

Galileo Galilei: A Conflict of Faiths

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The path from antiquity to the present was shaped by the shockwaves from a myriad of conflicts. Yet one contention stands out among the rest for both the length of the debate and the intensity of the parties involved: the clash between science and religion. Early scientific philosophers were devout, and early hypotheses coexisted with Holy Scripture. As scientific technique and technology matured, however, theories were developed that did not require the constant control of a Creator. Renowned astrophysicist Neil deGrasse Tyson spoke to this relationship by stating that the authors of these texts “invoke divinity only when they reach the boundaries of their understanding”.¹ This trend in scientific discovery brought the conflict between science and religion to its height in the sixteenth century; at this time, the Aristotelian model of the universe - which claims that the static Earth sits at the center of all planetary orbits - was accepted by scientific philosophers and the Catholic Church.² In the early 1500s, however, Nicolaus Copernicus furthered a theory that had sat on the scientific sidelines since the third century: the idea of a heliocentric, or sun-centered, universe.³ Despite the fact that this theory was grounded in scientific fact, its theological complications were extensive. Progress toward discovering the universe’s true nature might have lapsed along with the banning of Copernicus’s revolutionary yet unorthodox work, *De Revolutionibus*, had the mantle not been seized by an obstinate Florentine scholar who had no difficulty reconciling his own religious and scientific views. Galileo Galilei, though best known for his trial with the Church, was himself an ardent

¹Tyson, Neil deGrasse. *Death by Black Hole*. W W Norton & Co Inc, 2014.

²“Cosmic Engine: Early Models of the Universe.” *Commonwealth Scientific and Industrial Research Organisation*, Australia Telescope National Facility, 21 June 2017, Web.

See Appendix I

³Westman, Robert S. “Nicolaus Copernicus.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., 14 Nov. 2017, Web.

See Appendix II

Catholic and remained so until his death. Dava Sobel, author of the Pulitzer Prize-finalist biography *Galileo's Daughter* commented on this paradox, remarking that “for Galileo himself, I think the conflict was more between science and particular personalities in the Church hierarchy”.⁴ The man who precipitated the public conflict between the disciplines of science and religion also internally epitomized the compromise between them.

The remarkable life of Galileo Galilei began in 1564 in the Italian state of Tuscany. As a young man, he began his studies at the University of Pisa and became the mathematics professor at the age of 25 - even without completing a degree. Between lectures, he made contributions toward the experimental scientific method that would later earn him the title “Father of Modern Science”.⁵ Galileo’s most famous experiment - though some historians dispute its authenticity - involved the dropping of two metal balls off the Leaning Tower to challenge the Aristotelian notion that heavy objects fall faster than light ones.⁶ His results surprised him, as the heavier object hit the ground first - but only by a few inches attributable to air resistance. Comparatively, Aristotle had predicted that objects fall at rates proportional to their weight; a ball that is twice as heavy should fall twice as fast.⁷ This imperfect, unassuming experiment challenged the validity of all Aristotelian thought: and he had just begun.

Galileo later left Pisa for a more distinguished position at the University of Padua in the Most Serene Republic of Venice, where one seemingly inconsequential event would shape the rest of his life; in 1609, a new Dutch invention called the spyglass found its way to Italy.

⁴Sobel, Dava. 8 Jan. 2018.

⁵Diaz, Michael. “Galileo Galilei.” International Space Hall of Fame, Web.

⁶Lienhard, John H. “No. 166: Galileo's Experiment.” The Engines of Our Ingenuity, University of Houston, Web.

⁷“Aristotelian Physics.” How Things Move, Web.

Although Galileo never saw a Dutch glass, he created his own with a description and a basic understanding of lenses.⁸ Then Galileo turned his telescope skyward and made observations of the universe that shook the foundations of astronomy. He saw mountains on the moon, "rough and uneven, and just like the surface of the Earth itself", contradicting the flawless sphere that Aristotle described.⁹ He recorded traveling spots on the sun and the phases of Venus, evidence of moving bodies and heliocentric orbits. And he discovered four satellites that were perfectly content to travel around Jupiter, not the Earth, thus disproving aspects of the Aristotelian model.¹⁰ A year after he built his first telescope, Galileo published *The Starry Messenger* to relate to the public this most "beautiful and delightful sight to behold".¹¹ He dedicated the treatise to his most elite pupil: newly crowned Cosimo II de' Medici. As Cosimo I had often compared himself to Jupiter, the Roman king of gods, Galileo found it appropriate to give his grandson the Jovian moons.¹² Shortly after the publication, Cosimo II appointed his tutor "Philosopher and Mathematician to the Grand Duke", and Galileo found himself free to study the universe under the protection of the Grand Duchy of Tuscany.

As Galileo's fame flourished, however, so did the challenges he was forced to address. In 1611, he visited Rome with near-celebrity status to be awarded one of the highest honors for a philosopher: induction into the esteemed Lincean Academy.¹³ Whilst in the Eternal City, Galileo took it upon himself to defend his discoveries and the subsequent honor of Grand Duke Cosimo

⁸ Pogge, Richard W. "Lecture 16: 'The Starry Messenger': Galileo Galilei & the Telescope." *Astronomy 161*, 4 Oct. 2007, Web.

⁹ Galilei, Galileo. *The Starry Messenger*. people.rit.edu/wlrgsh/Galileo.pdf.

