Stress in the Book of Nature: the Supplemental Logic of Galileo's Realism

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Since the late medieval period, nature had been represented as a book that, like the Scripture, had signs, meanings, and secrets for the reader to interpret.[1] In 1623, Galileo turned this topos on its head and stated that the reading of the book of nature was not a matter of interpretation. As he put it in a much-quoted passage from the *Assayer*:

> Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But it cannot be understood unless one first learns to comprehend the language and recognize the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles and other geometric figures without which it is humanly impossible to understand a single word of it. Without these, one wanders about in a dark labyrinth.[2]

Although the understanding of nature remained an exceedingly complex and laborious process, it was open and transparent to

[1] James Bono, *The Word of God and the Languages of Man* (Madison: University of Wisconsin Press, 1995), 123–98; Ernst Robert Curtius, *European Literature and the Latin Middle Ages* (New York: Harper & Row 1963), 319–26; Olaf Pedersen, *The Book of Nature* (Vatican City: Vatican Observatory 1992), esp. 42–53; Hans Blumemberg, *Die Lesbarkeit der Welt* (Frankfurt: Suhrkamp Verlag 1981).

[2] Galileo Galilei, *The Assayer*, in Stillman Drake and C.D. O'Malley, *The Controversy on the Comets of 1618* (Philadelphia: University of Pennsylvania Press 1960), 183–4.

MLN 118 (2003): 557–585 © 2003 by The Johns Hopkins University Press

anyone with a specific linguistic competence: geometry.[3] Canonized by historians and philosophers of science, this passage has come to characterize Galileo's methodology and, more generally, mathematical realism.[4]

However, if we trace the genealogy of the "book of nature" to the various texts Galileo wrote between 1613 and 1615 to defend Copernican astronomy from objections based in literal readings of the Scripture, we see that Galileo's topos was ridden with aporias. The book of nature was very effective at casting nature as transparent, but could not claim the same transparency for itself. I want to argue that the aporias in the book of nature were not accidental but inherent in Galileo's methodological positions—positions he articulated in the midst of debates about the authority of astronomy vis à vis that of theology. The topos of the book of nature did not emerge as an abstract methodological reflection, but as a context-specific response to critics who had invoked the absolute authority of another book: the Scripture. By using some of the tools of literary theory to reconstruct the logic of this clash among authoritative books, I want to show that what has been canonized as a debate about the authority of the Scripture, the epistemological status of astronomical hypotheses, and the role of empirical evidence, was, in fact, about the predicaments of writing.[5]

Emerging in (and needing to comply with) a discursive context framed by the theologians' Scripture-based regime of truth, Galileo's book of nature did not and could not try to cast the domain of astronomy and philosophy as merely independent from theology. The space he tried to develop for astronomy was not carved away from that of theology but rather grafted on to it, constructed through the features and discursive practices of that more authoritative field. His moves were not and could not be merely oppositional. They were,

[3] Mario Biagioli, *Galileo Courtier* (Chicago: University of Chicago Press, 1993), 306–7; Bono, *The Word of God and the Languages of Man*, 193–8. Bono shows that Galileo's view of the book of nature as a text that could not be interpreted but only read marked a sharp break with previous characterizations of the topos.

[4] Alexandre Koyré, "Galileo and Plato" in *Journal of the History of Ideas*, 4 (1943), 400–428. For a critique, see Joseph C. Pitt, *Galileo, Human Knowledge, and the Book of Nature: Method Replaces Metaphysics*, (Dordrecht: Kluwer 1992), 53–77.

[5] My argument parallels some of the critiques made by Lily Kay to a similar construct—the book of life—in her *Who Wrote the Book of Life?* (Stanford: Stanford University Press 1999).

instead, supplemental in a sense similar to the one that Derrida has given to the term. As a result, Galileo's moves replicated or even amplified in variously displaced forms several of the irresolvable tensions underlying the theologians' attempt to root their authority in their ability to reconstruct God's original speech from the pages of the Scripture. While the content of Galileo's claims was often in conflict with the exegetical positions held by the Church, his logic was as logocentric as that of the theologians. This might explain why, almost four centuries later, debates about the relationship between scientific claims and scriptural teachings seem to have deadlocked.[6] Galileo's so-called mathematical realism was, in fact, a form of scriptural fundamentalism.

Timing, Constraints, and Supplements

There is no evidence that Galileo wanted to initiate a debate on the relationship between Copernicanism and the Scripture. His previous astronomical publications—the 1610 *Sidereus nuncius* and the 1613 *Letters on Sunspots*—presented a number of observations that contradicted traditional Ptolemaic astronomy while lending support to the Copernican alternative, but were careful to situate the discussion within the bounds of natural philosophy without trespassing into theology. A few years later, however, Galileo was forced to confront issues of Scriptural exegesis by critics who questioned his personal piety and the religious orthodoxy of the Copernican hypothesis by citing scriptural passages which, if interpreted literally, instantiated a geocentric cosmology.

Responding to a letter from his disciple Castelli who reported an unexpected question about the religious orthodoxy of Copernicanism raised by the Grand Duchess Christina during a meal at court in December 1613, Galileo sent him a short essay outlining his position on the relationship between astronomy and scriptural exegesis.[7]

[6] On the unending history of the debate on Galileo's trial see Maurice Finocchiaro, "The Galileo Affair from John Milton to John Paul II: Problems and Prospects," in *Science and Education* 8 (1999), 189–209; "Aspects of the Controversy about Galileo's Trial (from Descartes to John Paul II)," Jose Montesinos and Carlos Solis (eds.), *Largo Campo di Filosofare* (La Orotava: Fundacion Canaria Orotava de Historia de la Ciencia 2001), 491–511.

[7] Castelli to Galileo (14 December 1613), in Maurice Finocchiaro, *The Galileo Affair* (Berkeley: Univerity of California Press 1989), 47–8; Galileo to Castelli (21 December 1613), ibid., 49–54.

Worrying that the pious Grand Duchess might want to continue the conversation and perhaps develop doubts about the religious orthodoxy of her subject, Galileo composed this letter in just a few days.[8] That he never published it points to his reluctance to start a debate. However, the letter was copied and circulated locally, fueling further concerns within the Florentine clergy—concerns turned into public accusations during a sermon delivered in December 1614.[9] Soon after, a copy of Galileo's letter and a judicial deposition charging him of suspect heresy were delivered to the Congregation of the Holy Office in Rome.[10] Right as the inquisitorial process was set in motion, a Carmelite theologian unknown to Galileo, Antonio Foscarini, published a book aimed at reconciling Copernicus and the Scripture, but managed only to make the debate more polarized.[11] When Galileo's most articulate defense of his exegetical stance—the "Letter to the Grand Duchess"—started to circulate late in 1615, the debate had spread well beyond anything his text could hope to control. A few months later, Copernicus' *De revolutionibus* was placed on the Index, setting the stage for Galileo's trial of 1633.[12]

This chain of events reflected the striking pattern of constraints and handicaps facing Galileo: He was no expert in Biblical exegesis or theology; Scripture was deemed more authoritative than any astronomical text; Galileo's disciplinary authority (as a mathematician) was much inferior to that of the theologians; and the head of the theologians (the Pope) was clearly more powerful than Galileo's patrons (the Medici).[13] Besides this series of power differentials,

[8] Galileo to Castelli (21 December 1613), in Finocchiaro, *The Galileo Affair*, 49–54.

[9] Caccini's Deposition (20 March 1615), in Finocchiaro, *The Galileo Affair*, 136–7.

[10] "Lorini's Complaint (7 February 1615), in Finocchiaro, *The Galileo Affair*, 134–5. The copy sent by Lorini to Rome differed from Galileo's original in a few significant details, making it much more liable of censure (Massimo Bucciantini, *Contro Galileo*, (Florence: Olschki 1995), 35–6).

