The burden of Galileo's controversy: The Jesuit revisiting of the Aristotelian cosmos in Collegio Romano (1618-1677)

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Abstract
When studying the controversy prevailing between Galileo and the Jesuits over the comets of 1618, historians tend to focus primarily on the works that led to the publication of *Il Saggiatore* in 1623. This article demonstrates that the echoes of this controversy reverberated inside the walls of the Collegio Romano well beyond the publication of Galileo's *chef-d'oeuvre*. Its philosophy and mathematics professors strove to maintain – in opposition to Galileo – the Aristotelian principle that the heavens were ontologically superior to the terrestrial region throughout decades. Even after adhering to the planetary system of Tycho Brahe and the concept of celestial fluidity, they persisted in arguing that no corruption ever took place in the celestial region. Hence, accepting Tycho's astronomical theories meant the seventeenth-century Collegio Romano professors had to reject the Ptolemaic astronomical framework even if not necessarily denying the very core of the Aristotelian cosmology. Thus, Collegio Romano remained the champion of philosophical orthodoxy within the Jesuit educational network.

Keywords
Collegio Romano, Galileo Galilei, Orazio Grassi, comets, celestial incorruptibility

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In early November 1624, Galileo Galilei learned, in a letter received from Mario Guiducci, that whoever stood up for the new theories and disapproved of the Peripatetic doctrines would be vehemently and violently criticized in the public ceremony held to commemorate the opening of the Collegio Romano academic year.[1] Galileo was certainly not surprised by the news as it was neither the first time nor – in keeping with my argument in this paper – would it be the last occasion on which obedience to Aristotle was publicly proclaimed at the Roman Jesuit college.[2] However, the mood was now different. Maffeo Barberini had been elected Pope Urban VIII in 1623, and the expectations ran high among the *Lincei*. Galileo, who had received public support from Urban VIII, and the *accademici* believed a new age in the cultural politics of the Catholic Church was about to dawn. For the Roman Jesuits, this meant the Aristotelian orthodoxy was at stake. Furthermore, Galileo's *Il Saggiatore* had been published roughly one year earlier, raising the dispute with the Jesuits over the comets of 1618 to a new level in a controversy previously described as humiliating for the Jesuits from the polemic point of view.[3]

Historians have discussed Galileo's motivations for embarking on this dispute with the Jesuits at length, with some attributing it to Galileo's alleged psychological constraints and obsessive compulsion towards controversies while others place the emphasis on the social and professional nature of the debate.[4] More recently, Massimo Bucciantini, Ottavio Besomi, and Michele Camerota, among others, have convincingly demonstrated that the comet dispute requires understanding in the context of the cosmological debate arising in the aftermath of the Catholic Church's prohibition of the Copernican theory of Earth's motion, issued in 1616.[5] On the one hand, aware that the comets of 1618 were under consideration in Rome as the ultimate proof against the Copernican system, and

1 OG, XIII, 226-227.

2 For example, on 15 October 1624, Guiducci informed Galileo that he had received the copy of the conference "fatta al Collegio [Romano] contro a' seguaci di nuove opinioni, o più tosto contro a quelli che non seguitano Aristotile", OG XIII, 216.

3 Ruffner, "The Background and Early Development of Newton's Theory of Comets", 73.

4 Baldini, *Legem impone subactis*, 209 and Shea, *La rivoluzione intellettuale di Galileo*,102 ff., for example, epitomize the first tendency while Westfall, "Galileo and the Jesuits", 51 and Biagioli, *Galileo Courtier*, 268ff., account for the second. A critical review of this historiography is found in Beltrán, "Introducción. Galileo y la ciencia. Los jesuitas y la obediencia", LVII-LXXXVIII.

5 Besomi and Helbing, "Introduzione" *Discorso delle comete,* 15-22; Besomi and Helbing, "Introduzione" *Il Saggiatore*, 67-68; Bucciantini, *Contro Galileo. Alle origini dell'affaire*, 151; Bucciantini, *Galileo e Keplero*, 261-287; Camerota, *Galileo Galilei e la cultura scientifica nell'età della Controriforma,* 363-376. See also Favino, "Contro Tycho. Per una lettura contestuale del *Discorso delle comete*". In the seventeenth century, there was already the clear perception that cometary debate had further impacted on the discussion over the planetary systems. See the case of Riccioli in Gualandi *Teorie delle comete,* 83-102.

while prevented from discussing it openly,[6] in claiming that comets move in a rectilinear path between the Earth's surface and the sky, Galileo could then suggest the Earth actually moved around the Sun as Copernicus had argued.[7] On the other hand, the Jesuit mathematicians of the Collegio Romano applied their astronomical expertise to the observations of the 1618 comets to clear the way for the reception of Tycho Brahe's astronomical system. After the condemnation of Copernicus, Tycho's geo-heliocentric system appeared to orthodox Catholics as the most likely candidate for replacing the traditional Ptolemaic system, which no longer either fitted or accommodated the outcomes of the new telescopic observations (in particular the phases of Venus). Galileo soon realized this and did not hesitate to accuse the Jesuit Orazio Grassi of secretively following Tycho Brahe. At first, Grassi tried, somewhat unconvincingly, to deny the accusation. In his words,

> But, lest we waste time on useless complaints, first, I do not understand how Galileo can justly oppose my master and even declare him at fault, presumably because he appears to have sworn by the words of Tycho and to have followed him in all his vain devices. For *this is patently false*, since, except for the manner and method of calculation by which the location of the comet was sought, Galileo found nothing else in our *Disputation*, as its very words testify, in which Tycho was followed. Even with his telescope, the lynx-eyed astrologer cannot look into the inner thoughts of the mind. *But consider, let it be granted that my master adhered to Tycho. How much of a crime is that?*[8]

Although not a crime, advocating Tycho in 1619 might be perceived as an affront to the Jesuit authorities and their policy of keeping the *uniformitas et soliditas doctrinae* in place. Grassi was probably aware that, as he wrote those lines against Galileo, the *Sphaera*

6 In March 1619, Giovan Battista Rinuccini informed Galileo that in Rome "the Jesuits presented publicly a Problem [on the distance of the comet] which has been printed, and they hold firmly that it is in the sky, and some others besides the Jesuits have spread it around that this thing overthrows the Copernican system, against which there is no surer argument than this". GG, XII, 443. Translation by Drake, *Galileo at Work,* 265.

7 Galileo's cometary theory accounted for the changes in velocity, dimensions, and lengths of the comet. Yet it failed to explain why, arising with a vertical path, the comet moved northwards instead of pointing to the zenith. This led Galileo-Guiducci to state, somewhat ambiguously, "This forces us either to change what has been said or else to retain that, but to add some other cause for this apparent deviation". Galileo-Guiducci, *Discorso delle comete,* 182. Translation by Drake, *The Controversy on the Comets of 1618,* 57. This "other cause" was most likely the annual motion of the Earth. On this question, see Besomi and Michele, *Galileo e il Parnaso Tychonico*, 13; Camerota, *Galileo Galilei e la cultura scientifica nell'età della Controriforma*, 371ff.; Bucciantini, *Galileo e Keplero*, 273-274.

