs of Brahe and his Lutheran and Calvinist fellows. Thus, along with favourable allusions to Luther, the names of distinguished Lutherans, such as Philip Melanchthon and his disciple, the University of Rostock professor David Chytraeus, were eliminated from the text.[21] Tycho Brahe's criticism of Catholic authors was also subject to censorship. Brahe was particularly harsh on the eschatological interpretation of Theodorus Graminaeus, a former professor of mathematics at the University of Cologne and tutor to the Dukes of Cleves, who abhorred Protestantism and became a champion of the

see Pietro Daniel Omodeo, *Copernicus in the Cultural Debates of the Renaissance: Reception, Legacy, Transformation*, Leiden and Boston, MA: Brill, 2014.

19 This subtitle is drawn from a seminal article on the Jesuit censorship of Tycho Brahe by Lerner, op. cit. (10). This copy of Tycho Brahe's *Astronomiae instauratae progymnasmata* is preserved at the Biblioteca da Ajuda, Lisbon (35-XI-7) (henceforth BA, copy 35-XI-7). The front page of the book includes an explicit reference to its former owner: 'da livraria da Mathematica de Santo Antão' ('from the mathematical library of the [College of] Saint Anthony'). Along with the expurgation of sentences, the BA copy is provided with some mathematical annotations in the same ink as that of the erasures. The style of handwriting is typical of the seventeenth century.

20 On this book's composition process see Victor E. Thoren, *The Lord of Uraniborg: A Biography of Tycho Brahe*, Cambridge: Cambridge University Press, 1990, particularly pp. 283–5, 262, 282.

21 Brahe, *Astronomiae instauratae progymnasmata*, Frankfurt: apud Godefridum Tampachium, 1610, BA, copy 35-XI-7, p. 711; Cf. Brahe, *Astronomiae instauratae progymnasmata*, in T. Brahe, *Opera Omnia* (ed. J.L.E. Dreyer), vol. 3, Libraria Gyldendaliana, 1916, p. 225. For example, while referring to Theodorus Graminaeus's interpretation of the Abbott Joachim Lichtenberg's *vaticinia*, which Tycho Brahe considered to be odiously (*odiose*) pitched against Luther, the Jesuit censor erased the word *odiose*. A negative statement was thus turned positive. Tycho Brahe, *Astronomiae instauratae progymnasmata*, BA, copy 35-XI-7, p. 776; cf. Brahe, *Astronomiae instauratae progymnasmata* in *Opera Omnia*, op. cit., p. 290.

Counter-Reformation.[22] Accordingly, Brahe's sentences criticizing the anti-Luther statements of the Catholic Graminaeus were also inked out.[23]

In some cases, this involved suppressing extensive parts of the text. This was the case, for example, with Theodore Beza's poem on the eschatological meaning of the new star of 1572. Beza was a pre-eminent figure in French Calvinism. Upon Calvin's death, the French theologian and biblical scholar became the religious leader of the Geneva Republic.[24] Brahe, who praised Beza for being 'very famous and a nobleman, not only by birth but especially by knowledge, who plainly deserve to be praised in sacred letters as well as in philosophy', established an analogy between the 1572 *nova* and the biblical Star of Bethlehem.[25] The Jesuits deemed unacceptable not only this interpretation of the new star as a token of the second advent of Christ but also the praise of Beza's theological and philosophical scholarship.[26] Accordingly, the Jesuit censor eliminated Brahe's eulogium, just cited, as well as Beza's poem (Figure 1).

Less frequent but of no less significance was the exclusion of any excerpts that seemed to jeopardize the authority of the Bible. Although Brahe did not question the authority of the Bible in the scientific domain, the Jesuit censor found a couple of sentences worthy of suppressing. Those sentences vaguely challenged the Bible's absolute authority. The criticism that Brahe elaborated on Paul Hainzel's location of the new star of 1572 represents a case in point. According to the Dane, despite recognizing that the new star was deprived of observable parallax, the German astronomer paradoxically persisted in claiming that it appeared below the Moon. From Brahe's viewpoint, this approach was typical of those scholars who, despite sound evidence that they were wrong, continue to uncritically follow the well-received authorities. Brahe established an analogy between this sort of scholar and those who argued in favour of long and well-established theories with the sole purpose of supporting the biblical account:

> For that reason, I should not be further surprised if, in matters of religion, they fight to such an extent in favour of the ancestral principles in whatever way the Holy Scripture would sufficiently and openly prevail over the enemy on certain occasions.[27]

This sentence was accordingly inked out of Brahe's text.

Tycho Brahe's *Astronomiae instauratae progymnasmata* was not included in the Portuguese *Index auctorum damnatae memoriae*, nor did it feature in the *Index librorum prohibitorum* published in Rome.[28] Why, then, did the Saint Anthony Jesuits decide to censure the book? In fact, this stemmed from a broader censure process initiated in Rome. In 1620, Brahe's book was subject to the Roman Congregation of the Holy Office. The names of the 'heretic' astronomers were identified along with the proposal to suppress the praises

[22] On Theodorus Graminaeus see particularly Rienk Vermij, 'Theodorus Graminaeus: Een wiskundige in dienst van de contrareformatie', *Studium* (2010) 1, pp. 1–17.

[23] *Astronomiae instauratae progymnasmata*, BA, copy 35-XI-7, op. cit. (21), p. 777; Cfr. Brahe, *Astronomiae instauratae progymnasmata* in *Opera Omnia*, op. cit. (21), p. 291.

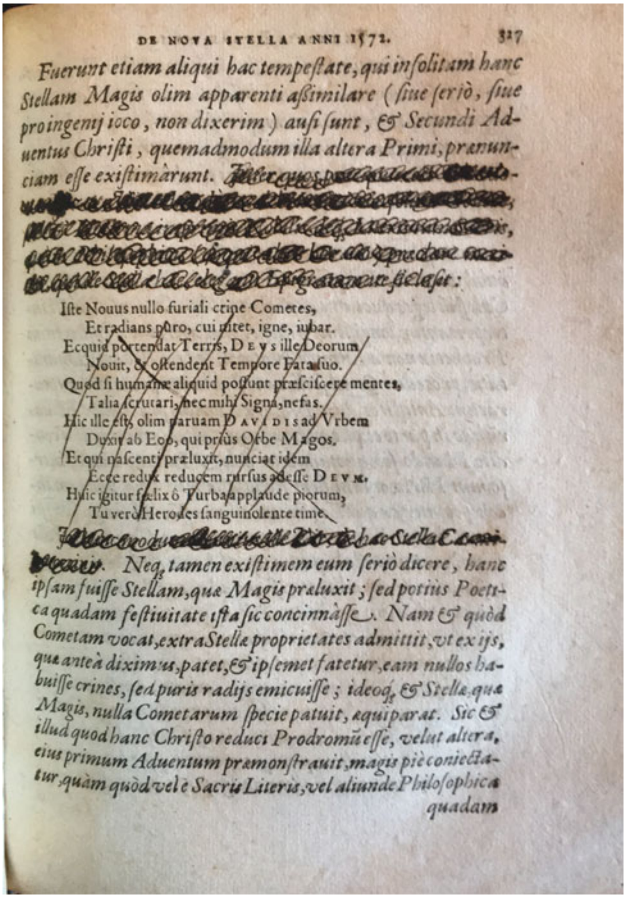
[24] *Encyclopaedia Britannica*, 11th edn., Cambridge: Cambridge University Press, 1910, vol. 3, pp. 839–40; Diarmaid MacCulloch, *The Reformation: A History*, New York: Viking, 2004, pp. 236, 244, 298, 303, 599–600.

[25] Brahe, *Astronomiae instauratae progymnasmata* in *Opera Omnia*, op. cit. (21), vol. 2, 1915, p. 325.

[26] Brahe, *Astronomiae instauratae progymnasmata*, BA, copy 35-XI-7, op. cit. (21), p. 327.