[11] Paolo Antonio Foscarini, *Lettera sopra l'opinione de' Pittagorici e del Copernico . . .* (Naples: Scoriggio 1615). A translation of this text is in Richard Blackwell, *Galileo, Bellarmine, and the Bible* (Notre Dame, University of Notre Dame Press 1991), 217–251. Blackwell also reproduces Cardinal Bellarmine's letter to Foscarini and a censor's report on his text. The Holy Office's documents relating to the inquisitorial process leading to the condemnation of 1616 are in Finocchiaro, *The Galileo Affair*, 135–46.

[12] Finocchiaro, *The Galileo Affair*, 146–50.

[13] Galileo told Dini that the controversy that the "Letter to Castelli" set in motion, "have made me look at other writings on the topic," Galileo to Monsignor Dini (16 February 1615), in Finocchiaro, *The Galileo Affair*, 55. Galileo relied on his friend Benedetto Castelli (a friar-mathematician who had also received theological training)

Galileo's reluctance to engage in a dispute on the authority of astronomy and the Scripture reflected an even greater handicap. He lacked the kind of evidence the theologians might have accepted as a conclusive proof of Copernicanism. This absence was the most important factor in structuring Galileo's discursive tactics, down to the topos of the book of nature.

It would have been in Galileo's best interest to avoid such a debate, but he was drawn into it by events that, although indirectly triggered by his earlier publications, were ultimately outside of his control. For instance, he could not refrain from writing the "Letter to Castelli" because allegations of heresy could have quickly endangered his patronage relationship with the Medici.[14] But while he tried to stall or slow down the debate to gain time to assemble more pro-Copernican evidence, the reluctant (and somewhat rough) response that he had conceived as a crisis-containment device only fueled its escalation. The "Letter to Castelli" had the further unintended consequence of shifting the debate from forums friendly to Galileo (Florence and its court) toward remote theaters of operation (the Holy Office in Rome) where he had less intelligence and fewer supporters. As the debate moved to Rome, its scope escalated too. What had started as a leisurely discussion between two or three people over lunch turned into a judicial process which, further fueled by Foscarini's unexpected intervention, bloomed into a full-fledged disputation over the authority of astronomy and theology.

As Galileo's epistemological and social resources did not increase to match such an escalation, his arguments became simultaneously

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to gather the appropriate sources. On January 6, 1615, Castelli reported that: "Io sono alle mani con il Padre Predicatore de' barnabiti, affezionatissimo alla dottrina di V.S., e m'ha promesso certi passi di S.Agostino e d'altri Dottori in confermazione del sentimento dato da V.S. a Giosue,'" Galileo Galilei, *Opere*, Vol. XII (Florence: Barbera 1902), 126–7. Galileo's "Letter to Castelli" includes no references to theological literature or to any of the rulings of the Council of Trent on matters of Biblical exegesis, but such references are very common in the "Letter to the Grand Duchess."

[14] Galileo wrote Monsignor Dini about the Bishop of Fiesole, Monsignor Gherardini, who "burst out with the greatest vehemence against me, appearing deeply agitated, and saying that he was going to mention the matter at great length to their Most Serene Highnesses, since my extravagant and erroneous opinion was causing much talk in Rome," Galileo to Monsignor Dini (16 February 1615), Finocchiaro, *The Galileo Affair*, 57. Within the Medici family, the Grand Duchess Christina seemed to be the most receptive to doubts about the Christian orthodoxy of the Copernican hypothesis and, therefore, of Galileo.

general and defensive.[15] The book of nature may sound like a confident if not arrogant methodological manifesto, but it was the final and most general expression of a defense engineered around a pattern of constraints and handicaps. The apparent positivity of the image of the book of nature and of Galileo's mathematical method resulted from a recasting of his many handicaps and absences into supplements which could produce effects of presence—positive social and epistemological resources he did not, in fact, have.

From the Aristotelian Corpus to the Book of Nature

In several texts from this period, Galileo grounded his defense of Copernicanism on the following assumptions:

1. Two truths cannot contradict each other.[16]
2. Both nature and the Scripture are authored by God and, consequently, are equally true.[17]
3. The domains of astronomy and theology, their interpretive protocols, and their different authority need to be understood as deriving from the specific features of the two divine texts read by these two disciplines.[18]

Galileo and the theologians agreed on the first two assumptions. The third claim, instead, encapsulated the many contentions about disciplinary boundaries, methods, and hierarchies between astronomy and theology that Galileo was trying to renegotiate. According to Galileo, the theologians believed that

> theology is the queen of all the sciences and hence must not in any way lower herself to accommodate the principles of other less dignified

[15] Galileo wrote the "Letter to the Grand Duchess" as if he were not defending himself but all Copernicans and even the entire discipline of mathematics from the attacks being brought forward against it by an unspecified "they." For instance, ". . . this was done with little consideration of the injury not only of the doctrine [Copernicus'] and its followers, but also to mathematics and all mathematicians," or "For in order to accomplish that objective, it would be necessary not only to prohibit Copernicus' book and the writings of the other authors who follow the same doctrine, but also ban all astronomical science completely." In Finocchiaro, *The Galileo Affair*, 89, 103.

[16] Finocchiaro, *The Galileo Affair*, 51, 52, 74, 75, 81, 96.

[17] Finocchiaro, *The Galileo Affair*, 50, 93.

[18] ". . . His works and by divine grace are read in the open book of the heavens. Nor should anyone think that the reading of the very lofty words written on those pages is completed by . . . ." Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 103.

> disciplines subordinated to her; rather, these others must submit to her as to a supreme empress and change and revise their conclusions in accordance with theological rules and decrees.[19]

By positing the existence of two equally divine and true books, Galileo was trying to turn a hierarchical relationship between theology and astronomy into a parallel one: both theology and astronomy dealt with the same truth, but one that was written in two different books.

Galileo's predicament was simultaneously reactive and proactive. By presenting both astronomy and theology as disciplines dealing with the same truth inscribed in two different but equally sacred books, Galileo tried to cast himself as respectful of the authority of divine books, not an atheist who put scientific evidence above scriptural teachings. But as he endorsed the theologians' book-based regime of truth and made it his own, he also elevated the status of astronomy as a science that, like theology, dealt with the decoding of divine speech—the speech that authored both nature and the Scripture. Galileo could then argue that when the reading of these two sacred books sent theology and astronomy on a collision course, such conflicts could no longer be adjudicated by considering which discipline was the most authoritative. One should instead evaluate the competing claims by considering the specific features of the two books and the exegetical options they did or did not offer to their readers. The power of solving disciplinary clashes was attributed to the books themselves, not to their readers. The book of nature, therefore, was a Trojan horse: it seemed to pay homage to the theologians and their regime of truth, but it would have restricted their authority if they allowed it through their gates.