8 Grassi, *Libra astronomica ac philosophica,* 5. Translation by O'Malley, *The Controversy on the Comets of 1618,* 71, my emphasis.

mundi written by his confrère Giuseppe Biancani was going through a distressing process of internal censorship in Rome on account of its "Tychonism". One year later, in 1620, Brahe's *Astronomiae instauratae progymnasmata* was submitted to the Roman Congregation of the Holy Office. Roberto Bellarmino, who happened to be an influential member of the Congregation of the Inquisition in addition to serving in the Congregation of the Index, recommended the book be expurgated of all the eulogies bestowed on Protestant authors.[9]

Besides the confessional dimension, the Tychonic system raised some cosmological questions that challenged the traditional Aristotelian-Ptolemaic worldview. Due to the intersection of the orbits of the Sun and Mars, the Tychonic system required the celestial region to be fluid, a cosmological principle that Christoph Clavius and his close collaborators at the Collegio Romano utterly refuted.[10] Furthermore, although clearly distinct from a cosmological point of view, the idea of celestial fluidity was commonly equated with the notion of celestial corruptibility among the 1610s and 1620s Jesuit milieux. Both doctrines seemed to receive validation from the celestial novelties occurring in the seventeenth century, and particularly the appearance of bright comets over the skies in late 1618. Johann Chrysostomus Gall, a German Jesuit who trained in astronomy under Johann Lanz and Christoph Scheiner at the University of Ingolstadt, where he observed the 1618 comets with Johann Baptist Cysat, stated, in 1621, for example, that,

> The observations carried out by the most modern astronomers give plenty to think about to both those who advocate that the heavens are solid and those who want them to be incorruptible. Let it be stressed, however, that corruptibility does not necessarily follow from denying [celestial] solidity and advocating [its] fluidity.[11]

As Gall proposed, the theory of celestial corruptibility generated greater consequences than celestial fluidity. Recognizing that comets moved across a heavenly region filled with a fluid and tenuous matter implied acknowledging that there was not a complex system of solid orbs. This, therefore, collapsed the Ptolemaic astronomical tradition. Nevertheless, accepting there were processes of coming-to-be and passing away in the celestial region produced further implications: it meant jeopardizing the ontological distinction between the terrestrial and celestial regions upon which the Aristotelian cosmos was based. This was exactly the link Galileo established both when he recognized how terrestrial exhalations ascend from the Earth's atmosphere into the planetary region and on arguing that

9 Lerner, "Tycho Brahe Censured". Cf. Godman, *The Saint as Censor*, 307.

10 Lattis, *Between Copernicus and Galileo*, 61-85; Dollo, "Le ragioni del geocentrismo nel Collegio Romano"; Carolino, "Between Galileo's Celestial Novelties and Clavius's Astronomical Legacy".

11 Gall, *In sphaeram*, BGUC, Ms. 192, f. 7v. On the common association between celestial fluidity and corruption made by Scholastic philosophers, see Grant, *Planets, Stars, and Orbs*, 350.

sunspots were real changes taking place on the Sun's body.[12] Galileo's *Il Saggiatore* proposed and discussed all these topics in detail.[13]

While studying the controversy between Galileo and the Jesuits over the comets of 1618, historians tend to focus on the works that led to the publication of *Il Saggiatore* in 1623. According to the common view, "with *The Assayer* the controversy comes to its virtual end".[14] Nevertheless, as this paper demonstrates, the echoes of this controversy reverberated inside the walls of the Collegio Romano well beyond 1623. The professors of philosophy and mathematics at this college strove throughout decades to maintain – in opposition to Galileo – that the heavens were ontologically different from the terrestrial region and, thus, immune to corruption. Even after adhering to the planetary system of Tycho Brahe and, consequently, to the principle of celestial fluidity, did they persist in arguing that no processes of coming-to-be and passing away took place in the celestial region. Hence, accepting the astronomical ideas of Tycho meant, to the majority of the seventeenth century Roman Jesuits, the rejection of the Ptolemaic astronomical framework but not necessarily denial of the very core of Aristotelian cosmology.

Ugo Baldini argued that "Galileo's polemic against Grassi" led the Jesuits to adopt a "defensive closure, breaking certain links with the *neoterici*".[15] This paper demonstrates that, on the eve of the controversy, the Jesuits in Rome were already endeavouring to ensure the

[12] As Galileo-Guiducci put it, "Never having given any place in my thoughts to the vain distinction (or rather contradiction) between the elements and the heavens, there is for me no qualm or difficulty about the idea that the material of which a comet is formed having sometimes invaded these nether regions of ours, and being sublimated here, having surmounted the air or whatever else it is that is diffused throughout the immense reaches of the universe". Galileo-Guiducci, *Discorso delle comete*, 175. Translation by Drake, *The Controversy on the Comets of 1618*, 53. On the debate over celestial fluidity and corruptibility in early seventeenth-century Rome, see Bucciantini, "Teologia e nuova filosofia".

[13] The ontological distinction between the terrestrial and celestial regions established a cornerstone of the Aristotelian natural philosophy endorsed in the early seventeenth century. Among other issues, this accounted for the apparent difference between the terrestrial bodies' rectilinear and finite motion and the celestial bodies' circular and infinite motion and the absence of visible changes occurring in the celestial region. Additionally, it explained the processes of generation and corruption of terrestrial bodies by means of hylomorphism. According to this theory, every terrestrial body was composed of matter of a form or quality that could be substituted by its contrary, bringing about generation and corruption. Being made of simple and perfect matter, often identified as a fifth element, the celestial region had no such processes of processes of coming-to-be and passing away. On the theory of celestial incorruptibility in the early modern Scholastic tradition, see Grant, *Planets, Stars, and Orbs,* 206-219.

[14] Gal and Chen-Morris, "Galileo, the Jesuits, and the controversy over the comets", 38.

[15] Baldini, *Legem impone subactis*, 203 n.3. In the original Italian: "La polemica di Galileo contro Grassi introdusse un dato del tutto non previsto [...]: quella di provocare una chiusura difensiva e di spezzare certi nessi con i gruppi *neoterici*".

Aristotelian orthodoxy was respected by the Order's scholars. After the controversy, they also continued sparing no efforts to consolidate a worldview consistent both with Aristotle's authority, the outcomes of the celestial novelties and the Tychonic innovations. This furthermore explains why the Collegio Romano professors continued teaching the theory of celestial incorruptibility until as late as the 1670s and thus even after their confrères in other regions of Europe had already abandoned it. From this point of view, self-censorship in the wake of the publication of Galileo's *Il Saggiatore* hit stronger in Rome than in the Jesuit peripheries.

1. December 1618: three cometary concepts, one cosmological tenet: celestial incorruptibility

Over the Christmas holidays of 1618/19, the Collegio Romano Jesuits held a public ceremony to celebrate the appearance of bright comets over the skies of Rome. At this prestigious celebration, in addition to the professor of rhetoric, representatives of the mathematical, philosophical, and theological communities made speeches on the comets.[16] This effectively unveiled three different understandings of the comets. The theologian, who was not concerned with the nature of the comet itself, mentioned in passing how the comet resulted from viscous and greasy exhalations that ascended from the Earth's surface to the upper region of air.[17] The philosopher, who was most likely Marcellino Albergotti[18] and held responsibility for discussing the nature of comets, termed it the visual outcome of the convergence of celestial matter at a certain spot in the skies produced by the overlapping of different celestial spheres.[19] The mathematician, Orazio Grassi himself, having restrained his sphere of action to the mathematicians' area of competence, hence, discussing the location, motion, and dimensions of the comet,[20] deliberated that the comet was a celestial body that moved with a quasi-circular path between the Moon and the Sun.[21] The mathematician's speech was later published under the title of *Disputatio astronomica de tribus cometis anni M.DC.XVIII publice habite in Collegio Romano Societatis Iesu.*[22] This

16 Copies of these speeches are preserved at the Biblioteca Nazionale Centrale di Roma, Cod. F. Ges. 458. See Baldini, *Legem impone subactis*, 255-257.