[27] Brahe, *Astronomiae instauratae progymnasmata*, BA, copy 35-XI-7, op. cit. (21), p. 542; Brahe, *Astronomiae instauratae progymnasmata* in *Opera Omnia*, op. cit. (21), vol. 3, p. 56.

[28] Lerner, op. cit. (10), p. 96. See, for example the celebrated *Index auctorum damnatae memoriae*, Lisbon: Pedro Craesbeeck, 1624.


DE NOVA STELLA ANNI 1572. 327

Fuerunt etiam aliqui hac tempestate, qui insolitam hanc Stellam Magis olim apparenti assimilare (siue seriò, siue pro ingenij ioco, non dixerim) ausi sunt, & Secundi Aduentus Christi, quemadmodum illa altera Primi, prænunciam esse existimàrunt. [redacted]:

Iste Nouus nullo furiali crine Cometes,
Et radians puro, cui nitet, igne, iubar.
Ecquid portendat Terris, DEVS ille Deorum
Nouit, & ostendent Tempore Fata suo.
Quod si humanæ aliquid possunt præsciscere mentes,
Talia scrutari, nec mihi Signa, nefas.
Hic ille est, olim paruam DAVIDIS ad Vrbem
Duxit ab Eoo, qui priùs Orbe Magos.
Et qui nascenti præluxit, nunciat idem
Ecce redux reducem rursus adesse DEVM.
Huic igitur fœlix ô Turba applaude piorum,
Tu verò Herodes sanguinolente time.

[redacted]. *Neque tamen existimem eum seriò dicere, hanc ipsam fuisse Stellam, quæ Magis præluxit; sed potius Poetica quadam festiuitate ista sic concinnàsse. Nam & quòd Cometam vocat, extra Stellæ proprietates admittit, vt ex ijs, quæ anteà diximus, patet, & ipsemet fatetur, eam nullos habuisse crines, sed puris radijs emicuisse; ideoque & Stellæ quæ Magis, nulla Cometarum specie patuit, æquiparat. Sic & illud quod hanc Christo reduci Prodromũ esse, velut altera, eius primum Aduentum præmonstrauit, magis piè coniectatur, quàm quòd vel è Sacris Literis, vel aliunde Philosophica quadam*

Figure 1. Brahe's quotation of Theodore Beza censured. Brahe, *Astronomiae instauratae progymnasmata*, Biblioteca da Ajuda, 35-XI-7, p. 327.

addressed to them.[29] Nevertheless, Robert Bellarmine, who participated in this process as a member both of the Congregations of Inquisition and of the Index, put forward a quite surprising censure.[30] Although recognizing that Tycho was most likely a 'heretic' – as he praised Luther, Melanchthon, Beza and Chytraeus – Bellarmine nevertheless suggested that he might have converted to Catholicism at some point – as his children dedicated the book to the Catholic Emperor Rudolph.[31] Once again, Tycho's religious beliefs were at stake! Although Brahe's book was never listed in the indexes of forbidden books, this censorship most likely circulated throughout the 'Jesuit *milieux*'.[32]

[29] On this process see particularly Lerner, op. cit. (10). See also Massimo Bucciantini, *Galileo e Keplero: Filosofia, cosmologia e teologia nell'Età della Controriforma*, Turin: Giulio Einaudi Editore, 2003, pp. 91–2; Stefania Tutino, *Empire of Soul: Robert Bellarmine and the Christian Commonwealth*, Oxford: Oxford University Press, 2010, pp. 279–80.

[30] I am grateful to Ivana Gambaro for drawing my attention to Roberto Bellarmine's role in the Brahe censorship process.

[31] In Peter Godman, *The Saint as Censor: Robert Bellarmine between Inquisition and Index*, Leiden, London and Cologne: Brill, 2000, p. 307, also 221–2.

[32] Lerner, op. cit. (10), p. 97. With the exception of Spain, where Brahe's *Progymnasmata* was extensively examined and included in the Spanish indexes of prohibited books. Lerner, op. cit. (10), pp. 97–8. On the Spanish Inquisitorial censorship of scientific books see José Pardo Tomás, *Ciencia y Censura: La Inquisición Española y los libros científicos en los siglos XVI y XVII*, Madrid: Consejo Superior de Investigaciones Científicas, 1991. After

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In the very year of Bellarmine's statement, Biancani's *Sphaera Mundi* was published following a distressing process of internal censorship.[33] As already mentioned, the publication of Biancani's book effectively marks the official approval of the Tychonic system by the Jesuit authorities. Michel-Pierre Lerner has pointed out the correlation between these two events: the publication of Biancani's *Sphaera Mundi*, 'from which was carefully eliminated any praise of Brahe or of other Protestant writers', and the censorship of Brahe's *Astronomiae instauratae progymnasmata*.[34] Should this be the case, the censure of the *Progymnasmata* constitutes one of the first steps in the long and complex process of integrating Tycho Brahe into the framework of the Jesuit authorities.[35]

The celestial novelties

The Jesuit adhesion to the astronomical ideas of Tycho Brahe was precipitated by a couple of historical events that occurred in the 1610s. In the three last decades of the sixteenth century, observations of a series of new stars and comets in the celestial region had already challenged the community of philosophers and astronomers. Although some of the most expert astronomers – with Tycho Brahe foremost among them – promptly recognized the celestial location and nature of such phenomena, an extensive group of distinguished intellectuals, which included several Jesuits, chose to accommodate them within the traditional cosmological framework – the path taken, for example, by the celebrated Jesuit Conimbricenses. In their influential commentaries on Aristotle's natural philosophy, the professors of the College of Arts of the University of Coimbra argued that the *nova* of 1572 was created by God, not by natural means but by *supernaturali generatione*.[36] As regards the comets, they stated simply that 'having measured the Moon's altitude using astronomical instruments, the mathematicians realize that the comets are below the Moon'.[37]

However, the telescopic observations of Galileo raised further objections to the Aristotelian–Ptolemaic cosmology. The Jesuit mathematics professors of the College of Saint Anthony were particularly well informed about the observations carried out by the Paduan professor in around 1610–11. A few years later, in 1615, Giovanni Paolo Lembo landed in Lisbon, where he would teach mathematics for a couple of years. However, before moving to Portugal, he had been a member of Christoph Clavius's inner group at the Collegio Romano. He was not only the first Jesuit to attempt to produce a telescope at the Roman college but also one of the *Clavisti* who had first observed the

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submitting this paper, I came across Luís Tirapicos, 'On the censorship of Tycho Brahe's books in Iberia', *Annals of Science* (2020), 77, pp. 96–107.

33 Prior to that, the Jesuit censor of Biancani's *Aristotelis loca mathematica* (Bologna, 1615) had already raised the question of Brahe's religious beliefs. In his report elaborated in the Collegio Romano, Giovanni Camerota complained that Biancani praised Tycho Brahe and other astronomers who were either 'heretic' or 'strongly suspected'. Camerota's censorship is included in Ugo Baldini, *Legem impone subactis: Studi su filosofia e scienza dei Gesuiti in Italia, 1540–1632,* Rome: Bulzoni Editore, 1992, pp. 229–31, 230-1: '… Constat enim aut hos omnes, aut ex his plerosque, atque adeo ipsum Tichonem, quem tanti facit, aut haereticos fuisse, aut valde suspectos.'

34 Lerner, op. cit. (10), p. 100. Godman, op. cit. (31), p. 221, also pointed to this 'coincidence'.

35 The Lisbon Jesuit copy of *Astronomiae instauratae progymnasmata* was censored according to the Roman guidelines, a fact that proves – as Lerner has suggested – that Tycho's censorship spread informally along the Jesuit information network.

36 *Commentarii Collegii Conimbricensis Societatis Iesu in quatuor libros De Coelo Aristotelis Stagiritae*, Lisbon: ex officina Simonis Lopesij, 1593, p. 62.

37 *Commentarii Collegii Conimbricensis Societatis Iesu In libros Meteororum Aristotelis Stagiritae*, Lisbon: ex officina Simonis Lopesij, 1593, p. 28.