The close fit between Galileo's socio-epistemological predicament and the discursive resources provided by the book of nature is far from coincidental. The genealogy of the topos is directly linked to the contingencies of Galileo's engagement with the theologians in the 1613–5 period. By the time the geometrical book of nature was presented in the 1623 *Assayer*, its relationship to the Scripture had already been effaced, thus facilitating later readings of the topos as a purely philosophical reflection on the relationship between mathematics and physical reality rather than a defensive, context-specific discursive tactic developed against an equally specific adversary. But the genealogical link between the Scripture and the book of nature is

[19] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 99.

explicit in Galileo's 1613 "Letter to Castelli" and in the 1615 "Letter to the Grand Duchess Christina." While those texts do not yet present nature as explicitly geometrical, they cast it as fully transparent, that is, as something that could be read but not interpreted. This defining feature of all subsequent incarnations of Galileo's book of nature emerged precisely from his casting nature in a complementary relation to the Scripture during the debates of 1613–5.[20]

Looking at Galileo's use of the topos of the book prior to the debate over astronomy and theology, we see that he did not always treat that image as the paradigm of epistemological transparency. Until 1613, the topos functioned as a negative marker—typically as a way to demarcate Aristotelian philosophers (allegedly bound to their master's corpus) from Galileo-style natural philosophers (who allegedly accepted only the authority of empirical evidence). In a 1611 letter to Kepler—another proponent of the book of nature[21]—Galileo derided the philosophical establishment for refusing to engage with the evidence produced by his telescope:

> What do you think of the chief philosophers of our gymnasium who, with the stubbornness of a viper, did not want to see the planets, the moon, or the telescope, even though I offered them the opportunity a thousand times? In truth, just as he [Odysseus] closed his ears, so they closed their eyes to the light of the truth. That is monstrous but it does not astonish me, for the men of this kind think that philosophy is a book, like the Aeneid or the Odyssey, and that the truth is to be sought not in the world and in nature, but in comparison of texts (as they call it).[22]

At this time Galileo was not presenting philosophy as written in the book of nature, but rather as something his opponents had wrongly reduced to a human book—Aristotle's corpus. In 1611, then, Galileo saw the book as a "bad" human copy that he opposed to the "truth to

[20] Galileo reproduced his 1623 description of the book of nature in a letter written just one year before his death. Late in 1641, he told the philosopher Fortunio Liceti: "I truly believe the book of philosophy to be that which stands perpetually open before our eyes, though since it is written in characters different from those of our alphabet it cannot be read by everyone; and the characters of such a book are triangles, squares, circles, spheres, cones, pyramids, and other mathematical figures, most apt for such a reading." (As translated in Stillman Drake, *Galileo at Work* (Chicago: University of Chicago Press 1978), 412.)

[21] Olaf Pedersen, in *The Book of Nature*, 42–6.

[22] Galileo to Kepler (19 August 1610), Galileo Galilei, *Opere*, Vol. X (Florence: Barbera 1900), 423, trans. in Hans Blumemberg, *The Genesis of the Copernican World*, 658.

be sought in the world and in nature." Nature, therefore, was not yet presented as a book. Galileo moved in that direction in 1613, just a few months before the "Letter to Castelli." In a text on sunspots he sent to Marc Welser, Galileo introduced the notion of "this grand book of the world" in opposition to the allegedly stultifying books of the Aristotelians:

> Some righteous defenders of every Aristotelian minutia [...] have been taught and fed since the beginning of their education the opinion that philosophy is—and could not be anything else than—working Aristotle's texts over and over. Because [they believe] that one can quickly cut and paste passages from this corpus to come up with answers to all questions, they never want to lift their eyes from these texts, as if nature had written this grand book of the world to have it read only by Aristotle and have his eyes see for all posterity.[23]

While the "grand book of the world" presented here seems almost identical to the "book of nature," an important piece is still missing: The opposition between the transparency of the book of nature and the opacity of the Aristotelian corpus or any other form of human writing. That dimension was added precisely during the debates of 1613–15. It was in that context that the book invoked against Galileo's claims ceased to be human (Aristotle's corpus) and became divine (the Scripture). It was the theologians' invocation of the divine authority of a super-human Book that allowed (or perhaps forced) Galileo to up his game and present natural philosophy as referencing an equally divine and super-human book of nature.

The texts from 1613–5, therefore, represent the penultimate step in Galileo's articulation of the book of nature. Nature was equated to a "grand book" (in the 1613 letter to Welser) and presented as transparent and outside of the domain of interpretation (in the letters to Castelli and to the Grand Duchess Christina). What was absent in 1615 was the geometrical character of the book of nature.

[23] ". . . Alcuni severi difensori di ogni minuzia peripatetica, li quali, . . ., educati e nutriti sin dalla prima infanzia de i loro studii in questa opinione, che il filosofare non sia, ne' possa essere altro, che un far gran pratica sopra i testi di Aristotele, siche` prontamente e in gran numero si possino da diversi luoghi raccorre, e accozzare per le prove di qualunque proposto problema, non vogliono mai sollevar gli occhi da quelle carte, quasi che questo grande libro del mondo non fosse scritto dalla natura per essere letto da altri, che da Aristotele, e che gl'occhi suoi avessero a vedere per tutta la posterita,'" Galileo, *Istoria e dimostrazioni intorno alle macchie solari*, in Galileo Galilei, *Opere* Vol. V, (Florence: Barbera 1895), 190.

That was added in 1623, without however changing anything about the logic of the topos.

A brief history of Galileo's book of nature shows that, at each step of its genealogy, the topos was deployed and articulated to counter the authority of increasingly more powerful disciplines. Paradoxically, the most powerful opponent—theology—provided Galileo with his most effective discursive tool. By fashioning the book of nature within the logocentric economy of the Scripture, not only did Galileo manage to represent astronomy as a sister discipline to theology, but he could, by the same token, elevate astronomy above Aristotelian philosophy. In Derridian terms, Galileo framed Aristotle's books as the product of writing as human technique, but presented both the Scripture and the book of nature as instances of "natural writing"—writing that was "immediately united to the voice and to breath" and whose nature "is not grammatological but pneumatological."[24] In the case of the book of nature and the Scripture, the terms "book" and "script" were used metaphorically, as "a sign signifying a signifier itself signifying an eternal verity, eternally thought and spoken in the proximity of a present logos."[25] Aristotle's corpus, instead, was just a set of all-too-human books, far removed from the Logos.

Selling the Book of Nature to the Theologians

Galileo did not have the disciplinary authority to force the theologians to accept the complementary relationship between natural philosophy and theology inscribed in the book of nature. He hoped, however, that his discovery of the phases of Venus could make the theologians perceive the book of nature as a solution to their problems. The phases of Venus did not prove Copernicus, but they did "clearly confute the Ptolemaic system"—the very astronomy the theologians relied on for their Scriptural exegesis.[26] Furthermore,

[24] Jacques Derrida, *Of Grammatology* (Baltimore: Johns Hopkins University Press 1974), 17.

[25] Jacques Derrida, *Of Grammatology*, 15.

[26] ". . . the same Venus appears sometimes round and sometimes armed with very sharp horns and many other observable phenomena which can in no way be adapted to the Ptolemaic system . . ." and "They [the critics] hear how I confirm this view [Copernicus'] not only by refuting Ptolemy's and Aristotle's arguments, but also by producing many for the other side, especially some pertaining to physical effects whose causes perhaps cannot be determined in any other way, and other astronomical ones dependent on many features of the new celestial discoveries; these discoveries clearly

Galileo's discovery was confirmed in 1611 by the Jesuit mathematicians of the Collegio Romano—a report the theologians could not ignore since it had been requested by and forwarded to Cardinal Bellarmine, the head of the Holy Office.[27] Galileo believed the Jesuits had fully understood the cosmological implications of this discovery. In the "Letter to the Grand Duchess," he argued that Clavius, the chief mathematician at the Collegio, "influenced by my recent discoveries, [has] admitted the necessity of changing the previous conception of the constitution of the world, since it can no longer stand up in any way."[28]

The theologians, Galileo tried to argue, were in deep trouble because the demise of Ptolemaic astronomy through the phases of Venus had effectively falsified their literal reading of the Scripture—a reading that was framed by geocentric assumptions.[29] As a result, they were in no position to assert that Copernicus was false because it did not fit the geocentric reading of the Scripture. If the theologians wanted to condemn Copernicus, they needed first to prove that it was

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confute the Ptolemaic system, and they agree admirably with this other position [Copernicus] and confirm it," Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 103, 88–9. I believe Galileo did not draw a stronger connection between the phases of Venus and the refutation of Ptolemy (or emphasized the fact that they had been corroborated by the Jesuit mathematicians) because he did not want to precipitate a confrontation between Jesuit mathematicians and their theologians (Bellarmine being one of them). It is clear from the letters he wrote to Dini that Galileo counted on the Jesuits mathematicians to support him. Had he stated that the refutation of Ptolemy was the result of a discovery that had been certified by the Jesuits, he would have openly cast them as "Ptolemy killers," that is, as the cause of the theologians' problems. The relationship between the phases of Venus and heliocentrism is discussed also in Galileo's 1615 "Considerations on the Copernican Opinion" in Finocchiaro, 78, 80.