17 "An quia spiritus est terrae quidam atque habitus pinguior crassiorque conglobatus in aerem uelut altor educatorque flammarum?". *Varia de Cometa Anni 1618.* BCNR, Cod. F. Ges. 458, f. 45v.

18 Baldini, *Legem impone subactis*, 256.

19 *Varia de Cometa Anni 1618.* BCNR, Cod. F. Ges. 458, ff. 38v.-39r. Baldini transcribed the philosopher's speech in *Legem impone subactis*, 257-271, here at 269-270.

20 Grassi, *Disputatio astronomica de tribus cometis*, 258.

21 *Ibid.*, 282.

22 Ottavio Besomi and Mario Helbing convincingly demonstrated that the text preserved in BNCR F. Ges. 458 is not the original but a copy made from the printed version. Besomi and

disputatio had better fortune than the other discourses publicly delivered at the Collegio Romano. Nevertheless, the arguments then made by the philosopher would influence the cometary discussion ongoing inside the walls of the Roman institution.

The three cometary doctrines espoused at the Collegio Romano, although diverging in their understandings and locations of the comets, shared a common and crucial feature: they all took celestial incorruptibility for granted. Even those who did conceive the comets as celestial bodies, preserved the principle that no celestial corruption ever took place in the celestial region.[23] The philosopher Albergotti, for example, was crystal clear in his presentation: "With this disputation, I will strive to prove that, even if one concedes, according to this hypothesis, that [comets] lighten in the skies, it does not follow from that the heaven is corruptible".[24]

Celestial incorruptibility represented a cornerstone of the Aristotelian cosmology officially endorsed by the Society of Jesus. The celebrated Coimbra Jesuits, for example, who produced an extensive commentary on Aristotle's natural philosophy at the turn of the seventeenth century, argued that the heavens were ontologically distinct from the terrestrial bodies based on four evidential claims: first, in the celestial bodies, matter and form are inseparable; second, the celestial bodies move in circular (and, therefore, perfect) paths; third, the heavens occupy the highest place in the universe; finally, the celestial bodies exert an overwhelming and universal influence over the terrestrial bodies.[25] These arguments made their way into the philosophical courses of Jesuit colleges throughout Europe and we see below that Collegio Romano was no exception.

In the early seventeenth century, the Jesuit authorities in Rome were deeply committed to retaining the ontological divide that characterized the Aristotelian cosmology as a philosophical tenet. The issue emerged while the Roman authorities were involved in the challenging process of adhering to the astronomical ideas of Tycho Brahe. In the 1610s, Giuseppe Biancani submitted his *Aristotelis loca mathematica* for Jesuit Roman censorship, a book in which, among other theories, the mathematics professor in Parma argued the case for the Tychonic theory of celestial comets. One of the Roman censors, Giovanni Camerota (the other being Christoph Grienberger), was acutely displeased by the book by his confrère.[26] Apart from the eulogies bestowed on Protestant authors, Camerota was particularly dissatisfied by the fact that Biancani argued, and in opposition to Aristotle, that the planets moved in the heaven like fish in water (*planetae in coelo gradiantur ut pi-*

Helbing "Introduzione" e "Nota ai testi", 83-85.

23 On Grassi's position, see note 62.

24 *Varia de Cometa Anni 1618*. BCNR, Cod. F. Ges. 458, f. 30r.; Baldini, *Legem impone subactis*, 260.

25 *Commentarii Collegii Conimbricensis Societatis Iesu in quatuor libros de coelo*, 39-40.

26 The censorships of Biancani's *Aristotelis loca mathematica* were published by Baldini, *Legem impone subactis*, 227-238.

sces).[27] Even worse, the Jesuit mathematician went as far as arguing, based upon the celestial location of comets, that "the heaven is generated and corruptible" claimed Camerota.[28]

Biancani's *Aristotelis loca mathematica* was eventually published in 1615. The printed version recognized celestial fluidity as one of the outcomes of the observation of the celestial novelties in the late sixteenth and early seventeenth centuries. In addition to the telescopic observations, Biancani mentioned the Tychonic observations of comets moving through planetary regions, which required them to be made up of fluid matter.[29] As far as celestial corruptibility was concerned, Biancani changed the original version submitted to the Jesuit censors. In the printed version, he adopted a more prudent stance. Upon recognizing the celestial nature of comets, Biancani raised the question of whether one could conclude, from the appearance of comets above the Moon, that there were processes of coming-to-be and passing away in the celestial region. In this context, he added, "but indeed the entire Peripatetic school exclaim against it that the heaven is ingenerated and incorruptible. Therefore, nothing new can ever happen in the heaven".[30] However, he could not resist the temptation of rhetorically inquiring how might one explain the appearance of new stars (*novae*) in 1572, 1600 and 1604 if the heavens were incorruptible.

2. Celestial comets in a Ptolemaic universe

We do not know just how Camerota reacted when he learned of the publication of Biancani's book and its defence of the theory of celestial fluidity. Before becoming an influential reviewer of the books written by the Jesuits in Italy, Camerota taught philosophy and later theology in Naples from the mid-1580s onwards.[31] This champion of Aristotelian orthodoxy almost certainly taught his students that comets were made up of exhalations that ascended from the Earth's surface to the upper region of air, where they deflagrated when coming into contact with fire.[32] Nevertheless, despite censuring Biancani's book and his sympathy for the notion of celestial fluidity, Camerota was probably aware that it still remained possible to stand up for the Ptolemaic planetary system with its solid epicycles

27 Baldini, *Legem impone subactis*, 231.
28 *Ibidem*.
29 Biancani, *Aristotelis loca mathematica*, 79. See also Granada, "Nove e comete nel periodo 1572-1623 e il dibattito Galileo-Grassi".
30 Biancani, *Aristotelis loca mathematica*, 94.
31 Gatto, *Tra scienza e immaginazione*, 281. Camerota served as a referee in Rome for almost two decades. Baldini, *Legem impone subactis*, 244. See also, Gatto, *Tra scienza e immaginazione*, 89-91.
32 This was, for example, the position held by Muzio Vitelleschi, the would-be Superior General of the Society of Jesus, when he lectured on comets in the Collegio Romano in 1590. Vitelleschi, *In libros meteorologicorum*, BNCR, F. Ges. 747, ff. 12v.-20r., at f. 13r. No lecture notes by Camerota seem to have survived.

and eccentric circles even after the mathematicians demonstrated how comets were likely to move above the Moon.

This was precisely the argument put forward by the Collegio Romano's philosophy professor, Marcellino Albergotti, on the eve of the controversy between Galileo and the Jesuits over the 1618 comets. As already seen, at the ceremony held by the Collegio Romano to celebrate the comets, Albergotti argued that the comets derived from an optical effect produced by the concentration of celestial matter at a vertical level resulting from the overlapping of celestial spheres. The comet's tail was thus nothing more than the effects of the Sun's light passing through this condensed matter. According to Albergotti, and in tune with Kepler's optical theory – which the Jesuit philosopher expressly quoted – this explained why the comet tail cone always pointed in opposition to the Sun.[33] From this point of view, the Ptolemaic cosmology remained compatible with the celestial location of the comets alongside the other celestial novelties.

After the Galileo controversy, this argument made its way into the teaching of natural philosophy at the Collegio Romano. Giacomo Lampugnano was one of its leading advocates.[34] In his course lectured in 1638/39, Lampugnano provided a comprehensive account of how to conciliate the celestial novelties and the Ptolemaic astronomical system. Accordingly, there were five feasible ways in which the incorruptibility of the heavens could be reconciled with the new celestial phenomena.