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celestial novelties revealed by Galileo.[38] Thus, upon Bellarmine's request to verify the physical reality of these appearances, Lembo signed the 1611 letter of response, alongside Clavius, Christoph Grienberger and Odon von Maelcote, wherein they recognized that telescopic observations revealed that there were a great number of stars in the nebulas of Cancer and Pleiades, that Saturn was not round like Jupiter and Mars, that Venus did wax and wane, that the Moon's surface did appear uneven, and, finally, that there were four stars moving quickly and in almost a straight line around Jupiter.[39]

In Lisbon, Lembo introduced his students to some of these Roman observations. The Italian professor described how, for example, on the night of 17 January 1611, he had carried out astronomical observations of Venus under such favourable conditions that this planet seen through the telescope appeared quite similar to the Moon viewed with the naked eye. Thus, he reported, 'the masters of theology, philosophy and mathematics of the Collegio Romano, who were almost all there, did ingenuously confess to seeing two Moons'.[40] Lembo also repeated some of Roman observations in the College of Saint Anthony. There, for example, he 'showed [the phases of Venus] not only to my students [*ouvintes*], but also to several other *virtuosi* [*pessoas curiosas*]'.[41]

The celestial novelties were also a topic very dear to the professor who followed Lembo in teaching mathematics in Lisbon, the German Johann Chrysostomus Gall.[42] Just like his Italian confrère, Gall also had first-hand experience of astronomical observation. As he mentioned in his Lisbon lecture notes, while a student of theology and collaborator of Johannes Baptista Cysat at the University of Ingolstadt, he observed one of the comets that appeared in 1618. Similarly to his master, Cysat, Gall concluded that the comet clearly moved in the celestial region.[43] The groundbreaking character of the celestial novelties of the late sixteenth century and the early seventeenth was continuously corroborated by the subsequent mathematics professors of the College of Saint Anthony.[44]

On the whole, they were plainly aware that these new celestial phenomena required abandoning the traditional Ptolemaic planetary system. As Clavius, Lembo's professor at the Collegio Romano, remarked in the final edition of his *Sphaera*, in a striking reference to Galileo's discoveries – the Moon's uneven surface, Venus's phases, the four satellites of Jupiter and the apparent three-bodied Saturn – 'as this is so, astronomers ought to see how the celestial orbs may be arranged in order to save the phenomena'.[45]

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[38] Lattis, op. cit. (6), pp. 181–95; Eileen Reeves and Albert van Helden, 'Verifying Galileo's discoveries: telescope-making at the Collegio Romano', in Jürgen Hamel and Inge Keil (eds.), *Der Meister und die Fernrohre: Das Wechselspiel zwischen Astronomie und Optik in der Geschichte*, Frankfurt am Main: H. Deutsch, 2007, 127–41; Massimo Bucciantini, Michele Camerota and Franco Giudice, *Galileo's Telescope: A European Story* (trans. Catherine Bolton), Cambridge, MA and London: Harvard University Press, 2015, 205-11.

[39] Galileo Galilei, *Le Opere di Galileo Galilei*, vol. 11, Florence: Tipografia di G. Barbèra, 1901, pp. 92–3.

[40] Giovanni Paolo Lembo, *Tratado da Esfera*, Arquivo Nacional da Torre do Tombo, Lisbon, Manuscrito da Livraria 1770, fol. 33v.

[41] Lembo, op. cit. (40), fol. 33v.

[42] Johann Chrysostomus Gall, *In Sphaeram Ioanis De Sacrobosco Commentarius … Ulisipone, ano Domini 1621*, Biblioteca Geral da Universidade de Coimbra, Ms. 192, fols. 17–18v, 36r–36v, 43r, 49v; Gall, *Tratado sobre a e[s]phera material, celeste e natural … em Lisboa no anno de 1625*, Biblioteca Nacional de Portugal, COD. 1869, fols. 81r–86r.

[43] Gall, *In Sphaeram*, op. cit. (42), fol. 17v.

[44] Cristoforo Borri, who followed Gall as professor of mathematics at Saint Anthony, for example, informed his Lisbon students that he observed the comet of 1618 'in the kingdom of Amam, which the Portuguese call Cochinchina'. Cristoforo Borri, *Nova Astronomia*, 1628, Biblioteca Geral da Universidade de Coimbra, Ms. 44, fol. 94v. Among all the professors of the Lisbon Jesuit college, Borri was the one who discussed the celestial novelties at greater length.

[45] Christoph Clavius, *Commentarius in sphaeram Ioannis de Sacro Bosco*, in Clavius, *Opera mathematica*, Mainz, Sumptibus Antonii Hierat excudebat Reinhardus Eltz, 1611, vol. 3, p. 75: 'Quae cum ita sint, videant Astronomi, quo pacto orbes coelestes constituendi sint, ut haec phaenomena possint salvari'.

The Jesuit rejection of Copernicanism

The College of Saint Anthony mathematics professors obviously knew that the heliocentric model put forward by Copernicus was not the sort of solution Clavius had in mind. In his *Commentarius de Sphaera Ioannis de Sacrobosco*, Clavius presented a somewhat concise refutation of Copernicus based on astronomical, physical and biblical arguments, which would become quite influential among Jesuit mathematicians.[46] In addition, in March 1616, the cardinals belonging to the Congregation of the Index, among whom Bellarmine was a leading character, deemed heliocentrism false and contrary to the Bible. Copernicanism was, henceforth, considered a quasi-heretical theory.

As such, it nevertheless remained an issue for teaching and criticism in Jesuit colleges and universities.[47] Just like their confrères in Rome and throughout Europe, the professors of Saint Anthony also delved into the Copernican theory.[48] While Lembo set out the Copernican planetary system but refrained from discussing its cosmological consequences in detail, his successor in the mathematics chair at Lisbon, Johann Chrysostomus Gall, however, did not avoid discussing the topic in greater detail.[49] He approached it first when introducing his students to the main planetary rearrangement hypotheses as well as subsequently when making his point in favour of geocentrism and geostaticism.[50]

Gall, who taught in Lisbon from 1620 until 1627, when he departed for Goa, India, presented the standard criticism of Copernicanism. Like Clavius before him, his disapproval of heliocentrism relied upon three sorts of argument. In the realm of mathematical astronomy, Gall pointed out that the heliocentric planetary rearrangement would require the apparent position of the fixed stars to shift over the course of a year (the so-called parallax argument) – which was not the case, Gall argued – and/or alternatively the region between Saturn and the fixed stars to be much more extensive than astronomers had traditionally conceived – which clashed with the authority of Brahe and Christoph Scheiner.[51] Additionally, the German Jesuit enumerated the typical set of physical evidences that he maintained contradicted the notion of terrestrial motion, namely the fact that a small rock, when thrown directly upwards, falls back in exactly the same place and not at some distance eastwards; were the Earth to be moving very fast in an eastwards direction, neither would a bird flying eastwards ever reach its destination, nor would it fly at the same speed in both eastern and western directions.[52] The Copernican theory also violated the basic cornerstone of Aristotelian physics; that is to

[46] On the Clavius critique of Copernicus see particularly Lattis, op. cit. (6), pp. 106–44. See also Volker R. Remmert, who has argued that the rebuttal of Copernicanism within the Society of Jesus was due not only to the theologians but also to the mathematicians, and particularly to Clavius, who played a key role in building up a consensus to reject Copernicanism in the late sixteenth and early seventeenth centuries. V.R. Remmert, '"Our mathematicians have learned and verified this": Jesuits, biblical exegesis, and the mathematical sciences in the late sixteenth and early seventeenth centuries', in Jitse M. van der Meer and Scott Mandelbrote (eds.), *Nature and Scripture in the Abrahamic Religions*, vol. 2: *Scripture and the Rise of Modern Science (1200–1700)*, Leiden: Brill, 2008, pp. 665–90.

[47] Renée J. Raphael has convincingly argued that the need to refute Copernicanism led the Jesuits to teach it rather than simply suppress it. Renée J. Raphael, 'Copernicanism in the classroom: Jesuit natural philosophy and mathematics after 1633', *Journal for the History of Astronomy* (2015) 46, pp. 419–40.