[27] Bellarmine to the Mathematicians of the Collegio Romano (19 April 1611); Mathematicians of the Collegio Romano to Bellarmine (24 April 1611), in Galileo Galilei, *Opere*, Vol. X (Florence: Barbera 1901), 87, 92. The report of the Jesuit mathematicians was never impugned since it was made available in April 1611.

[28] Galileo, "Letter to the Grand Duchess" in Finocchiaro, *The Galileo Affair*, 102. The reference to Clavius was added in margin in the original (Galileo Galilei, *Opere* Vol. V (Florence: Barbera 1895), 328).

[29] As I discuss toward the end of the essay, Galileo's claim rested on his remarkable erasure of Tycho's model as one of the alternatives open to the theologians. Tycho's model could explain the phases of Venus within a geocentric (but non-Ptolemaic) framework. However, it is equally surprising that the theologians did not dismiss Galileo's refutation of geocentrism by bringing in Tycho. Perhaps, the theologians felt they should not use Tycho because such a move would have changed the rules of engagement by showing that the theologians were willing to engage with astronomical doctrine, not simply scriptural arguments.

false because a proposition cannot be true and heretical at the same time.[30] As Galileo had already refuted Ptolemy, it was now up to the theologians to refute Copernicus (and thus undo Galileo's refutation of Ptolemy) if they wished to maintain the credibility of their literal reading of the Scripture. Until then, the authority of a geocentric reading of the Scripture was void and could not be used to declare Copernicus false, which meant that the theologians (or any other critic) ought to refute Copernicus only through astronomical arguments. The other option Galileo was implicitly offering to the theologians was to agree that nature and the Scripture were two different but equally true books to be read following different protocols.

The book of nature, therefore, was presented to the theologians as part of a "two-book package" to establish a logically-looking, face-saving truce between astronomy and theology, and to relieve them from the burden of having to refute Copernicus to recover their disciplinary authority. The theologians, however, did not seem to realize that they had such a burden (or that they needed Galileo's help to regain their authority) when they condemned Copernicus in 1616. Therefore, despite Galileo's confident if not belligerent presentation, the book of nature came into being as an unsuccessful defense device articulated around his lack of a proof of Copernicanism, and the limited hope to stall its condemnation.

Galileo's attempt to turn a defensive predicament into an apparently proactive stance rested on his ability to graft his claims on the authority and resources of his opponents. For instance, his attempt to force the theologians into refuting Copernicus was not presented as a challenge from a disciplinary underling, but as an affirmation of the theologians' power to prosecute heretical claims. Because of the unique legal authority of theology—an authority that allowed the theologians not only to declare the falsehood of certain claims but also to punish their authors—Galileo implied that their pronouncements had to be bound to particularly stringent standards: "whoever wants to condemn [heliocentrism] judicially must first demonstrate it

[30] "If it is inconceivable that a proposition should be declared heretical when one thinks it may be true, it should be futile for someone to try to bring about the condemnation of the earth's motion and sun's rest unless he first shows it to be impossible and false," Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 114; see similar remarks on 56, 81, 83, 111.

to be physically false by collecting the reasons against it."[31] Condemning Copernicanism as heretical without proving its falsehood first would have violated the codes of responsibility of their discipline. But because he knew that it would have been virtually impossible for the theologians to refute Copernicus with astronomical arguments, he could count on their "authoritative failure" as a device for creating an effect of truth around Copernicus. He claimed the heliocentric cosmos as "presence," but was then forced to admit that he could not prove it yet. Heliocentrism instantiated the logos, but Galileo could only create effects of that presence through "bad copies," that is, negative arguments like the untenability of other cosmologies or the theologians' failure to disprove Copernicus. In this sense, their authority functioned as a supplement to Copernicanism and, indirectly, to Galileo's authority as an astronomer.

An analogous negative-positive reversal can be found in his treatment of the notion of proof in astronomy. While he routinely referred to "conclusive evidence and necessary proofs" as the protocols one had to follow in debates about natural philosophy, Galileo never quite spelled out the meaning of those terms, despite the fact that he invoked the evidentiary and demonstrative standards of astronomy to relativize the hermeneutical practices of Scriptural exegesis.[32] He probably did so because he did not have the authority to impose his mathematico-physical methodology (whatever that might have been) over his disciplinary superiors—the theologians.[33] In the specific context of 1613, however, Galileo could act as if the methodological and philosophical underpinnings of the crucial "proof" on which his entire argumentative edifice hinged (i.e., the refutation of Ptolemy through the phases of Venus) were non-issues. He could not define what proof meant in astronomy, but neither did he need to. Whatever proof meant, it had been exemplified by the corroboration of his discovery of the phases of Venus by the Jesuit

[31] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 81 (emphasis mine).

[32] Some of Galileo's many invocations of "sensory experience and necessary demonstrations" are in Finocchiaro, 93, 96, 99, 101.

[33] Most of Galileo's methodological remarks are found in his later books, especially the *Assayer* (1623) and the *Dialogue* (1632). On the tensions between mathematicians and philosophers or theologians over the status of demonstrations in mixed mathematics see Peter Dear, "Jesuit Mathematical Science and the Reconstitution of Experience in the Early Seventeenth Century," *Studies in History and Philosophy of Science* 18 (1987), 133–75.

mathematicians of the Collegio Romano in 1611.[34] Not only had they made their findings quite public during an elaborate celebration of Galileo at the Collegio in the Spring of 1611, but their report had entered the Church's record by virtue of having been sent to the head of the Holy Office. Once again, Galileo was able to use the Church's authority as a supplement for a notion of proof he badly needed but whose articulation and legitimation he could only defer.

The very logic of the book of nature is, I believe, supplemental. Needing to simultaneously use and subvert the authority of his superiors whose regime of truth rested on God's word as embodied in a Book, Galileo was forced to claim that nature was a book too. At the same time, the logic of his own discourse required nature to be a non-book. Nature had to be a sacred book like the Scripture so as to fit in the theologians' regime of truth and lend authority to natural philosophy. But in order to be the domain of things-in-themselves, nature could be neither a book (an instance of human writing) nor a Book (a divinely-inspired text). As with the deferred proof of Copernicanism, Galileo could not give presence to the book of nature, but could only constitute its effect of presence by using the theologically authoritative Scripture as supplement.

Galileo's predicament added another level of aporias to logocentrism. Unlike Plato who could use writing as the supplement for presence by presenting it as a poor copy of speech, Galileo could not say that the Scripture was a "poor copy" of God's word and that, instead, the book of nature was the "good" one. As Galileo's discourse was grafted on the theologians', he simply could not kill his host. The positive terms in which Galileo cast his supplements mirrored his subordinate disciplinary status.