The first *via componendi incorruptibilitatem coeli cum phoenomenis in ipso concessis* simply considered that the comets and new stars had been produced not by natural means but by God's *potentia absoluta*. They were, therefore, miracles that could herald whether the death of kings and popes or the destruction of kingdoms and peoples due to the occurrence of plagues, wars, and great famines.[35] Historical evidence proved that, throughout history, comets or new stars were followed by major political events and natural disasters. Such cases then included the death in 1578 of Portuguese King Sebastião in the battle of Al-Ksar al-Kabir, in contemporary Morocco, which Lampugnano associated with the new star that appeared in the constellation Cassiopeia in 1572 (rather than the comet of 1577 which was usually taken as the token for Sebastião's disaster in Africa), and the miraculous events that led to the victory of the Habsburg Emperor Ferdinand in Prague, following the appearance of a comet on 25 June 1618.[36]

The second eventual way of recognizing how comets and new stars would pop up in

33 *Varia de Cometa Anni 1618*. BCNR, Cod. F. Ges. 458, ff. 39v.-40r.; Baldini, *Legem impone subactis*, 270-271.

34 Lampugnano taught at the Collegio Romano between 1632 and 1639 (logics, 1632-33 and 1636-37; natural philosophy, 1633-34 and 1637-38; metaphysics, 1634-35 and 1638-39). Villoslada, *Storia del Collegio Romano*, 327, 330, and 332.

35 Lampugnano, *In libros Aristotelis de coelo*, APUG 2390, 42.

36 *Ibid.*, 43-46.

the skies while simultaneously retaining the principle of celestial incorruptibility consisted of arguing that those phenomena resulted from concentrations of celestial matter. This celestial matter condensed in certain points within the heavens and the Sun's rays falling upon that condensation then produced a comet or a new star. Different degrees of celestial matter concentration explained the difference between new stars and comets. According to the Collegio Romano professor, this also accounted for the different types of comets. As Lampugnano expounded,

> If there is a large [and compact] condensation, none will be the refraction of the Sun's rays from the opposite part and, therefore, a simple star will become visible, such as [those that appeared] in the years 1572, 1600 and 1604. When the comet's central parts contain large amounts of condensation and there are, around it, other parts less dense, a hairy comet (*cometa crinitus*) will appear. This happens because those less dense parts surrounding the centre do not set bound to light perfectly. Therefore, the comet refracts very little light and, for that reason, takes the shape of hairs or rays. Nevertheless, when the density is a little more than mediocre so that a fraction of light can be refracted from the opposite side of the condensation, a bearded comet (*cometa barbatus*) will shine out. Likewise, should the density be mediocre and able to refract a lot of light, a tailed comet (*cometa caudatus*) will result.[37]

According to this view, comets and new stars took place *de novo*. Under certain conditions, celestial matter happened to condense in such a way that comets or new stars appeared and shone until their disintegration months or years later.

The third means of reconciling both the notions of celestial incorruptibility and the celestial location of comets and new stars was also grounded on the principle of concentration and rarefaction of the celestial matter. However, in this case, comets and *novae* were no celestial novelties. They had been created in the celestial region at the beginning of times but only occasionally became visible when the rarefaction of heavenly matter allowed people on Earth to see them shining high in heaven.[38] Lampugnano explicitly attributed this view to the Catholic Dutch physician Johannes van Heeck, who was one of the four founding members of the Accademia dei Lincei and a ferocious opponent of Tycho Brahe for his Protestant beliefs and cosmological views.[39] In his *De nova stella disputatio*, published in 1605, van Heeck argued that the so-called *nova* of 1604 – as well as those of 1572 and 1600 – was not a new star but a body created above the Firmament

37 *Ibid.*, 48.

38 *Ibid.*, 50-53.

39 On Van Heeck's life and works, with a particular focus on his *De nova stella disputatio* and the surrounding confessional debate, see Caredda, "Aspetti e momenti del dibattito astronomico nella prima Accademia dei Lincei", 62-105.

and similar for the later variations in the density of parts of the Milky Way that were occasionally visible to observers on the Earth's surface.[40] The Collegio Romano philosophy professor extended the argument to include comets but recognized that this theory was *ingeniosa* only insofar as stars and comets appeared above the Firmament.[41]

These two comet theories, based on the principle of matter concentration, not only preserved celestial incorruptibility, as a concentration of matter is not a change in substance, but they also sanctioned the solidity of the heavens. In the second theory, comets, like the sunspots that orbited the Sun, move with the planets in their respective heaven.[42]

However, there was a fourth way of integrating the celestial novelties into the heavens without having to acknowledge their corruptibility and fluidity, which appealed to Lampugnano more strongly (*modus hic explicanda phoenomena pulcherrimus est et ualde probabilis*). In his words,

> This opinion states that the stars seen *de novo* are nothing but some aggregation of stars, which are so small that they cannot be seen by us while separated but, concentrated by the motion of the epicycles, they become visible. For this reason, a new star was seen shining in [the constellation of] Cassiopeia at the moment when, not one, but many stars aggregated into one star. This star was not produced *de novo* but was rather ancient stars that, through their conjunction *inter se*, became visible *de novo* [aggregated in one star]. The same must be said of the other stars and the celestial comets except, moreover, that the latter have a tail, beard or hair deriving from the solar rays falling upon and refracting on these small stars.[43]

This theory was not new in the Collegio Romano. As already referenced above, the philosopher Albergotti had argued along those lines twenty years earlier in the public ceremony celebrating the comets of 1618. On this occasion, however, Lampugnano went into further detail to explain how the overlap of different epicycles produced a concentration of stars which was seen "by us [as one single star] on the same plane as if they were the lowest of them".[44] From this point of view, the controversy with Galileo did not lead the Collegio Romano Jesuits to develop new and more conservative positions with respect to the *neoterici*. They were already in place prior to the celebrated controversy.

Finally, there was the scope for simply denying that the comets and new stars were located above the Moon. [45] Lampugnano stressed that the absence of consensus among

40 Van Heeck, *De nova disputatio*, 23-28. See Randles, *The unmaking of the Medieval Cosmos Christian Cosmos*, 84-85.
41 Lampugnano, *In libros Aristotelis de coelo*, APUG 2390, 53.
42 *Ibid.*, 49.
43 *Ibid.*, 57-58.
44 *Ibid.*, 61.
45 *Ibid.*, 70ff.

astronomers and philosophers about the location of these phenomena left the space for recognizing that these took place below the Moon. The controversy between Galileo and Scheiner over the nature and location of the sunspots represented an example of such disagreement, according to the Jesuit.[46] Furthermore, the lack of consensus produced further epistemological consequences: observations could not serve as the main premise upon which the philosophical syllogism was based. This was particularly detrimental for those standing up for celestial corruption. Their theory relied exclusively on the postulate that new phenomena had been observed in the skies.[47] Again, Lampugnano operated exclusively within the Aristotelian philosophical framework.