[48] On the Jesuit teaching of Copernicanism see particularly Raphael, op. cit. (47).

[49] Lembo, op. cit. (40), fol. 24v, included a drawing of the heliocentric system.

[50] The Portuguese public libraries and archives preserved two copies of Gall's lecture notes, respectively at the Biblioteca Geral da Universidade de Coimbra and Biblioteca Nacional de Portugal (47). Copernicanism is discussed in Gall, *In Sphaeram*, op. cit. (42), fols. 14r–14v, 56r–58v; Gall, *Tratado*, op. cit. (42), fols. 43r–45v, 64v–65.

[51] Gall, *Tratado*, op. cit. (42), fols. 43v–44v.

[52] Gall, *In Sphaeram*, op. cit. (42), fols. 56v–57v, Gall, *Tratado*, op. cit. (42), fols. 44v–45r.

say, a simple body cannot move with more than one simple motion – thus the Earth could not be provided with the three motions attributed to it by Copernicus.[53]

Finally, Copernicus's heliocentric theory conflicted with the many biblical passages that state the Earth stands still at the centre of the universe. Gall invokes some of the usual passages deployed in this debate: Psalm 103:5 and Ecclesiastics 1:5.[54] In this context, the Jesuit adds a subtle reference to the Protestant Copernicans (whom he did not name), who recommended 'understanding these passages in a non-literal sense'.[55] Approximately two decades later, the Irish Jesuit Simon Fallon would address the point more directly in his criticism of the recourse to the theory of accommodation by Copernican astronomers:

> Neither is it worth what Kepler and others answer by claiming that the Scripture speaks, in those passages, in the common and ordinary sense of men, nor is it worth the fact that this hypothesis has pleased, in the past, some learned men in the Scripture, nor the fact that the same Copernicus dedicated this work to [Pope] Paul III, as one can conclude from the Prolegomena to this book, because as regards the interpretation of the Holy Scripture, there is a very well-received rule that advises not to deviate from the real meaning of the words when the proper sense of their meaning can be verified. It should also be added that there is already a statement produced by the Cardinals against this opinion as well as the fact that this book is prohibited by the Index until amended.[56]

Fallon here epitomizes the essential attitude that Jesuit intellectuals were required to adopt in the Copernican dispute: to interpret biblical passages in the literal sense.[57] As this article will demonstrate in its final section, this literalist approach conditioned the Jesuit cosmological discussion and correspondingly their own ongoing relationship with Tycho Brahe's heliocentric system. Furthermore, the Irish Jesuit recalls the critical events of 1616 deriving from the Galileo affair, specifically the statement produced by the cardinals of the Congregation of the Index which banned Copernicanism, condemned Foscarini's book and censured Copernicus's *De Revolutionibus* and similar books. The authority of the Bible and the Church thus emerged as undisputable in cosmological matters.[58]

The virtues of the Tychonic 'astronomical compromise'

Nevertheless, any return to Ptolemy's planetary system traditionally endorsed by the sixteenth-century scholars was out of the question. The Jesuit mathematics professors of the College of Saint Anthony would have been familiar with Clavius's plea to come up with a new planetary rearrangement that might account for the celestial novelties of the 1610s. These celestial phenomena – Gall emphasizes – led Clavius himself to

[53] Gall, *Tratado*, op. cit. (42), fol. 43v.

[54] Gall, *In Sphaeram*, op. cit. (42), fol. 58r.

[55] Gall, *In Sphaeram*, op. cit. (42), fol 14v: 'ainda que seos defensores, sem necesidade, pretendam auerse de tomar estes lugares no sentido menos proprio'.

[56] Simon Fallon, *Compendio Spiculativo das Spheras Arteficial, Soblunar e Celeste …* 1639, Biblioteca Nacional de Portugal, COD. 2258, fol. 97v.

[57] On the Jesuit bond to biblical literalism see in particular Irving A. Kelter, 'The refusal to accommodate: Jesuit exegetes and the Copernican system', in Ernan McMullin (ed.), *The Church and Galileo*, Notre Dame: University of Notre Dame Press, 2005, pp. 38–53. See also Richard J. Blackwell, *Galileo, Bellarmine, and the Bible*, Notre Dame and London: University of Notre Dame Press, 1991.

[58] Therefore Gall was willing to affirm that 'if its author [Copernicus] lived today, he would not support those things because he was a good Christian and dedicated [the book] to the Pope Paul III'. Gall, *Tratado*, op. cit. (42), fol. 64v.

abandon the conventional Ptolemaic world system of ten or eleven solid heavens that he had endorsed almost his entire life: 'in this way [Gall refers to Clavius's plea], our Clavius utterly shows how his system is not sufficient [to save the phenomena]'.[59]

Giovanni Paolo Lembo was the first professor at Saint Anthony to face this challenge. Having trained in Clavius's inner circle, he is likely to have been aware of the solution Clavius had in mind in the aftermath of these astronomical observations. In fact, he set forth a planetary solution that came to terms with the Galilean novelties while simultaneously retaining intact the foundations of Clavius's astronomical and cosmological ideas. His solution consisted of a geo-heliocentric system of Capellan inspiration, in which Mercury and Venus orbited the Sun while the Sun, together with the superior planets, revolved around the Earth.[60]

However, following Lembo's mathematics teaching, the Jesuits active in the College of Saint Anthony soon adhered to the geo-heliocentric model put forward by Tycho Brahe, in spite of the fact that he was a Lutheran. In fact, in the early 1620s, Gall included a description of the Tychonic system in his lecture notes, wherein the Earth stands still in the centre of the universe, and around it move the Sun, the Moon, and the fixed stars, with the planets revolving around the Sun (Figure 2). From that moment onwards, Tycho became the astronomical authority in matters of planetary theory in the College of Saint Anthony.

Kenneth J. Howell has argued that conceiving of the Tychonic system as a compromise between 'an ancient Ptolemy and a modern Copernicus' does not account for Tycho's own view.[61] The same further applies to the very few Jesuits who decided in favour of the Tychonic system prior to the 1616 condemnation of heliocentrism and the official 1620 acceptance of Tycho Brahe by the Jesuit authorities. This was, for example, the case of Cristoforo Borri, who advocated the Tychonic system based on what he regarded as its intrinsic astronomical value while teaching at the Brera College, Milan, in the early 1610s.[62]

Unlike these cases, the Jesuit astronomers (or the majority) who moved to the Tychonic solution after the Galilean affair of 1616 nevertheless seem to have regarded Tycho Brahe's system as a 'compromise' between the astronomical requirements imposed by the Galilean observations and the need to avoid the physical and biblical 'inconveniences' of Copernicanism.[63] In this context, Gall stressed how Tychonic geo-heliocentrism permitted the incorporation of the astronomical achievements of the Copernican system without having to accept the idea of a Sun-centred universe:

> This opinion [the Tychonic system] is greatly supported by the system of Copernicus who, apart from the movement of the Earth and the stability of the Sun and the firmament, because of his persistence and diligent observations, deserved to be

[59] Gall, *In Sphaeram*, op. cit. (42), fol. 14r: 'Assi o nosso Clauio no qual asás mostra que o seu sistema não he bastante'. As far as Clavius's plea is concerned see note 46 above.

[60] Lembo, op. cit. (40), fol. 36v. On Lembo's cosmology and the way it accounts for both Clavius's cosmological tenets and the Galilean astronomical observations see Luís Miguel Carolino, 'Between Galileo's celestial novelties and Clavius's astronomical legacy: the cosmology of the Jesuit Giovanni Paolo Lembo (1615)', *Galilaeana: Studies in Renaissance and Early Modern Science* (2020) 17, pp. 193–217. Other astronomers, who were working on the transformation of the Copernican system into geostatic models, came out with a similar solution. Paul Wittich is a case in point. See Owen Gingerich and Robert S. Westman, *The Wittich Connection: Conflict and Priority in Late Sixteenth-Century Cosmology*, Philadelphia: The American Philosophical Society, 1988.