Truth in the Eyes of the Absent Beholder

The documents of the 1616 condemnation give no indication that Galileo's two-book model or his claim that the phases of Venus had falsified geocentrism and literal Scriptural exegesis were ever taken

[34] See note 27 above. Although there were disagreements between astronomers and theologians as to what counted as proof and refutation, Galileo could probably assume that the theologians would not dismiss the phases of Venus, a discovery that had been publicly corroborated by the Jesuits and reported to Cardinal Bellarmine, the head of the Holy Office.

seriously by the Holy Office. The theologians took the position that, no matter what the astronomers said, their claims could not be granted the status of philosophical demonstrations. Of course Galileo did not know of these decisions in 1615 as he was writing the "Letter to the Grand Duchess," but he knew very well that theologians and philosophers tended to take a nominalist view of the astronomers' claims. A letter from Monsignor Dini confirmed that:

> His Most illustrious Lordship [Bellarmine] says [...] the worst that could happen to the book [Copernicus'] is to have a note added to the effect that its doctrine is put forward in order to save the appearances, in the manner of those who have put forth epicycles but do not really believe in them, or something similar. And so you could in any case speak of these things with such a qualification. . . .[35]

Galileo's correspondence, his "Letter to the Grand Duchess," and the unpublished "Considerations on the Copernican Opinion" (1615) show that he was deeply concerned with the theologians' nominalist views—views that would have taken all the bite out of his tactics.[36] To counter that possibility, Galileo added a crucial twist to the parallel between nature and the Scripture as two divinely created books. In the "Letter to the Grand Duchess" Galileo argued that in natural matters (but not in matters of morals and faith) the conclusive evidence and necessary proofs produced by natural philosophy could not be refuted by the theologians.[37] He did so by arguing that while

[35] Dini to Galileo (7 March 1615), in Finocchiaro, *The Galileo Affair*, 58. Within a few weeks, Bellarmine delivered the very same message to Foscarini: "It seems to me that Your Paternity [Foscarini] and Mr. Galileo are proceeding prudently by limiting yourselves to speaking suppositionally and not absolutely, as I have always believed that Copernicus spoke. For there is no danger in saying that, by assuming the earth moves and the sun stands still, one saves all the appearances better [...] and that is sufficient for the mathematician [astronomer]," Bellarmine to Foscarini (12 April 1615), in Finocchiaro, *The Galileo Affair*, 67.

[36] Finocchiaro, *The Galileo Affair*, 60–63, 75–80, 89–90.

[37] Finocchiaro, *The Galileo Affair*, 50, 81, 93, 94, 101. Bellarmine claims to agree to this principle: "I say that if there were a true demonstration that the sun is at the center of the world and the earth in the third heaven, and that the sun does not circle the earth but the earth circles the sun, then one would have to proceed with great care in explaining the Scriptures that appear contrary, and say rather that we do not understand them than that what is demonstrated is false. But I will not believe that there is such a demonstration, until it is shown to me." Bellarmine to Foscarini (12 April 1615), in Finocchiaro, *The Galileo Affair*, 68. The last sentence, however, indicates that Bellarmine considered the possibility of mathematics directing theology little more than a mere hypothesis.

both the Scripture and nature were equally true, there were essential differences between the two texts:

> For the Holy Scripture and nature derive equally from the Godhead, the former as the dictation of the Holy Spirit and the latter as the most obedient executrix of God's orders; moreover, to accommodate the understanding of the common people it is appropriate for Scripture to say many things that are different (in appearance and in regard to the literal meaning of the words) from the absolute truth; on the other hand, nature is inexorable and immutable, never violates the terms of the laws imposed upon her, and does not care whether or not her recondite reasons and ways of operating are disclosed to human understanding; but not every scriptural assertion is bound to obligations as severe as every natural phenomenon . . . And so it seems that a natural phenomenon which is placed before our eyes by sensory experience or proved by necessary demonstrations should not be called into question, let alone condemned, on account of scriptural passages whose words appear to have a different meaning.[38]

Galileo's argument about the differences between the two books relies, ultimately, on their audiences or, rather, on the fact that one book (the Scripture) has an audience while the other (nature) does not. The Scripture was written with a goal and an addressee in mind, nature was not. God, being infinitely good, had His speech written down by the prophets so that humans could reach salvation. Nature, instead, was a completely different book, one that was not written to guide us to heaven. As Galileo put it (quoting Cardinal Baronio): "The intention of the Holy Spirit is to teach us how to go to heaven and not how heaven goes."[39] The Scripture had a message, the book of nature had laws.

[38] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 93. A very similar version is found in the "Letter to Castelli": "For the Holy Scripture and nature both equally derive from the divine Word, the former as the dictation of the Holy Spirit, the latter as the most obedient executrix of God's commands; moreover in order to adapt itself to the understanding of all people, it was appropriate for the Scripture to say many things which were different from absolute truth, in appearance and in regard to the meaning of words; on the other hand nature is inexorable and immutable, and she does not care at all whether or not her recondite reasons and modes of operation are revealed to human understanding, and so she never transgress the terms of the laws imposed on her; therefore, whatever sensory experience places before our eyes or necessary demonstrations prove to us concerning natural effects should not in any way be called into question on account of scriptural passages whose words appear to have a different meaning, since not every statement of the Scripture is bound to obligations as severely as each effect of nature," Finocchiaro, *The Galileo Affair*, 50–51.

[39] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 96.

Several implications followed from Galileo's audience-based arguments. Because we know that the Scripture was written for an audience (and this follows from our certainty of God's infinite goodness that led him to give us a book through which we may attain salvation), it follows that such a book was written in a language that must allow for interpretation so that its message can be made clear to the audience it was meant for. Galileo did not simply invoke the so-called principle of accommodation, that is, the doctrine that the Scripture, being aimed at illiterate masses, was written by God-inspired prophets in a form that could be understood by an unsophisticated audience. Galileo's argument was more radical: it depended on the very existence of an audience, not on its quality. It was because the Scripture had a message for an addressee that it was an ontologically soft book.

If Scripture is ontologically soft, nature is ontologically hard—"inexorable," as Galileo put it. Nature is rigidly bound to laws because God made it so, and he made it so because he never meant it to be a book of salvation-oriented teachings. If the softness of the Scripture derives from God's infinite goodness, the rigidity of nature's laws derives from His absolute power.[40]

It is important to notice that Galileo did not simply argue that nature is transparent to humans who read it, but that such a transparency was the effect of having been created as something free from teachings for human readers. As he stated in the "Letter to Castelli":

> [...] nature is inexorable and immutable, and she does not care at all whether or not her recondite reasons and modes of operation are revealed to human understanding, and so she never transgresses the terms of the laws imposed on her . . .[41]

The transparency of nature, therefore, is not presented as a methodological assumption, but as a consequence of God's logic and choices. The transparency of nature derives from its meaninglessness which, in turn, is the result of the presence of a parallel book—the Scripture—that is opaque and carries plenty of teachings for its human readers.

[40] It should be noticed that the meaning of "nature's laws" is quite distinct from what we now call "natural laws." The former are orders imposed by God on nature, the latter are laws that are inherent in nature, and may not be of divine origin.

[41] Galileo, "Letter to Castelli," in Finocchiaro, *The Galileo Affair*, 50.

However, to make his argument fit the theologians' metaphysics of truth, Galileo was forced to present nature as a book and, at the same time, say that it was reality-in-itself. It quickly becomes apparent that the book of nature had to be even more of a non-book in order to perform the discursive task assigned to it by the logic of Galileo's argument. While a book is something to be read, Galileo argued that the book of nature's special status vis à vis the Scripture derived precisely from the fact that, since the beginning, nature was a book that was not written to be read. Yet, his central claim was that he could read nature, and read it right. Basically, Galileo fashioned himself as the reader whom God had not planned to exist, but whose existence He had not explicitly forbidden either. The way Galileo had constructed the book of nature in relation to the Scripture did not allow him to assume a less dangerous position. His ability to read the truth in the book of nature was inherently tied to his quasi-sacrilegious predicament. It is precisely because he was not expected to exist as a reader that he could read the truth in the book of nature. As he developed new discursive resources by grafting his argument on the theologians' logocentric discourse, Galileo did not solve their aporias but only added new ones.