In short, the appearance of comets and *novae* in the celestial region denied neither celestial corruptibility nor their solidity. By explaining these phenomena as concentrations of pristine heavenly matter, Lampugnano reinforced the authority of Aristotle and Ptolemaic astronomy. Accordingly, after presenting the heliocentric planetary system of Copernicus and the geo-heliocentric system of Tycho Brahe (whom he did not name), the Collegio Romano professor could proclaim authoritatively that "the order of planets that we approve is the one endorsed by those [astronomers] who conceive the heaven as solid, and divide it into concentric, eccentric and epicycle orbs".[48]

3. Grassi and the reception of Tycho Brahe in Rome

However, there was an important issue with Lampugnano's cometary theory. Although radically different, it still shared one common feature with Galileo's theory of comets. According to both Galileo and the Jesuit philosopher, comets were optical illusions. Galileo-Guiducci's *Discorso delle comete* describes comets as the reflection of the sunlight on vapours which, having originated on the Earth, rose perpendicular to the earth's surface through the space where the planets move.[49] Lacking the material characteristics of physical bodies meant applying the parallax technique to measure the supposed

[46] *Ibid.*, 76. Here, Lampugnano probably refers to Scheiner's early understanding of sunspots as shadows of small satellites on the face of the Sun. Later, in his *opus magnum*, the *Rosa Ursina* (1626-1630), the German Jesuit agreed with Galileo that sunspots were actually on the Sun's surface. On Scheiner's cosmology and his different views on sunspots, see Ingaliso, *Filosofia e cosmologia in Christoph Scheiner.*

[47] *Ibid.*, 79.

[48] *Ibid.*, 108.

[49] Some historians have associated Galileo with the Aristotelian theory of comets – for example, Zinner, *Entstehung Ausbreitung der copernicanischen Lehre*, 362; Redondi, *Galileo Heretic*, 32; and, above all, Gal and Chen-Morris, "Galileo, the Jesuits, and the controversy over the comets". Nevertheless, Galileo's understanding of comets was not only substantially different from the Aristotelian theory but also had cosmological consequences that collided with the Aristotelian cosmos.

location of these illusions was simply not possible.[50] However, the Collegio Romano mathematicians were arguing against this view and maintained that comets were real physical phenomena.

Following the public ceremony held at the Collegio Romano in the Christmas holidays of the 1618/19 academic year, Orazio Grassi published the *Disputatio astronomica de tribus cometis anni M.DC.XVIII publice habite in Collegio Romano Societatis Iesu*. The booklet, which presented the viewpoint of the Collegio Romano's mathematicians, was published anonymously even though it was public knowledge who had written it.

After briefly describing the three comets that appeared in 1618, Grassi focused on the third, the brightest comet visible in Rome from late November onwards. Three arguments led the Collegio Romano mathematics professor to conclude that the comet originated above the Moon. First, he drew that conclusion from his parallax calculation. Grassi compared the observations carried out in Rome with others done on the same day in Antwerp. By paying close attention, firstly, to the distances between the comet and a set of fixed stars and, secondly, to the angle drawn from the observation of the comet in each city, he concluded that "our comet was not sublunar but clearly celestial".[51] Inspection of further observations received from Parma, Innsbruck and Cologne further corroborated this conclusion.

The second argument focused on the path of motion displayed by the comet. By comparing the angular distances of the comet to the fixed stars along its motion, the Jesuit was able to register the comet's trajectory under the background of the celestial sphere. Then, deploying a gnomonic projection, he obtained the representation of the comet's trajectory on a planisphere of the celestial sphere and concluded that the comet moved along a straight line. Seen from the centre of the universe, which Grassi took to be the Earth, the gnomonically projected straight line corresponds to the projection of the great circles of the sphere, such as the ecliptic. Grassi, therefore, concluded that "the motion of the comet was along a great circle and very much resembled the motion of the planets".[52]

Finally, Grassi proposed that the comet was placed above the Moon "by the fact that when the comet was observed through a telescope, it suffered scarcely any enlargement".[53] This optical argument, in conjunction with the other two, was subject to severe criticism by Galileo.

Nevertheless, based upon these reasons, Grassi felt entitled to claim that the comet of late 1618 moved like the other celestial bodies with a quasi-circular orbit somewhere between the Sun and the Moon. In his words,

50 Galileo-Guiducci, *Discorso delle comete*, 147-148.
51 Grassi, *Disputatio astronomica de tribus cometis*, 276. Translation by O'Malley, *The Controversy on the Comets of 1618*, 14.
52 *Ibid.*, 282. *Ibid.*, 17.
53 *Ibidem.*

> Thus, in order that we may now determine almost the true place of the comet, let us say that it can probably be placed between the Sun and the Moon. Since for those lights which are excited by particular motions, there is an established law according to which the more slowly they move the higher they are, and since the motion of our comet was midway between that of the Sun and of the Moon, it will have to be placed between the two of them.[54]

Historians have praised the quantitative approach of Grassi's account of the comets of 1618.[55] Nevertheless, this approach was due not to any new epistemological stance but rather to how the Jesuit was anchored in a traditional Aristotelian classification of sciences, wherein mathematics occupied a subordinate position with respect to natural philosophy. Not fulfilling all the requirements of scientific syllogism, the Aristotelian tradition considered that astronomy, as a mixed science, described quantitative aspects, such as the trajectory, dimensions, and distances of celestial bodies, without explaining the reason (*propter quid*) of those quantitative properties. This belonged to natural philosophy.[56] Grassi operated within this epistemological framework, as he himself recognized,

> Mindful that I am of supporting the single role of the mathematician, on this day I propose considering those things which do not exceed the bounds of our knowledge, limited solely to what has been proposed, which are confined to the sole domain of quantity. Hence, should I explain the position, motion, and magnitude of those fires, I shall be satisfied that I have fulfilled my purpose.[57]

This epistemological approach explains why Grassi was silent about the cosmological nature and role of the 1618 comet. In fact, as Antonio Beltrán has already argued, Grassi never put forward any cometary theory.[58] In both the *Disputatio* and the *Libra*, his major contribution is undoubtedly the celestial location of the comet but not a single word is spent on explaining the essential features of the comet or its cosmological consequences. The furthest he goes is suggesting the comet is a "crystalline globe", which, alongside Kepler's optical theory – which Grassi quoted – refracted the sunrays produc-

54 *Ibid.*, 282-284. *Ibid.*, 17-18.

55 For example, Heidarzadeh, *A History of Physical Theories of Comets*, 60; Heilbron, *Galileo*, 234; Gal and Chen-Morris, "Galileo, the Jesuits, and the controversy over the comets", 42.

56 On the Aristotelian classification of sciences, see Weisheipl, "Classification of the Sciences in Medieval Thought"; Ariew, "Christopher Clavius and the classification of sciences".

57 Grassi, *Disputatio astronomica de tribus cometis*, 256, 258. Translation by O'Malley, *The Controversy on the Comets of 1618*, 6-7, with my revision. Inexplicably the translation by O'Malley omitted the key sentence "which are confined to the domain of sole quantity" (*solius quantitatis terminis inclusos*) which I have translated and included.

58 Beltrán, "Introducción. Galileo y la ciencia. Los jesuitas y la obediencia", CXVIII.

ing the characteristic tail.[59] But how was this crystalline globe produced? Did it result from a concentration of celestial matter or was it produced *de novo*? His fellow Jesuit mathematician, professor of mathematics and Hebrew at the University of Ingolstadt, Johannes Baptist Cysat, argued that the comet's body was similar to a concentration of stars that shine upon receiving the sunlight.[60] Grassi did not quote Cysat in the course of his dispute with Galileo but, in all likelihood, he shared some crucial cosmological views with him, namely the opinion that comets were produced by concentrations of celestial matter. Indeed, later, in his 1626 *Ratio ponderum librae et simbellae*, Grassi would argue that comets and planets were made up of the same matter and proposed comets were produced by the aggregation of a large quantity of corpuscles.[61] Thus, he endorsed the view that no corruption occurred in the celestial region.[62] In addition, Grassi agreed with his fellow professor at Ingolstadt that the celestial bodies moved according to the geo-heliocentric system of Tycho Brahe. This led Grassi to recognize the fluidity of celestial matter. The Collegio Romano mathematics professor made that point clear only in *Ratio ponderum*.[63]

Besomi and Helbing convincingly argue that, with his *Disputatio*, published in 1619, Grassi aimed to implicitly prove the validity of Tycho's explanation of cometary motions and, in so doing, he suggested the explanatory supremacy of the Tychonic planetary system.[64] Galileo was quick to understand this and made it clear:

> The Mathematician of the Collegio Romano has also accepted the same hypothesis for this last comet; beyond the little which that author has written about it, which agrees with Tycho's position, I am led to affirm this by seeing how much he concurs with Tycho's other

59 Grassi, *Disputatio astronomica de tribus cometis*, 278. Translation by O'Malley, *The Controversy on the Comets of 1618*, 15.