[61] Kenneth J. Howell, 'The role of biblical interpretation in the cosmology of Tycho Brahe', *Studies in History and Philosophy of Science* (1998) 19, pp. 515–37, 516.

[62] Carolino, op. cit. (5).

[63] This point was already made by, among others, Schofield, op. cit. (6), p. 227.

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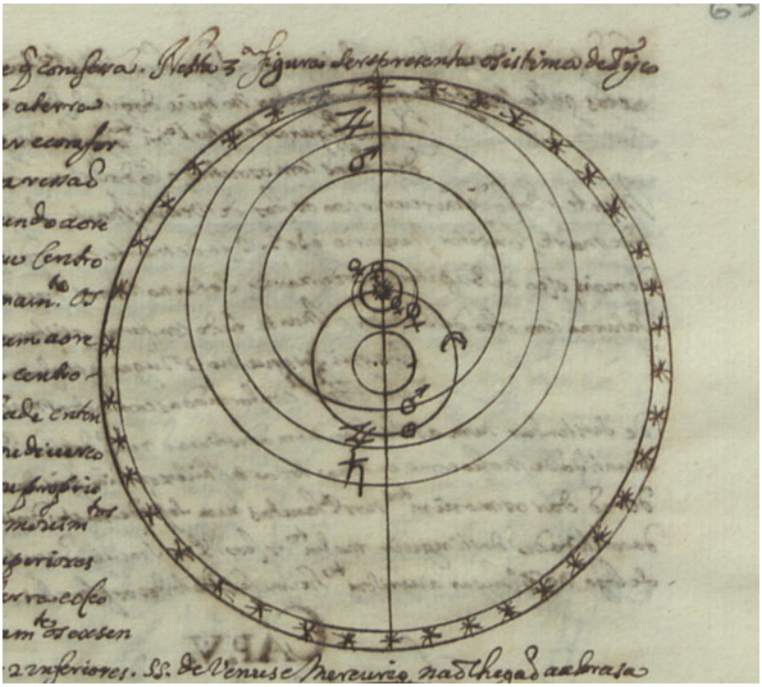

Figure 2. Tycho Brahe's planetary system according to Johann Chrysostomus Gall, *Tratado sobre a e[s]phera material, celeste e natural … em Lisboa no anno de 1625*, Biblioteca Nacional de Portugal, COD. 1869, fol. 65r.

> praised by our Clavius, who called him *alterum Ptholomeum e[t] restitutorem astronomiae egrerium*.[64]

From this point of view, the Tychonic compromise solution, as with the Copernican system, accounted for the entirety of the celestial novelties revealed by the telescope while simultaneously preserving the central assumption of Ptolemaic cosmology – the Earth's centrality.[65]

Given that this was the case, Gall extended to Brahe the sort of encomiums Clavius had previously addressed to Copernicus: Brahe was the 'Ptolemy of this age' (*Tolomeo destes tempos*)![66] Yet the Tychonic system also raised some delicate cosmological issues even though they were not as pressing as those put forward by that of Copernicus. Tycho's system deeply challenged, for example, the notion of celestial solidity that structured the Aristotelian–Ptolemaic world view. Furthermore, the proponent was a Lutheran astronomer, a fact that distressed the Jesuits around 1620. Gall was acquainted with these challenges as he recognized, for example, that for those who advocated the Tychonic system, 'neither the [celestial] solidity nor the real destruction of the celestial orbs [*céus*] can be sustained'.[67]

The German Jesuit, while teaching in Lisbon, circumvented this challenge in a somewhat conventional way. He sidestepped the cosmological upshots originating from

[64] Gall, *In Sphaeram*, op. cit. (42), fol. 17r.

[65] Gall, *In Sphaeram*, op. cit. (42), fol. 17r–18r. Gall mentioned Venus's phases, the four satellites of Jupiter, the apparent three-bodied Saturn, comets and sunspots.

[66] Gall, *Tratado*, op. cit. (42), fol. 86v.

[67] Gall, *Tratado*, op. cit. (42), fol. 65v.

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Tychonic geo-heliocentrism by circumscribing Tycho's contributions to the realm of mathematics. A similar approach to Tychonism had already been undertaken by his astronomy professor at the University of Ingolstadt, Johannes Baptista Cysat.[68] Thus Gall took Tycho as the ultimate authority on a whole gamut of topics concerning astronomical observations and measurements. Computations regarding the celestial location of new stars (1572) and comets (1577), the number of fixed stars or the likely dimensions of the universe and its constituents were all the domain of Tycho Brahe.[69] The accuracy of his astronomical instruments and the precision of his computations made him the definite authority one should follow in mathematical astronomy: 'I do not intend to determine anything in these matters even if, in what concerns the calculation or astronomical computation, I follow only Tycho Brahe as astronomers very rightly do nowadays.'[70]

However, despite taking Tycho as the astronomical authority, Gall never integrated any of his ideas about physics or the cosmological foundations of his planetary system into his Lisbon lectures. According to Gall, Tycho Brahe was a mathematician rather than a natural philosopher. In fact, Gall himself refrains from drawing any cosmological consequences from the astronomical theories he endorsed. For example, while discussing the number and division of the celestial region, Gall alluded to the authors who argued, based on observations of the comets, that there was only one heaven from the Moon concave to the Empyrean heaven. Nevertheless, he immediately added, 'it is not right for me to decide on these questions'.[71]

By integrating Tycho Brahe, the Lutheran astronomer, into the realm of the Jesuit astronomical authorities, while simultaneously rejecting his cosmological views, Johann C. Gall, like other leading Jesuit mathematicians of his time, such as Cysat, reinforced the traditional distinction between mathematics and natural philosophy. In a time when astronomers were increasingly delving into the study of the physical causes of planetary motion, Gall continued to argue that 'that question belongs more to the natural philosopher than to the astronomer because the philosopher considers the cause of the natural motions and the astronomer mainly their quantity and proportion'.[72]

Tycho Brahe Catholicized

In 1627, Gall taught his last mathematical course at the College of Saint Anthony. A couple of years later, he departed for India, where he would eventually die as a missionary. In Lisbon, Gall was replaced by a mathematician who, in turn, came back to Europe after a decade's experience as a missionary, astronomer and occasionally soldier in the Far East: the above-mentioned Cristoforo Borri. Borri was to a certain extent the right man to fill the position left vacant by Gall's imminent departure for Asia. Borri had been an engaged supporter of Tycho Brahe's theories ever since he was appointed professor of mathematics in Brera College back in 1611/12. Additionally, he had just finished writing his cosmological masterpiece, the *Collecta astronomica ex doctrina* (Lisbon, 1631), a book upon which he would rely heavily in his mathematical lessons in Lisbon in 1627/8. Still furthermore, Borri believed that it was possible for a Catholic astronomer to avail himself

[68] Cysat, op. cit. (7), p. 57, presents a detailed discussion of the 1618 comet that he located in the celestial region and which ran counter to a Tychonic world system; nevertheless, he did not discuss either the Tychonic system or Brahe's cosmological ideas. On Cysat's contribution to the Tychonic technical astronomy see H. Siebert, *Die große kosmologische Kontroverse: Rekonstruktionsversuche anhand des Itinerarium exstaticum von Athanasius Kircher SJ (1602–1680)*, Stuttgart: Franz Steiner Verlag, 2006, pp. 316–25.

[69] For example, Gall, *In Sphaeram*, op. cit. (42), fols. 17v, 38v; Gall, *Tratado*, op. cit. (42), fols. 70r–70v, 86v.

[70] Gall, *Tratado*, op. cit. (42), fol. 92r.

[71] Gall, *In Sphaeram*, op. cit. (42), fol. 7v: 'A mim me não esta bem meterme em desedir estas opinioins'.

[72] Gall, *Tratado*, op. cit. (42), fol. 69.

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of some of the key cosmological ideas produced in Tycho's Protestant milieu. In so doing, Borri simply merged the mathematical and natural-philosophical approaches to the study of the cosmos in order to supply a picture entirely consistent with the Catholic orthodoxy.