Inexorability vs. Inspiration

Despite its aporias (or perhaps because of them), the book of nature proved to be quite a prolific tool for Galileo. For instance, because the Scripture was meant to carry a divine message conveyed by the Holy Spirit and written down by inspired prophets, the correct decoding of such a message should take place in an equally inspired context. But, as Galileo put it, "we cannot assert with certainty that all interpreters speak with divine inspiration since if this were so then there would be no disagreement among them about the meaning of the same passages."[42] Under these circumstances, one should rely on "wise interpreters," that is, on theologians authorized by the Church.[43]

[42] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 96, and "Letter to Castelli," 51.

[43] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 92. Galileo does not say explicitely that these "wise interpreters" are the theologians of the Roman Church, but that identification is very clear from the context.

Instead, because nature offers neither a message nor a path to salvation (and thus there is no coding and decoding in its creation and reading) natural philosophers do not need to be divinely inspired to read the book of nature, and read it right. One cannot be simultaneously a criminal and a prophet or a theologian. Nature, instead, does not care about what kind of humans might read it because it does not care about being read and understood to begin with. The book of nature allowed Galileo to turn a necessity into a virtue. When he entered the debate, he lacked the social and disciplinary resources to present the astronomers' cognitive authority as superior to that of the theologians, or to claim at least that the theologians could not speak authoritatively about astronomical matters. The book of nature, however, buttressed his claim that the hermeneutical authority of the knower did not matter in astronomy, and achieved that while confirming the theologians' authority on theological matters.

In 1623 Galileo stated the transparency of the book of nature as a fact. But in 1613 he was still trying to find an argument for why nature was transparent and could thus provide a condition of possibility for the certainty of the astronomer's knowledge. That the astronomer's credibility was rooted neither in moral or institutional authority, nor in divine inspiration, but in the transparency of the book of nature was only half of Galileo's argument. The rest was that such a transparency resulted from God having sent the teachings necessary to achieve salvation through another book (the Scripture) which, because of its message, had to be read only by special Church-sanctioned people. As the hermeneutical softness of the Scripture constituted (as supplement) the transparency of the book of nature, it was the inspired status of prophets and theologians that justified the uninspired credibility of the natural philosophers who read the book of nature.

Inexorability of Nature and the Pursuit of Novelty

The interpretability of the Scripture and the inexorability of nature allowed Galileo to de-stigmatize a feature of astronomy and natural philosophy deemed suspect by many theologians and Aristotelians: the pursuit of novelty. Impious dispositions were thought to drive people to seek novelties instead of embracing well-established authoritative doctrines. Galileo's response was categorical:

> Who wants the human mind put to death? Who is going to claim that everything in the world which is observable and knowable has already been seen and discovered? [...] Nor should it be considered rash to be dissatisfied with opinions which are almost universally accepted.[44]

The inexorability of nature helped to justify Galileo's aggressive philosophical stance as the work ethics appropriate to the pious astronomer. The Scripture conveyed one kind of message and it did so not because of any limitation in God's power but rather because of his infinite goodness. God was trying to send a limited message—salvation—to very limited humans.[45] Nature, instead, was not framed by those limitations precisely because it had no message to deliver and no audience to reach. It is not that the Scripture had a limited set of messages and that nature had many. Rather, because nature had no teachings, it had many laws—as many as God wished to impose on it. The progress of philosophical knowledge (to use a somewhat anachronistic notion) derived from the fact that the laws that God had imposed on nature were not evident all at once, and they were not evident all at once because they were not meant to be evident to begin with.

Galileo could argue that because nature was the domain of divine laws (rather than messages directed to humans), these laws could be infinitely numerous (as opposed to a limited range of salvation-oriented teachings) and that, therefore, their uncovering could require a potentially infinite amount of time.[46] Astronomy taught "how the glory and greatness of the supreme God are marvelously seen in all His works and by divine grace are read in the open book of the heavens."[47] However, one should not think that

[44] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 96–7. A similar line is in the "Letter to Castelli": "Who wants to fix a limit for the human mind? Who wants to assert that everything which is knowable in the world is already known?" 51.

[45] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 92, 93, 94, 95, 106.

[46] The relation between infinitely numerous laws and the infinitely long time required for their understanding is inscribed in the logic of Galileo's argument, but is not addressed extensively in his text. However, he does quote St. Augustine on the issue of time constraints in both the study of nature and of the Scripture, and remarks repeatedly on the many generations of astronomers who have worked incessantly on a few problems without being able to fully understand them—a scenario that is much different from that encountered in theology, Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 94–5, 103–4.

[47] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 103.

> the reading of the very lofty words written on those pages is completed by merely seeing the sun and the stars give off light, rise, and set, which is as far as the eyes of animals and common people reach. On the contrary, those pages contain such profound mysteries and such sublime concepts that the vigils, labors, and studies of hundreds of the sharpest minds in uninterrupted investigation for thousands of years have not yet completely fathomed them.[48]

A comparably open-ended and ever-revised reading of the Scripture might have sent millions to hell. In theology, progress is called heresy.

In sum, scriptural meanings were "generational" while the laws of nature were not. Or perhaps nature's laws were "eternal" because they were not supposed to be uncovered within a lifetime (or within an indefinitely long human history in which each generation had to worry primarily about salvation).[49] Galileo could not claim to have uncovered many of nature's laws, but that could be justified by the fact that infinitely more laws existed. That these laws existed (and that they were "inexorable" and eternal) followed from the fact that those laws were not what God expected pious humans to understand during their lifetime. Under these circumstances, it was no surprise that Galileo had not yet discovered a proof for Copernicus. The temporal limitation of human life and its primary focus on salvation were supplements for the eternity and infinite number of nature's laws.

The book of nature, however, was made to juggle so many different discursive needs that the conflicts and aporias started to build up. For instance, through its supplemental relationship to the Scripture, the book of nature allowed Galileo to uphold a notion of truth—the truth God inscribed in the book of nature—as something transparent and self-evident. At the same time, other features of the topos allowed him to say that the actual finding of such a truth was bound to be deferred, possibly forever—a claim that could be read as an admission that the self-evidence of nature is, in fact, not evident. More generally, it is not at all clear how the book of nature could simultaneously support a view of knowledge as progressive (because of the potentially infinite levels of evidence contained in the book) and of knowledge as absolutely and permanently true (because of the

[48] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 103.

[49] On the very limited time allowed to humans to learn God's teachings of salvation, see Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 94, 95.

transparency and inexorability of nature). In a telling passage, Galileo argued that:

> because of many new observations and because of many scholars' contributions to its study, one is discovering daily that Copernicus's position is truer and truer and his doctrine firmer and firmer. . .[50]

Obviously, he believed that astronomical knowledge was converging toward truth, but it is not clear how such a convergence could coexist with the book of nature as Galileo had articulated it. He did not suggest that nature was an infinite book one read page after page building up knowledge as one went. Such an image would present each chapter as a fixed entity, but Galileo upheld a notion of knowledge that was both progressive and revisable. His statement that "those pages contain such profound mysteries and such sublime concepts that the vigils, labors, and studies of hundreds of the sharpest minds in uninterrupted investigation for thousands of years have not yet completely fathomed them" conjures a completely different image of reading—one that involves thousands of years of going back and forth over a few pages rather than reading on *ad infinitum*.