60 Cysat was most likely influenced by Scheiner's early understanding of sunspots as agglomerations of celestial matter moving very close to the Sun's surface. Cysat explicitly attributes this theory of sunspots to Scheiner. Cysat studied under Scheiner and is usually described as one of the witnesses in attendance when Scheiner first perceived the existence of sunspots. Cysat, Johann Baptist. *Mathemata astronomica de loco, motu, magnitudine et causis cometae*, 75-77. On Cysat's concept of comets and their similarity with stars, see in particular Siebert, *Die große kosmologische Kontroverse*, 321-325; Ribordy, "Neue Phänomene am Himmel", 247-249. A comprehensive account of the Cysat cometary theory can be found in Ribordy, "Neue Phänomene am Himmel". See also Granada, "Nove e comete nel periodo 1572-1623 e il dibattito Galileo-Grassi".

61 Grassi, *Ratio ponderum librae et simbellae*, 70 and 111.

62 In fact, in his *Ratio ponderum librae et simbellae*, alluding to the Peripatetic thesis that the heavens were made up of *quinta essentia*, Grassi maintained that celestial matter was very pure and refined (*purissima et defaecatissima*). Grassi, *Ratio ponderum librae et simbellae*, 133.

63 Grassi, *Ratio ponderum librae et simbellae*, 18.

64 Besomi and Helbing, "Introduzione", *Il Saggiatore*, 18.

fantasies throughout the remainder of the work.[65]

As we have seen, Grassi first tried to repudiate the accusation. Jesuits were publicly committed to the authority of Aristotle. Aristotelian natural philosophy had for centuries matched not only with Thomist theology but also with Ptolemaic astronomy. Nevertheless, in 1626, the Jesuit mathematician openly acknowledged his reliance on Tycho Brahe. He was crystal clear in his *Ratio ponderum librae et simbellae:*

> Since we should make clear our research on comets, it should be established first which hypothesis and planetary system [*Mundi dispositio*] is better suited. I would say that I adhered to that pleasing more to Tycho, that is to say, the one that considers the heavens to be fluid.[66]

Although different reasons could explain Grassi's change of strategy in 1626, one factor certainly stands out as decisive in his decision: the fact that the Jesuit authorities in Rome accepted the planetary system of Tycho Brahe in 1620.[67] Following a distressing process of internal censorship, Giuseppe Biancani's *Sphaera mundi* was published that year. This book was the first printed work by a Jesuit author to endorse the Tychonic planetary system even though the system did not get explicitly attributed to the Lutheran astronomer.[68]

4. Did the planets move "like the birds in the air or the fish in the water"?

The reception of Tycho Brahe's geo-heliocentric system was the "coup de grâce" for Ptolemaic astronomy even though some philosophers still subsequently maintained the traditional order of the celestial bodies. Such cases include Luigi Bompiani, who taught philosophy between 1640 and 1646.[69] In his lecture-notes *Disputationes physicae*, despite discussing the Copernican system briefly (he included a representational diagram) and accepting the fluidity of the planetary heaven, he was still committed to arguing in favour of the "common opinion" (*communis sententia*) that "places the immobile Earth at the centre of the universe, surrounded by the other elements and then by the planets, which move

65 "Il Matematico del Collegio Romano ha parimente per questa ultima cometa ricevuto la medesima ipotesi; e a così affermare, oltr'a quel poco che n'è scritto dall'Autore, che consuona con la posizion di Ticone, m'induce ancora il vedere in tutto 'l rimanente dell'opera quanto e' concordi con le altre Ticoniche immaginazioni". Galileo-Guiducci, *Discorso delle comete*, 174. I revised the occasionally misleading translation by Drake, *The Controversy on the Comets of 1618*, 52.

66 Grassi, *Ratio ponderum librae et simbellae*, 18.

67 On the Jesuit reception of Tycho Brahe's astronomical system, in particular see Lerner, "L'entrée de Tycho Brahe chez les jésuites".

68 Biancani, *Sphaera mundi*, 56-57.

69 Bompiani taught logics in 1640-41 and 1644-45, natural philosophy in 1641-42 and 1645-46, and metaphysics in 1642-43. Villoslada, *Storia del Collegio Romano*, 327, 330, and 332.

around the Earth, first the Moon, second Mercury, third Venus, fourth the Sun, fifth Mars, sixth Jupiter, seventh Saturn, eighth the heaven of [fixed] stars and in the ninth the Empyrean heaven [which is] immobile".[70]

According to the Tychonic system, all the planets moved around the Sun, and the Sun, together with the fixed stars and the Moon, orbited about the Earth, which stood still at the centre of the universe. However, for philosophers teaching after the 1651 publication of the influential *Almagestum novum* by Riccioli, there was a significant variation in this system. The Jesuit professor in Parma argued that Jupiter and Saturn were no longer Sun-centred but rather moved around the Earth.[71]

At the Collegio Romano, in keeping with their disciplinary divide, mathematicians and philosophers paid different attentions to the question of planetary systems, with the latter avoiding discussion of the *theorica planetarium*.[72] The philosophers Silvestro Mauro and André Semery preferred the Ricciolian planetary rearrangement, while Gabriele Beati favoured the Tychonic system.[73] According to this mathematics professor, who later taught natural philosophy twice at the same institution in the 1640s,[74] Riccioli's system did not account for the great eccentricity needed for the orbits of Jupiter and Saturn.[75] Nevertheless, there was also an issue with Tycho Brahe's system: it did not explain why planets moved in a fluid heaven in two apparently contrary motions (westwards and eastwards).[76] This led Beati, and other philosophy professors of the Collegio Romano, to adhere to the notion, already popular among Jesuit mathematicians, that the planets moved *per lineas spirales*, thus, according to a helicoidal pattern.[77]

The adherence to geo-heliocentric systems, associated with the appearance of comets crossing the skies and the telescopic observations of Venus's phases, the four satellites of Jupiter and the apparently three-bodied Saturn, paved the way for the acceptance of a new architecture for the universe: the tripartite division of the cosmos. The idea was not new.

70 Bompiani, *Disputationes physicae*, FC 1347, ff. 313r-313v.

71 On the Tychonic planetary system and its variations, including that of Riccioli, see, among others, Schofield, *Tychonic and Semi-Tychonic World Systems*; Marcacci, *Cieli in contraddizione*; Granada, *El debate cosmológico*, 31-59; Lerner, *Le Monde des Sphères. II - La fin du Cosmos*, 39-66.

72 Although discussing the issue *Utrum Terra moueatur circa Solem*, Cattaneo did enter into details about the different world systems in his *Cursus philosophicus.*

73 Mauro, *Quaestionum philosophicarum*, 42-43; Sémery, *Triennium philosophicum*, 723.

74 Beati taught mathematics in 1638-39, 1642-44, 1646-47 and 1660-61, logics in 1647-48, natural philosophy in 1644-45 and 1648-49, and metaphysics in 1645-46 and 1649-50. Villoslada, *Storia del Collegio Romano*, 327, 330, 332, and 335.