Like the large majority of his Jesuit fellows, Borri was a keen advocate of biblical literalism. The Bible was to be understood literally whenever its proper meaning could be corroborated. In interpreting the biblical text, the consensus of theologians, and particularly that of the Church Fathers, was an additional principle of authority. Thus Borri vigorously refuted the theory of accommodation put forward by 'Kepler and others',

> Because that interpretation of the Holy Scripture is so far from exposing the [proper] sense that it rather adulterates it, nor indeed an opportunity to ascribe a particular meaning to the Scripture is offered, without any one necessity, when men's common opinion bears otherwise and the Scripture exposes itself *ad literam* without displeasing anyone.[73]

In advocating such an understanding of the biblical text, Borri was strictly aligned with the Catholic Church's guidelines reinforced by the Council of Trent. In fact, the text just cited echoed the celebrated decision taken at Trent's Fourth Session, held on 8 April 1546, which prohibited 'distorting the Holy Scriptures in accordance with his own conceptions' and reserved the monopoly of determining the meaning of the Scripture to the Church, in keeping with the 'unanimous teaching of the Fathers'.[74]

In his effort to build a cosmological edifice based upon foundations other than the Aristotelian principles, Borri turned to the 'unanimous teaching of the Fathers'. The early Church fathers had endorsed cosmological theories that, in some cases, differed radically from those of the Aristotelian tradition that became hegemonic throughout Western Europe in the late twelfth and the thirteenth centuries. Borri explicitly quoted them while discussing critical issues such as, for example, the elemental nature of celestial matter, its fluidity or the tripartite division of the cosmos. Borri emphasized that neither were these notions new, nor did they collide with the Bible's common interpretation. Furthermore, they were sanctioned by the early Fathers. Thus the theory according to which the planetary heaven is a fluid and tenuous body was proved 'ab authoritate Sanctorum Patrum', namely by Saint Augustine, Basile and Chrysostom.[75] This fluidity was due to the fact that, according to the Bible's interpretation of Chrysostom and Beda, the planetary heaven was made up of an airy element. For example, Borri claimed, 'Beda, in the first chapter of Genesis, [states that] the golden ether is divided into the heavens of which these are the names: air, ether [*aether*], Olympus, the region of fire, the firmament'.[76] The early Fathers' biblical exegesis on Genesis also corroborated, according to the Italian Jesuit, the tripartite division of the cosmos into the *caelum aereum*, the *caelum sidereum*, and the *caelum empyreum*.[77]

Edward Grant has suggested that the diffusion of the Church Fathers' Hexameron literature in sixteenth- and seventeenth-century Europe paved the way for an increasing

[73] Cristoforo Borri, *Collecta Astronomica ex Doctrina*, Lisbon: Matias Rodrigues, 1631, p. 44.

[74] *The Canons and Decrees of the Council of Trent* (trans. Reverend H.J. Schroeder), Charlotte, NC: TAN Books, 2011, pp. 18–19. On the impact that the Church's principle of authority and tradition in interpreting the Bible had on science see particularly Blackwell, op. cit. (57).

[75] Borri, op. cit. (73), pp. 233–5.

[76] Borri, op. cit. (73), p. 263. Borri refers to the following excerpt of Beda Venerabilis's *In Pentateuchum Comentarii*, Patrologia Latina 91, col. 192B: 'Coelum hic proprie dicuntur, quia multi sunt, ut, Scinditur auricolor coeli septemplicis aether, quorum haec sunt nomina, aer, aether, olympus, spatium igneum, firmamentum, coelum angelorum, et coelum Trinitatis'.

[77] Borri, op. cit. (73), pp. 263–71.

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acceptance of the idea that the celestial region was made up of one or more terrestrial elements.[78] Obviously, Jesuits became acquainted with those commentaries on Genesis in the course of their philosophical and especially their theological studies.[79] Additionally, the notion of the tripartite division of the heavens and the possibility of their elemental nature was a widely held conception among Jesuit theologians concerned with biblical exegesis, such as Luis de Molina and Robert Bellarmine, for example.[80]

Nevertheless, the source of inspiration for those Jesuit mathematicians striving to provide the geo-heliocentic planetary system with a new cosmological foundation dated to much closer in time. Alongside other likely sources, such as the Stoic-inspired ideas of Jean Pena, Borri was most likely influenced by Tycho Brahe and particularly by his correspondent Christoph Rothmann.[81] Tycho and Rothmann exchanged an important correspondence that was later published by Tycho under the title *Epistolarum astronomicarum libri* (Uraniborg, 1596).[82]

The notion of celestial matter, a critical issue for those advocating the Tychonic system, provides a case in point. According to Borri, and his followers in the mathematical chair at the College of Saint Anthony, the sidereal heaven was made of an airy substance called *aura aetherea*: 'the heaven of all the planets is no more than only one, and it is pure and tenuous like the air; therefore, it shall be called ether [*aether*] or *aura aetherea*'.[83] Although it was substantially the same element as the common air, this 'celestial' air was named differently because it was in a pristine state and not mixed up with terrestrial exhalations.[84] Some decades earlier, while discussing the celestial matter with Brahe, Rothmann had already made this point. He wrote to the Danish astronomer,

> as you know, I hold that the space between the Earth and the sphere of the fixed stars is composed of nothing but the air surrounding the seven planets … Following the teachings of nature itself, I separate this air into the thicker one more exposed to the terrestrial exhalations and the pure one, which is not tainted by these exhalations.[85]

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78 Edward Grant, *Planets, Stars, and Orbs: The Medieval Cosmos, 1200–1687*, Cambridge: Cambridge University Press, 1994, p. 267.

79 On the importance of the Church Father's Hexameron literature in the early modern cosmological debates see W.G.L. Randles, *The Unmaking of the Medieval Christian Cosmos, 1500–1760: From Solid Heavens to Boundless Aether*, Aldershot: Ashgate, 1999, particularly pp. 1–57. See also Arnold Williams, *The Common Expositor: An Account of the Commentaries on Genesis, 1527–1633*, Chapel Hill: University of North Carolina Press, 1948, 40–65.

80 See Luis de Molina, *Commentaria in primam Divi Thomae partem*, Venice: apud Minimam Societatem, 1594 (1st edn Cuenca, 1592), p. 705; and R. Bellarmine, *The Louvain Lectures ('Lectiones Lovaniensis') of Bellarmine and the Autograph Copy of his 1616 Declaration to Galileo* (ed. U. Baldini and G.V. Coyne), *Studi Galileiani* (Vatican Observatory Publications), 1:2, 1984, pp. 1–48, 17.

81 On the influence of Pena's ideas see, among others, Peter Barker, 'Stoic alternatives to Aristotelian cosmology: Pena, Rothmann and Brahe', *Revue d'histoire des sciences* (2008) 61–2, pp. 165–86; and Miguel A. Granada, *Sfere solide e cielo fluido: Momenti del dibatitto cosmologico nella seconda metà del Cinquecento*, Naples: Edizioni Angelo Guerini e Associati, 2002, pp. 3–46.

82 *Epistolarum astronomicarum libri* was later reprinted in 1601 (Nuremberg) and in 1610 (Frankfurt am Main). On the correspondence between Brahe and Rothmann on the nature of celestial matter see Randles, op. cit. (79), pp. 63–77. See also Adam Mosley, *Bearing the Heavens: Tycho Brahe and the Astronomical Community of the Late Sixteenth Century*, Cambridge: Cambridge University Press, 2007, pp. 70–80, 89–96.

83 Borri, op. cit. (73), p. 161.

84 Borri, op. cit. (73), p. 324.

85 Rothmann to Brahe, 2 October 1587, Brahe, *Epistolae Astronomicae* in *Opera Omnia*, op. cit. (21), vol. 6, p. 112. Rothmann did not use the term *aura aetherea*, a term that was coined by Kepler in his *Mysterium cosmographicum* (1596). Rothmann usually refer the celestial air as *aether*. Randles, op. cit. (79), p. 177, has suggested that Borri took the term *aura aetherea* from Kepler but did not acknowledge it because Kepler was a Protestant.