But how can the image of the page with a finite number of perfectly unambiguous characters be made to sustain the image of a reading that stretches over thousands of years, searching for an infinite amount of laws on each page, and recasting the significance of each line in the light of how one has re-read the previous line, or of a new character found between two old ones? The image of Galileo's book of nature is very powerful if one thinks of knowledge as already achieved—as a well organized, unambiguous map of a terrain that has been fully measured and triangulated. The book of nature conveys an image of totality—a magisterial image of knowledge like that of the encyclopedia or, even better, the Scripture. Galileo put forward the book of nature because he needed an appropriate topos to counter the magisterial knowledge image of the theologians. But the irresolvable tensions that were generated within the topos as he articulated it show that, in the end, the book of nature had become Galileo's pharmakon.

[50] Galileo, "Letter to the Grand Duchess," in Finocchiaro, *The Galileo Affair*, 103.

Keeping the Dichotomies Straight

When it came to the relationship between theology, philosophy, and astronomy, nominalism was not just a philosophical doctrine but also a symptom of the philosophers' and theologians' attempt to keep astronomers in a subordinate position by denying them the disciplinary authority to make physical, philosophical claims. Typically, philosophers and astronomers treated the astronomers' hypotheses and their geometrical tools (like eccentrics, equants, and epicycles) as fictions that could be quite useful for computational purposes, but could not aspire to the status of philosophical explanations of the real, physical nature and causes of celestial phenomena. This was the position Bellarmine repeated to Dini and Foscarini in 1615, claiming (quite wrongly) that Copernicus himself thought of his claims as hypothetical.[51]

The nominalist view of astronomy was precisely what Galileo was opposing with the book of nature—the domain of transparent truth, not of effective computational models. But unable to buttress his realist stance by proving Copernicus, he could only try to show that the opposite position—nominalism—was untenable, thus creating the conditions of possibility for the theologians' acceptance of the book of nature model.

That goal, however, introduced some substantial lacunae in Galileo's logic. He started by claiming that his refutation of Ptolemy through empirical evidence—the discovery of the phases of Venus—amounted to a refutation of astronomical nominalism because it broke down the theologians' symmetrical treatment of Ptolemy and Copernicus as hypotheses:[52]

[51] Bellarmine to Foscarini (12 April 1615), in Finocchiaro, *The Galileo Affair*, 67. Bellarmine, like many other theologians, believed that Copernicus himself presented his claims as hypothetical. Bellarmine's argument appeared to be based on a short anonymous preface appended to Copernicus' 1543 *De revolutionibus* which, in fact, cast the book's arguments in nominalistic terms. That preface, however, was the work of a Lutheran theologian—Andreas Osiander—not Copernicus (who most probably never knew of its existence). Kepler was the first to realize that the preface was not by Copernicus. Galileo too argued from textual evidence (and largely in response to Bellarmine) that the preface was not authentic as it contradicted the explicitly realist position taken by Copernicus in the text (Galileo, "Considerations on the Copernican Opinion," in Finocchiaro, *The Galileo Affair*, 78–9).

[52] Because the theologians tended to have a nominalist view of astronomy in general, they treated both Ptolemy and Copernicus (and later Tycho) as hypothetical models developed to 'save the appearances.' This position is represented in the letter from Bellarmine to Foscarini (12 April 1615), in Finocchiaro, *The Galileo Affair*, 68.

> It is true that it is not the same to show that one can save the appearances with the earth's motion and the sun's stability, and to demonstrate that these hypotheses are really true in nature. But it is equally true, or even more so, that one cannot account for such appearances with the other commonly accepted system [Ptolemy]. The latter is undoubtedly false, while it is clear that the former [Copernicus], which can account for them, may be true.[53]

Galileo seemed to agree that it would be legitimate to hold a nominalist view about hypotheses if they are precisely that: hypotheses, that is, claims that are both unproven and irrefuted. Instead, one could no longer hold a nominalist position about a given hypothesis (Ptolemy's) if that hypothesis had been refuted. A hypothesis refuted through empirical evidence was no longer a hypothesis but a claim proven physically false. As a result, one could not continue to treat the hypothesis which still stood irrefuted as a mere computational model. The irrefuted half of a pair of mutually exclusive hypotheses was transformed into a less hypothetical and more "physical" claim by having its opposing hypothesis physically refuted.

Additionally, Galileo tried to refute Bellarmine's nominalism by asserting that the distinction between computational models and physical reality was hardly sustainable in cosmology. Because there are only two conceivable scenarios—the sun goes around the earth or the earth goes around the sun—the difference between models and reality is meaningless if the argument is limited to the relative motion of the sun and the earth. Under these circumstances, Ptolemy stands for geocentric cosmology and Copernicus stands for heliocentric cosmology:

> Note carefully that, since we are dealing with the motion or stability of the earth or of the sun, we are in a dilemma of contradictory propositions (one of which has to be true), and we cannot in any way resort to saying that perhaps it is neither this way nor that way. Now, if the earth's stability and the sun's motion are de facto physically true and the contrary position is absurd, how can one reasonably say that the false view [Copernicus] agrees better than the true one with the phenomena [phases of Venus]. . . ?[54]

[53] Galileo, "Considerations on the Copernican Opinion," in Finocchiaro, *The Galileo Affair*, 85.

[54] Galileo, "Considerations on the Copernican Opinion," in Finocchiaro, *The Galileo Affair*, 75.

In different ways, these two quotes try to argue that Copernicus is true—and true physically—because Ptolemy is not just "underperforming" but has been shown to be physically false. If Ptolemy is physically false it means that geocentrism itself is false, which then means that heliocentrism (and Copernicus as the only possible embodiment of heliocentrism) must be true. Galileo's play of dichotomies (real/false, physical/fictional) may reflect a desperate attempt to move away from a nominalist framework to a discursive space where he could impose the book of nature on the theologians.

To get there, Galileo tried to shift the discussion from a framework structured around a pair of hypotheses to one informed by a logocentric opposition—an opposition through which he could put supplements to work. As mere hypotheses, geocentrism and heliocentrism were neither good nor bad copies of reality. But once they ceased to be mere hypotheses, they became "good" or "bad" representations of the cosmos. Of course Galileo wished he could have shown that Copernicanism was not just a "good" copy of the cosmos but its very structure, that is, that Copernicanism was written straight in the book of nature not as a representation but as presence itself. However, unable to prove Copernicus with physical arguments, Galileo tried at least to use a refuted Ptolemy as the "bad" copy of presence thereby casting Copernicus as the "good" mimesis of presence.

It was only within a realist framework that a refuted geocentrism could function as a supplement producing an effect of presence of both mathematical realism and heliocentrism. In the context in which he operated and with the handicaps he was confronting, Galileo needed Ptolemy—a Ptolemy that was both endorsed by the theologians (so as to be authoritative) and physically refuted (so as to be usable as a supplement). He needed Ptolemaic astronomy to be simultaneously authoritative and dead—dead wrong. This time, however, the end result of the process of supplementation was not an effect of presence. All Galileo could say was that Copernicus should not be condemned as heretical because, unlike Ptolemy, it had not been proven false yet.

If Galileo was only partially successful in this case it is because Copernicus and Ptolemy did not constitute a strict dichotomy as that between the book of nature and the Scripture, or between speech and writing. As the dichotomy "bled," Galileo could not use one term as the full-fledged supplement for the other. A refuted Ptolemy did not constitute Copernicus as true simply because—contrary to Galileo's

claims—Ptolemy and Copernicus did not exhaust all the range of possible cosmologies. Since 1588, there was a very well-known alternative to Copernicus and Ptolemy, and it was called Tycho.[55] And, sadly for Galileo, Tycho's hybrid planetary model could easily account for the phases of Venus while keeping the earth at the center of the cosmos.