75 Beati, *Sphaera triplex*, 131.

76 *Ibid.*, 132.

77 *Ibid.*, 118, Mauro, *Quaestionum philosophicarum*, 47. On Beati's cosmological views, see Magruder, "Jesuit Science After Galileo" and Raphael "Teaching Sunspots: Disciplinary Identity and Scholarly Practice in the Collegio Romano".

The reflection on "the work of the Days", described in the Book of Genesis, had already led some Jesuit theologians, such as the Spanish Luis de Molina, to support a tripartite division of the cosmos and thereby potentially endorse the notion of planets moving in a fluid region.

By the 1630s, the tripartite division of the cosmos became common place in the Society of Jesus philosophical courses. Yet, despite the plurality of opinions regarding the limits of the three heavens, their nature and essential matter found among Jesuit scholars, there seems to have been a great deal of consensus on this issue in the Collegio Romano.[78] The mathematics and philosophy professors in Rome divided the heavens into the planetary heaven (*caelum planetarum*), the heaven of fixed stars or Firmament (*caelum stellatum*), and finally, sealing the universe, the Empyrean heaven (*Caelum Empireum*). Furthermore, the Roman professors agreed that the planetary heaven was most likely fluid, while the other two were deemed solid.[79] For example, Silvestro Mauro, who had taught natural philosophy twice by the mid-1650s, argued that only a fluid planetary heaven could account for the complex and helicoidal motion of the planets (especially Mars and Mercury), the intersection of the solar and Mars orbits, and the movement displayed by comets and particularly by those of 1618.[80] As for the starry heaven, the constant order and stability of the stars led scholars to conclude that the firmament must be a solid heaven.[81]

In the planetary heaven, planets move "like the birds in the air or the fish in the water" as Beati put it.[82] Nevertheless, his colleague Cattaneo disapproved of the analogy because "the motion with which the planets move through the sky is supremely orderly and uniform, and therefore should in no way be compared to that lawless and unordered motion with which the fish move in the sea and the birds in the air".[83] The order in which the planets and new stars move was granted, according to the Collegio Romano professors, by angels who were supposed to drive them.[84] Cattaneo argued, in tune with the Thomist

[78] On the diversity of opinions on these issues, see Randles, *The unmaking of the Medieval Cosmos Christian Cosmos*, 163-181; Carolino, "Astronomy, Cosmology and Jesuit Discipline", 680-683.

[79] Beati, *Sphaera triplex*, 110-113; Cattaneo, *Cursus philosophicus*, 766-767; Mauro, *Quaestionum philosophicarum*, 43-48; Sémery, *Triennium philosophicum*, 724-725. Gabriele Beati, nevertheless, distinguished between the inferior face of Empyrean heaven, which he considered solid, and the superior side that he maintained was fluid. Beati, *Sphaera triplex*,113.

[80] Mauro taught logics in 1653-54, natural philosophy in 1654-55 and 1657-58, and metaphysics in 1655-56. Villoslada, *Storia del Collegio Romano*, 327, 330, and 332.

[81] Mauro, *Quaestionum philosophicarum*, 46-47.

[82] Beati, *Sphaera triplex*, 111. Semery made use of the same analogy. Sémery, *Triennium philosophicum*, 725.

[83] Cattaneo, *Cursus philosophicus*, 765.

[84] Beati, *Sphaera triplex*, 119-120; Cattaneo, *Cursus philosophicus*, 769-772; Mauro, *Quaestionum philosophicarum*, 48; Pallavicino, *De universa philosophia*, 114; Sémery, *Triennium philosophicum*, 750.

conception of providence supported by the Jesuit hierarchy and reaffirmed both in the Order's statutes and in the *Ratio studiorum*, that non-animated bodies, such as planets and stars, were driven by intelligences that guide them according to higher and ultimate purposes. According to this view, God governed the created world through the mediation of secondary causes. Hence, angels moved the celestial bodies which exerted a universal influence over the terrestrial region.[85]

5. The Aristotelian divide: celestial incorruptibility in the 1670s

In Rome, adherence to the geo-heliocentric system of Tycho Brahe did not necessarily mean the collapse of the Aristotelian cosmological framework. While Aristotelian natural philosophy rested upon the idea there was an ontological distinction between the celestial and the terrestrial regions. We have already seen that, for example, the Jesuit professors at Coimbra in the late sixteenth century had deduced the ontological superiority of the celestial region from the assumption that celestial bodies lacked privation (matter and form were supposedly inseparable), move in a circular path, occupy a higher place, and influence the terrestrial region. This idea still remained popular in Rome until the mid-seventeenth century[86].

The reason for celestial incorruptibility lay in the matter that made up the celestial bodies, the *quinta essentia*, which Orazio Grassi had alluded to in his *Ratio ponderum librae et simbellae.*[87] In the philosophical theses sustained at the Collegio Romano by Sforza Pallavicino in 1625, the would-be professor of philosophy and celebrated historian of the Council of Trent stated it was easy to conclude, from its appropriate accidents, that the *coelum esse quintam quandam substantiam.*[88] As Pallavicino graduated in the aftermath of the controversy over comets that opposed the Jesuits against Galileo, he could not simply ignore the celestial novelties. Referring to the new stars of 1572, 1600, and 1604, he argued they were most likely not new stars but rather the aggregation of a great number of small stars otherwise invisible to the naked eye from the earth's surface. An additional explanation was God's extraordinary intervention in the regular course of nature.[89] This understanding of celestial matter and celestial novelties experienced great longevity at the Collegio Romano, taught by Luigi Bompiani, in the 1640s, and by

85 Cattaneo, *Cursus philosophicus*, 772.

86 Beati, *Natura in Arctum coacta*, 8-9.

87 See note 62.

88 Pallavicino, *De universa philosophia*, 102. Sforza Pallavicino taught philosophy at the Collegio Romano between 1639 and 1642 (logics, 1639-40; natural philosophy, 1640-41; metaphysics, 1641-42). Villoslada, *Storia del Collegio Romano*, 327, 330, and 332.

89 Pallavicino, *De universa philosophia*, 107-108.

Silvestre Mauro, in the late 1650s.[90]

Nevertheless, in the early 1660s, alternative conceptions of celestial matter did emerge at the Collegio Romano. Gabriele Beati, once an advocate of celestial incorruptibility, put forward the thesis according to which the heavens displayed an elementary nature.[91] They were made up of fire and water. As far as the planetary heaven (*caelum sydereum*) was concerned, this consisted of fire.[92] As the case, the Jesuit stated that "the heavens are by their nature corruptible".[93] The sunspots, comets, and new stars recently observed in the skies were examples of celestial corruption. Contrary to that traditionally taught at the Collegio Romano, Beati conceived of these phenomena not as the aggregation of very small and previously unseen stars but instead as the concentration of celestial exhalations provoked by the motion and conjunctions of the celestial bodies.[94] Although one could argue that the concentration of celestial matter was not a substantial change, Beati recognized that these phenomena were indeed produced *de novo*, and, therefore, the *caelum, natura sua, esse corruptibile*.[95] Nevertheless, Beati added an important caveat: the heavens may be by accident (*per accidens*) incorruptible. In his words,

> However, because of the great distance at which they are from us, their extensive matter, or the prodigious mixture of their God-given qualities, the heavens have no natural agent that can change them substantially [*substantialiter*]. Thus, the heavens may be considered incorruptible by accident [*per accidens*].[96]

Therefore, while the substance of the heavens paved the way for celestial corruption, the absence of any natural cause might lead them into remaining unchangeable. This could explain – the reader concludes – why there were relatively few comets, new stars, and sunspots in comparison to the great variety of processes of comings-to-be and passings away constantly happening on Earth.[97] In the heavenly region, these changes were produced either by the motion of the celestial bodies, natural ways imperceptible to human under-

90 Bompiani, *Disputationes physicae*, FC 1347, ff. 326v-327v.; Mauro, *Quaestionum philosophicarum*, 54-57, and 64.

91 Renée Raphael has already pointed out this apparent contradiction, which she attributes to the disciplinary distinctions and scholarly practices ongoing at the Society of Jesus. Raphael "Teaching Sunspots: Disciplinary Identity and Scholarly Practice in the Collegio Romano".