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For confessional reasons, Cristoforo Borri and his Jesuit mathematician fellows did not recognize Rothmann's paternity of their notion of 'celestial air', nor did they quote any other contemporary theory of celestial matter. For them, it was strategic to ascribe the idea to the Church Fathers in order not only to match Aristotle in authority but also to remain in line with the Counter-Reformation guidelines.[86] Hence Tycho Brahe's and Rothmann's cosmological ideas were correspondingly integrated into Jesuit natural philosophy even if the Dane was never granted the status of authority in philosophical matters among the Jesuits.

Jesuit Tychonic cosmology

Once already part of the Jesuit philosophical *corpus*, the notion of *aura aetherea* and celestial fluidity became a *topos* in the Jesuit mathematical milieu.[87] The strategy of attributing this 'old' idea to the Church Fathers continued, as did the silence regarding the Tychonic source. The English Jesuit Ignace Stafford, who took the chair of mathematics when Borri departed for Madrid and from there to Rome, where he eventually died in 1632, for example, stated,

> Whoever who carefully reads the writings of the ancient Fathers would find that they did not make any case for the gentile philosopher [Aristotle] – rather, they challenged him at every step with the utmost freedom – and everything they taught about the fluidity and corruptibility of the heavens and the heavenly bodies was based upon the Sacred Scripture.[88]

The notions of celestial fluidity and corruptibility, against which generations of Aristotelians had stood in opposition, therefore represented true and proper 'Catholic' theories. Excited at the prospect of putting forward a newfangled Tychonic cosmology, the English Jesuit even went so far as to claim that 'the father Christoph Clavius adhered to the notion of celestial fluidity upon observing the comet of 1572'.[89] Clavius was actually famous for his life-long commitment to supporting the Ptolemaic claim regarding the solidity of celestial orbs.[90]

Stafford taught at the College of Saint Anthony from 1630 until 1636. When Stafford returned to Spain, where he had previously studied at the Royal English College of Valladolid, he was replaced by the Irish Simon Fallon. Fallon, who already had experience as a mathematics professor at the University of Coimbra, resumed mathematics teaching in Lisbon in 1638, and carried on in the position until 1640, when King João IV promoted him to chief engineer.

[86] Borri constitutes an interesting case as he had acknowledged, in the past, the paternity of his ideas on celestial fluidity in Tycho Brahe. It took place when he was a professor of mathematics at Brera College in 1612. However, Borri paid a high price for having defended Tycho Brahe's system and the notion of celestial fluidity in the period before the official acceptance of Tycho by the Jesuit authorities. He was expelled from the mathematics chair at Brera. In the *Collecta Astronomica*, published about two decades later, Borri was more cautious, omitting Brahe's name in the cosmological discussion. On the analysis of Borri's concept of celestial matter at Brera see Carolino, op. cit. (5), pp. 320–2.

[87] It was profusely referenced by the professors who followed Borri in Saint Anthony college's mathematics chair. See, for example, Fallon, op. cit. (56), fol. 105v; and John Rishton, *Curso de Mathematica*, 1652, Biblioteca Nacional de Portugal, PBA 54, fol. 9r.

[88] Ignace Stafford, *Tractado das Theoricas das Estrellas Fixas e Errantes*, 1633, Biblioteca Nacional de Portugal, COD. 4323, fols. 79v–80r.

[89] Stafford, op. cit. (88), fol. 79v: 'o Padre Christouão Clauio se reduzio à doctrina do ceo fluido depois que obseruo o Cometa de 1572'.

[90] On Clavius's astronomy and cosmology see Lattis, op. cit. (6).

Stafford and Fallon shared basically the same sort of astronomical and cosmological ideas that had already been developed by Borri in his efforts to establish a Tychonic cosmology.[91] These efforts, in turn, led these Jesuit astronomers on to addressing some of the problems that Tycho left unsolved, especially the issue of celestial dynamics; that is, an inquiry into the causes of heavenly motions. Crucially, there was also the need to integrate the Tychonic system within a world view in which there was room for the empyrean heaven, the metaphysical heaven in which God, the Saints and the Blessed were to be found, even while Brahe and a large majority of the Protestant philosophers and astronomers opposed the existence of this latter heaven.[92]

In coming up with a cosmology able to come to terms with the Tychonic system, Stafford and Fallon did introduce certain variations on the initial outline proposed by Borri. The Saint Anthony professors agreed to divide the cosmos into three heavens. However, whereas Borri distinguished between the airy heaven, the sidereal heaven wherein planets and the fixed stars moved, and the empyrean heaven, Fallon preferred to allocate the planets to the inferior heaven, corresponding to the space extending between the Earth and Saturn (the planetary heaven), to which he added a solid heaven where fixed stars moved (sidereal heaven) and, finally, the empyrean heaven.[93] Nevertheless, Fallon agreed with Borri in sustaining that celestial bodies were pushed by angels while Stafford argued that planets and fixed stars moved by their own intrinsic nature.[94] Both Stafford and Fallon maintained that celestial bodies followed a spiral path in their motion, an idea elaborated in detail by Borri in his *Collecta Astronomica*.[95]

As for the planetary rearrangement, Stafford and Fallon endorsed the Tychonic system, just as Gall and Borri had done before them. What is more, they unanimously considered the Tychonic system to be the true representation of the world.[96] As Stafford put it, 'the order according to which the planets and the stars move, and therefore the constitution of the universe [*mundo*] that we follow as true, is that of Tycho Brahe'.[97]

The final boundary: the ecclesiastic ban on Copernicus's planetary theory

By the mid-seventeenth century, mathematics professors at Saint Anthony seem to have become ever less confident about the accuracy of Tycho Brahe's system. In Lisbon, the Copernican system for the first time emerged as a remote candidate for explaining the

[91] On Borri's making of a Tychonic cosmology see Carolino, op. cit. (5).

[92] Randles, op. cit. (79), p. 133. On the notion of Empyrean heaven see Gregor Maurach, *Coelum Empyreum: Versuch einer Begriffsgeschichte*, Wiesbaden: Franz Steiner Verlag, 1968; Michel-Pierre Lerner, *Le monde des sphères*, 1: *Genèse et triomphe d'une représentation cosmique*, Paris: Les Belles Lettres, 1996, pp. 215–21; Randles, op. cit. (79), pp. 133–50.

[93] Fallon, op. cit. (56), fol. 107r. Stafford did not discuss this topic in his course on planetary theory.

[94] Fallon, op. cit. (56), fol. 109r; Fallon, *Tratado sobre a Theorica dos Planetas*, Biblioteca Nacional de Portugal, COD. 2127, fol. 219r; Stafford, op. cit. (88), fol. 91r, 92r.

[95] Stafford, op. cit. (88), fol. 81v, 90v, 96r ff., Fallon, *Compendio*, op. cit. (56), fol. 108v; Fallon, op. cit. (94), fol. 219v–220r. Borri argued that being thought of as purely intellectual entities, and therefore superior to other beings in ontological terms, angels were responsible for moving the celestial bodies. This view was consistent with the Thomist conception of providence endorsed by several Scholastic scholars. According to this view, God governed the created world through the mediation of secondary causes. A good example was precisely the angelical action of moving the planets according to divine intention. Angels moved the planets, perpetually maintaining the constancy of the celestial order and indirectly bringing about planetary influence over the terrestrial region, upon which life on Earth was thought to depend. On Borri see Carolino, op. cit. (5), pp. 329–30. On the Scholastic discussion of celestial dynamics see Grant, op. cit. (78), pp. 514–68.

[96] Nevertheless, Saint Anthony's Jesuits maintained that the Ptolemaic planetary system should serve as an instrument for planetary computations. Gall, *Tratado*, op. cit. (42), fol. 65v; Stafford, op. cit. (88), fol. 100v.

[97] Fallon, op. cit. (56), fol. 105v.