Competent readers must have been flabbergasted to find no mention of Tycho in the "Letter to the Grand Duchess." Nor, for that matter, was Tycho mentioned in any of the texts Galileo wrote in the context of this dispute, or in his famous 1632 *Dialogue on the Two Chief World Systems*—the book that triggered the final trial of 1633. Galileo's erasure of Tycho was as stunning as it was mandatory. Tycho's model did not simply take the wind out of Galileo's alleged refutation of geocentrism, but, even more insidiously, it indicated that the "book of nature" (as it could be read at that time) had more than one reading, that is, that the book of nature, was just a book, not nature itself. Tycho could undermine not only heliocentrism but the very dichotomic metaphysics of truth through which Galileo was trying to constitute his brand of philosophical realism.[56] The logocentrism of the book of nature required Tycho's erasure.

From Constraints and Resources to Supplements

One may argue that Galileo's predicament was extreme and therefore unrepresentative of the contexts experienced by common natural philosophers and, later on, by scientists. No doubt, he confronted a remarkable amount of difficulties, constraints, and handicaps: he could not prove Copernicus; did not have sufficient socio-disciplinary authority to oppose the theologians; did not have sufficient time to produce more pro-Copernican evidence; could control neither the pace of the debate (a debate he did not initiate) nor the forums in which it would be adjudicated; could not rely on indefinitely patient

[55] Tycho made Venus and Mercury orbit the Sun (which in turn was orbiting the earth). Because the motions of Venus in relation to the Sun were the same in both Copernicus and Tycho, the phases of Venus could be explained equally well in either system.

[56] If Galileo gave up on claims of absolute truth (such as those belonging to the theologians' regime of truth), he would have slid into the non-realist position in which the theologians wished to keep the astronomers. Again, he was in a position in which, although he had access only to probable truths, he could not present them as such, but could only create "truth effects" about an absolute truth he could only defer.

and trusting patrons; did not have a notion of proof the theologians could accept as such, and more generally, a legitimate metaphysics of truth on which to ground such a notion. As we have seen, this list could be expanded.

A perception of Galileo's predicament in these terms may lead one to conclude that he was forced by external circumstances in an impossible uphill battle in which he scrambled to transform a defensive position into a proactive one by turning constraints into resources. In the end, his articulations of Copernicanism and mathematical realism did not close the initial gaps and tensions, but simply reproduced them in variously displaced forms. He upheld a realist view of astronomy, but could not prove that his cosmological claims were physically true; he needed to read the book of nature, but could read it only because it was not meant to be read; he had to present nature simultaneously as a book and a non-book, etc.

If we perceive Galileo's final predicament as the result of his having entered into scriptural exegetical debates without the resources he needed, it then makes sense that he was unable to avoid the theologians' first condemnation of Copernicus in 1616 and, years later, of himself. But a perspective framed by notions of "resource" and "constraint" introduces a series of unanswerable psychological and moral questions: was Galileo right or wrong in assessing the situation and his chances of success? Was he led astray by over-optimistic supporters? Was he driven by the love of truth or by his overgrown ego? And what about the theologians? Did they simply follow their disciplinary protocols or did they produce undue obstacles for Galileo? Answering these questions requires some way of demarcating between "enough" or "not enough" resources and "too many" or "not too many" constraints. However, the status of such demarcations is problematic because we can only infer them a posteriori, based on the closure of a dispute.

A different perspective emerges if we suspend the positive and negative connotations of "resources" and "constraints," that is, if we cease to treat them as presences and absences. For instance, if we think of the articulation of Galileo's and the theologians' discourse as structured by the logic of the supplement, then Galileo's lack of resources and abundance of constraints (or his possible misperceptions about his own predicament) cease to appear as causes of the condemnation of 1616. Instead, they actually emerge as the engine (maybe the conditions of possibility) for the articulation of his discourse.

That Galileo could not deliver presence but could only effect it through supplements was not an anomaly but rather the rule of any logocentric discourse. We may say, then, that Galileo did not get in trouble with the Church because he entered into exegetical debates without the resources necessary to prove Copernicus, but that he articulated his alternative exegetical approach precisely because he lacked the kind of proof the theologians would have accepted. Lacking that proof, he engaged the theologians on exegetical grounds to prevent them from issuing an early condemnation of heliocentrism—a condemnation that would have brought the debate to a halt thereby depriving him of the possibility to prove Copernicus at a later time.

In sum, he played the role of the theologian (and made his discourse even more aporia-ridden than that of the theologians) because he could not not be a theologian. And he could not avoid playing a theologian because he could not bring the debate to a closure through positive, presence-instantiating, astronomical arguments. Similarly, the theologians censored Galileo's discourse not because, unlike him, they could instantiate presence and truth and prove him wrong, but because their metaphysics of truth was as unstable as Galileo's own and could have been further destabilized by his exegetical proposal.

Gaps and absences were, from beginning to end, constitutive of both Galileo's and the theologians' discourses, not just the cause of the condemnation of Copernicanism in 1616. As with Plato's pharmakon, the supplement was simultaneously "good" and "bad." The theologians' authority (but also the Scripture, Ptolemy, the phases of Venus, the book of nature, etc.) were, at the same time, a poison and a cure for Galileo's discourse.

Recently, Hans-Jörg Rheinberger has proposed a critique of notions of "representation" and "strategy" as commonly used in science studies.[57] He has argued that these two categories are logocentric in nature as they assume an originary presence (in the case of representation) and a pre-defined object of knowledge (the strategy's goal).

[57] Hans-Jörg Rheinberg, "From Microsomes to Ribosomes: 'Strategies' of 'Representation,'" *Journal of the History of Biology*, 28 (1995), 49–89; "Experiment, Difference, and Writing," *Studies in History and Philosophy of Science*, 23 (1992) (part I, 305–31; part II, 389–422); and "Experimental Systems: Historiality, Deconstructions, and the 'Epistemic Thing,'" *Science in Context* 7 (1994), 65–81.

Far from being given, these categories can be constituted only as supplement through non-mimetic writing—a category he extends to cover all instrument-produced scientific inscriptions. Along the same lines, I believe that the notions of "resource" and "constraint" are also logocentric. They turn a historical event (a dispute's closure or lack thereof) into an object (an instance of "presence" of either resources or constraints) by erasing the fact that the knowledge claims being stabilized (or the claims that may have opposed such a stabilization) are not and cannot be "presence" but only "effects of presence" constituted through supplements.

Finally, the replacement of "resources" and "constraints" with the "supplement" enables the reconsideration of another traditional dichotomy: text and context. The tensions inherent in Galileo's book of nature were of the same kind as those we find in his socio-cultural predicament—tensions that simultaneously constituted and destabilized Galileo's authority as reader of that book. More generally, the microscopic aporias of Galileo's textual articulations of his metaphysics of truth were literal inscriptions of the macroscopic instability of his social authority as developed in his disciplinary and political field (and *vice versa*). Differences between text and context were a matter of scale (from micro to macro), not of kind. The context is neither a resource nor a constraint to the claims made in the text because the construction of presence and authority in both text and context reflect the same supplemental logic.

Acknowledgments: Many friends and colleagues have commented on different aspects of this essay since it emerged as a conference paper several years ago. I would like to thank Nick Jardine, Sande Cohen, Barbara Herrnstein-Smith, Philippe Hamou, Hans-Jörg Rheinberger, Lily Kay, Andy Pickering, Arnold Davidson, Katy Park, Owen Gingerich, Maurice Finocchiaro, Rüdiger Campe, the students of my science and literature seminar, and especially Kriss Ravetto-Biagioli for their help.

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