92 Beati, *Sphaera triplex*, 108.

93 *Ibidem*.

94 *Ibid.*, 196, 245-248, and 253.

95 *Ibid.*, 199.

96 *Ibid.*, 109.

97 Beati mentioned that only some very small parts of the heaven are susceptible to corruption. *Ibid.*, 108-109.

standing, or divine miracles.[98] The final cause was divine providence.[99]

By the late 1670s, Ottavio Cattaneo was much more assertive than his confrère.[100] He held no doubts in claiming "with Aristotle, whom St. Thomas follows, that the heaven is incorruptible".[101] His arguments were neither new – celestial bodies' circular motion, lack of contrary elements and terrestrial qualities, etcetera – nor particularly persuasive.[102] Nevertheless, they appeared rather convincing to orthodox theologians. Referring to the appearance of comets over the skies, for example, he determined that "it should be asserted that the cause of the comets is only God, who without doubt lit up such bodies to announce beforehand a great number of future effects".[103]

Away from Rome, in other Society of Jesus provinces, philosophy and mathematics teachers had by then developed different understandings of what Aristotelian orthodoxy consisted of. For teachers on the geographical peripheries of Europe, there was no difficulty in recognising, from the 1640s and 1650s onwards, that celestial novelties proved celestial corruptibility. In Coimbra, writing in the 1630s, Baltazar Teles did not hesitate to consider celestial bodies being as corruptible as the sublunar bodies[104]. At the University of Würzburg, Melchior Cornaeus taught, in the 1650s, that the *novae* of 1572, 1600, and 1604 showed that substantial changes took place in the heavenly region.[105] In Warsaw, one year after the publication of Cattaneo's orthodox philosophical course, Adam Kwiryn Krasnodebski serenely acknowledged, in his *Philosophiae Aristotelis explicatae*, that the heavens were corruptible.[106] Even further away, the Moravian Valentin Stansel, composing his fantastic *Uranophilus caelestis peregrinus* in São Salvador da Bahia, Brazil, at around the same date, described the planets almost as if they were terrestrial bodies:

> After telescopes were invented, mountains and valleys appeared in the stars, there is nothing that was more quarreled over or doubted by philosophers. Planetary bodies, including the earth, discharge liquids and vapors in which comets are formed, after sucking up the rays of the sun.[107]

98 *Ibid.*, 109.
99 *Ibid.*, 253.
100 Cattaneo taught logics in 1670-71 and 1674-75, natural philosophy in 1671-72 and 1675-76, and metaphysics in 1672-73 and 1676-77. Villoslada, *Storia del Collegio Romano*, 328, 330, and 332.
101 Cattaneo, *Cursus philosophicus*, 760.
102 *Ibid.*, 757-765.
103 *Ibid.*, 764-765.
104 Teles, *Summa Universae Philosophiae*, 317.
105 Cornaeus, *Curriculum philosophiae peripateticae*, vol. 1, 489.
106 Krasnodebski, *Philosophiae Aristotelis explicatae*, § 205.
107 Quoted in Camenietzki, "The Celestial Pilgrimages of Valentin Stansel", 260.

Concluding remarks

The Collegio Romano championed philosophical orthodoxy throughout the seventeenth century. In the past, the echoes of the different philosophical disputes of the late Renaissance had resonated within the college. The debates on the epistemological status of mathematics had also animated the college's intellectual ambience, eventually shaping the broader Jesuit mathematical curricula. Nevertheless, Claudio Acquaviva's generalate inaugurated a new phase in the Jesuit struggle to preserve the desired *uniformitas et soliditas doctrinae* within the Order. As Acquaviva's governance was coming to an end, the issues with Copernicanism were gaining momentum within the Catholic Church. It was against this scenario that three bright comets crossed the skies in late 1618, further raising the debate on the very foundations of Aristotelian philosophy and Ptolemaic astronomy.

The dispute was particularly intense in Rome, opposing the professors of the Collegio Romano against Galileo and the *Lincei*. At stake was not only the intellectual prestige of the contenders but, and above all, the explanatory validity of the astronomical systems of Copernicus and Tycho Brahe and the cornerstones of Aristotelian natural philosophy. Thus, as a consensus emerged that the 1618 comets moved above the Moon, both the principles of celestial solidity and incorruptibility seemed at jeopardy.

At first, the Jesuits strove to make the cometary observations compatible with the thesis of celestial solidity. On the eve of the controversy with Galileo, the philosophers proposed the *ingeniosa* thesis according to which comets were the optical output of an aggregation of stars located in different epicycles. Even if the thesis was as ingenious as it was fanciful, it returned one main advantage: its respect for both the principle of celestial solidity and that of incorruptibility. Because of its orthodox nature, this argument retained its place in the natural philosophy teaching at the Collegio Romano well into the 1640s. From the historiographical point of view, this thesis is particularly interesting because it demonstrates how for some early modern scholars, the observation of comets in the celestial region did not necessarily lead to the collapse of Ptolemaic astronomy.

Furthermore, the Collegio Romano Jesuits proved more tenacious. In addition to demonstrating that the comet of 1618 was placed between the Moon and the Sun, Grassi proposed it moved according to the cometary and, what is more, the planetary theory of Tycho Brahe. This led him and the majority of Jesuits who followed him in the Collegio Romano mathematical and philosophical chairs to recognize that the heavens were fluid. Again, this idea was aligned with the Tychonic geo-heliocentric system.

Galileo, who was forbidden to follow the heliocentric model following the Catholic Church's ban on Copernicanism in 1616, was quick to recognize the Jesuit shift towards Tychonic ideas. Accordingly, he accused Grassi of following Tycho Brahe and, in so doing, raised the question of the Jesuit commitment to following Aristotelian philosophy. Galileo, in turn, proposed a cometary thesis that acknowledged celestial corruptibility and, as such, opposed the ontological division upon which Aristotle's natural philosophy was based. The celebrated controversy over the comets was to follow.

Analysis of the seventeenth century teaching of cosmology at the Collegio Romano proves that the controversy continued to impact on Roman Jesuits well beyond the publication of Galileo's *Il Saggiatore* in 1623. The arguments deployed in the controversy reverberated inside the classes of the Collegio Romano for decades, with the professors of philosophy and mathematics struggling to maintain – against Galileo – that the heavens were ontologically different from the terrestrial region and, thus, immune to corruption. Even after adhering to the planetary system of Tycho Brahe, they continued to stand up for celestial incorruptibility. Thus, the reception of Tycho Brahe did not equate to the collapse of Aristotelian cosmology in the Collegio Romano viewpoint.

The Collegio Romano Jesuits were therefore proclaiming the authority of Aristotle in philosophy well into the second half of the seventeenth century. In so doing, the Collegio Romano became the champion of philosophical orthodoxy within the Jesuit educational network. This was the ultimate consequence of the celebrated debate that opposed the Jesuits and Galileo over the comets and their cosmological significance.

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