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order of the universe by the hand of the Belgium-trained English Jesuit John Rishton, who taught mathematics at Saint Anthony in the 1651–2 academic year. In doing so, the Saint Anthony mathematical community shared the tendency of some Jesuit mathematicians active in European colleges to increasingly regard the Copernican system as a plausible model. After the 1616 condemnation, the Copernican system was presented in the Jesuit classrooms merely as a hypothesis and/or as a tool for astronomical computation. Nevertheless, as the seventeenth century progressed, some Jesuit mathematicians progressively adhered to the Galilean arguments based on the application of his proto-inertial physics and mechanics to the cosmological discussion. This was the case of Andreas Tacquet, Honoré Fabri and Charles François Milliet Dechales, mathematicians who, based on the Galilean tradition, refused all the physical arguments traditionally evoked in favour of a motionless Earth and demonstrated a true interest in Copernican cosmology. Accordingly, as Ivana Gambaro has impressively demonstrated, by the late 1650s and the 1660s, a more ambiguous attitude towards the Copernican system emerged within this scholarly community. After Riccioli's attempts to prove the Earth's immobility and to justify Galileo's condemnation in his *Almagestum novum* (1651), the leading authorities of the Jesuit mathematical community tended to recognize that Copernicus's heliocentric system offered a simpler and more reliable account for the celestial phenomena. Nevertheless, they claimed in unison the impossibility of supporting this system because of their commitment to biblical literalism.[98]

Rishton epitomized this new approach to the study of the world systems. He was indeed the first Jesuit in the Lisbon college to take the Copernican system seriously as viable. In his detailed discussion of Copernicanism, he refuted the traditional arguments that Copernicus's model was physically absurd. Having first demonstrated that 'all the celestial phenomena can be solved by Copernicus's system', Rishton concentrated his efforts on the physical discussion.[99] He was closely acquainted with the plurality of arguments raised against Copernicus. From the Aristotelian standpoint, two sorts of argument stood out in Rishton's opinion: on the one hand, the Copernican theory which attributed a threefold motion to the Earth collided with the principle of natural motion and, on the other hand, contradiction came with a cluster of physical 'evidences' – Rishton mentioned some of these key 'evidences', namely the crashing down of edifices, the vertical fall of objects, the motion of projectiles and the flight of birds.[100]

Very briefly, the English Jesuit stood up against both these Aristotelian criticisms. As regards natural motion, he refuted the principle according to which a simple body could not perform more than one simple motion, by claiming that the motions that Copernicus assigned to the Earth were not contrary among themselves. They occurred in different plans and thus were not contrary when judged by reference to the same fixed point.[101] Those philosophers who claimed that according to Copernicus the Earth should be subject to a violent motion because its natural motion should otherwise necessarily be in a straight line towards the centre of the universe Rishton answered by denying their reasoning. According to him, this argument does not stand because it was produced by an extrinsic cause that always operates in accordance with the same virtue and in the same manner.[102] The English mathematician thus deeply delved into the subtleties of

[98] Gambaro, op. cit. (6).
[99] Rishton, op. cit. (87), fol. 140v.
[100] Rishton, op. cit. (87), fols. 142r–143v.
[101] Rishton, op. cit. (87), fol. 141r. It is interesting to note that Clavius had already applied the same sort of argument in his dispute with the advocates of homocentric cosmologies. Clavius, op. cit. (45), p. 29.
[102] Rishton, op. cit. (87), fols. 141r–141v.

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Aristotelian natural philosophy to argue that the Copernican theory did not necessarily run counter to physics.

More innovative was his denial of the above-mentioned physical evidence that the Earth could not move around the Sun and rotate around its own axis. Although Rishton never quoted Galileo on this topic, he drew upon the Galilean argument that motion is relative to the position of the observer against a frame of reference. Should the observer move with the Earth, without any external reference point, he would be unable to notice the Earth's motion. As the English Jesuit expressed this,

> Let us suppose that, according to the sentence of Copernicus, the starry sky does not move, the Sun occupies the centre of the world, and the Earth moves with diurnal and annual movements. It shall be proved that the observer would not perceive such a movement because motion is detected only with reference to a fixed point. If the observer is placed not far away from the moving object or at least with respect to the objects that move slower or faster to one another … it would be impossible to perceive their motion because the [moving] objects keep the same distance between themselves and the observer.[103]

From this point of view, Rishton had no doubt about stating that 'the system of Copernicus is not physically impossible' ('O sisthema de Cupernico não he naturalmente impossiuel').[104] Nevertheless, the apparent lack of stellar parallax and the probable lack of scale of the universe discouraged contemporary astronomers from advocating this hypothesis.[105] The main obstacle to the adoption of Copernicanism remained 'the authority of the Sacred Scripture, which in various places clearly attributes motion to the Sun and stillness and stability to the Earth'.[106] Furthermore, the English Jesuit added, the Bible should be 'explained literally' according to the 'unanimous consensus of Saint Fathers' and taking into account the decisions made by the 'Cardinal collegium' established by Pope Urban VIII in 1633.[107]

Such being the case, the geo-heliocentric system of Tycho Brahe emerged as the only solution Rishton and the whole community of Jesuit astronomers ought to be following.[108] The Tychonic system was the achievable compromise between ancient Ptolemy and modern Copernicus:

> [Copernicus] observed that the planets, provided with their proper motions, revolved around the Sun as their centre [and], therefore, the system of Ptolemy could not be true. For the same reasons, Tycho Brahe, a renowned astronomer, tried to open his safe path between the principles of Ptolemy's ancient system and those of Copernicus's modern system. He rejected what seemed false in both systems and chose what appeared to be according to reason and the truth of celestial phenomena; he reversed both the systems and created [a new] one.[109]

103 Rishton, op. cit. (87), fol. 134v.
104 Rishton, op. cit. (87), fol. 140v.
105 Rishton, op. cit. (87), fols. 143v–144v.
106 Rishton, op. cit. (87), fol. 146v.
107 Rishton, op. cit. (87), fol. 147r.
108 It is important to note that, despite Rishton seeming to be well informed about recently published books (for example quoting from the influential *Cursus Philosophicus* by the Portuguese Jesuit philosopher Francisco Soares, published in 1651, fol. 147r), he made no reference to Riccioli's *Almagestum novum* (Bologna, 1651).
109 Rishton, op. cit. (87), fol. 133r.

Concluding remarks

In the first half of the seventeenth century, the international community of Jesuit mathematicians active at the Lisbon College of Saint Anthony came to terms with the planetary system of Tycho Brahe. This geo-heliocentric rearrangement accounted for the astronomical novelties of the late sixteenth and early seventeenth centuries while simultaneously retaining intact the principle of a stationary Earth, itself a cornerstone of the traditional cosmology and, above all, of the prevailing literal understanding of the Bible. Nevertheless, there was a major problem with the Tychonic system from the viewpoint of the confessional divides of the time: it had been put forward by a Lutheran astronomer. In a context in which the Counter-Reformation was gaining momentum and where any criticism of the Aristotelian theoretical framework was perceived as an attack on Catholicism, the integration of the 'impious' Tycho Brahe into the pantheon of Jesuit authorities emerged as rather problematic. Nevertheless, as this analysis of Tycho's integration process among the professors of the College of Saint Anthony demonstrates, it did prove possible to convert Tycho into a 'Catholic' *auctoritas*. Besides purging any Protestant overtones in Tycho's works, the Jesuit professors in Lisbon strove to confine Tycho Brahe's influence to the realm of mathematics. Accordingly, they initially reinforced the traditional distinction between mathematics and natural philosophy. From the late 1620s onwards, when Jesuit astronomers got increasingly involved in the physical discussion of the structure and composition of the cosmos, they made recourse to Tychonic ideas on topics such as celestial matter and fluidity. Nevertheless, they still explicitly avoided crediting Tycho Brahe and his correspondents with these new notions. In so doing, the Jesuits never came to grant Tycho Brahe the full status of an *auctoritas*. Philosophy apparently remained in the realm of Catholic orthodoxy.

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