¹⁰ See Appendix III

¹¹ Sobel, Dava. *Galileo's Daughter: A Historical Memoir of Science, Faith, and Love*. Walker & Company, 1999.

¹² Naess, Atle. *Galileo Galilei: When the World Stood Still*. Springer, 2010.

¹³ Scott, Michon. "Cesi and the Linceans." *Strange Science*, 26 Mar. 2017, Web.

II. His telescope was received with admiration, and Galileo left Rome with several important allies, including Cardinal Barberini (the future Pope Urban VIII). With the Lincean Academy as his publisher and influential figures providing support, Galileo's works became more brazen. He published *Discourse on Bodies in Water* in 1612, directly challenging Aristotelian physics and using sunspots to question the immutability of the heavens.¹⁴ Not only did the content of *Bodies in Water* enrage Galileo's contemporaries, but the fact that he published it in colloquial Italian insulted them. Unable to challenge the validity of Galileo's scientific arguments, his opponents turned to a new defense: Holy Scripture.

To Galileo, no discrepancy existed between the universe he observed and the one recorded in Holy Writ. "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", he wrote.¹⁵ Few of Galileo's contemporaries, however, accepted this compromise between the authorities of scripture and nature. One critic went so far as to dub Galileo and his followers "practitioners of diabolical arts... enemies of the true religion".¹⁶ They quoted the Bible in their defense, particularly the Book of Joshua, in which the sun is ordered to stop its movement.

And the sun stood still, and the moon stayed, until the people had avenged themselves upon their enemies... So the sun stood still in the midst of heaven, and hasted not to go down about a whole day.¹⁷

¹⁴"How Galileo Proved Spots Were on the Sun." Stanford Solar Center, 13 Aug. 2008, Web.

¹⁵Galilei, Galileo. "Letter to Benedetto Castelli." Translated by Antonio Faravo, Interdisciplinary Encyclopedia of Religion and Science, Web.

¹⁶"Tommaso Caccini." The Galileo Project, Rice University, Web.

¹⁷*Joshua. King James Bible*. N.p.: n.p., n.d. *Bible Hub*. Web.

Galileo retorted that God had not stopped the *motion* of the sun, merely its *rotation* - he argued that the monthly turn of the sun granted planets their movement (as gravity was yet unknown). Furthermore, the phrase “midst of heaven” could not be taken as synonymous with noon, as Joshua would have had time enough to fight his battle in daylight, but rather as the middle of the planetary orbits - where the Copernican system puts it.¹⁸ Although Galileo seemed adroit at wielding biblical verses in his defense, one major obstacle still prevented his progress: the Council of Trent. In 1564, the fourth session of the council had made the following decree.

No one, relying on his own skill, shall, wresting the sacred Scripture to his own senses, presume to interpret the said sacred Scripture contrary to that sense which holy mother Church... held and doth hold.¹⁹

Galileo was, arguably, guilty of violating this command. Hoping to salvage any remaining vestiges of the Copernican model from further slander, Galileo retaliated by traveling to Rome in 1615 with what he thought to be his strongest scientific defense of a moving Earth - the ebb and flow of tides.²⁰

Galileo made his way to Rome in the midst of a flurry of scientific and religious strife. He spent hours audaciously arguing for the Copernican model, much to the dismay of the ambassador of Tuscany. Various complaints were sent home to the Grand Duke on behalf of his “vehement and stubborn and very worked up” court philosopher.²¹ Galileo was still in Rome in

¹⁸Galilei, Galileo. “Letter to the Grand Duchess Christina of Tuscany.” Internet Modern History Sourcebook, by Paul Halsall, Web.

¹⁹CO Now LLC, Chicago, IL (reg): “The Council of Trent - Session 4.” *The Council of Trent*, Web.

²⁰Tyson, Peter. “Galileo's Big Mistake.” *PBS*, Public Broadcasting Service, 29 Oct. 2002, Web.

²¹“The Trial (1633).” Scientific Itineraries in Tuscany, Institute and Museum of the History of Science, Florence, Italy, 16 Jan. 2008, Web.

the final weeks of February of 1616 when, partially prompted by the uproar from his newly-completed “Treatise on the Tides”, the Sacred Congregation of the Index passed a new decree. The subject of the edict was simple: the Copernican theory was henceforth considered "foolish and absurd philosophically and formally heretical".²² Galileo was also personally summoned by Cardinal Bellarmine and forbidden to teach, defend, or discuss heliocentrism. If he was dismayed by the ruling, Galileo made no outward complaint; for eight years, he remained silent on the subject of Copernican doctrine. He continued to make strides in scientific discovery, attempting to solve the problem of determining longitude at sea, studying comets that appeared over Italy in 1618, and serving as the consul of the Accademia Fiorentina.²³ In 1623, however, a surprising occurrence brought Galileo back into the glare of society. Cardinal Barberini, friend and patron of the scientist, was elected pope Urban VIII. Not one to miss out on an opportunity for advancement, Galileo returned to Rome in the summer of the following year for a series of audiences with the pontiff. Although no record was kept of their meetings, by all accounts the two friends remained amicable when Galileo left Rome with permission to again discuss Copernican doctrine - provided it was kept entirely hypothetical. Urban had not supported the 1616 edict, recognizing the heliocentric model of the universe for its cosmological merit while discounting its scientific authenticity.²⁴ Enlivened by this ruling, Galileo returned again to his “Treatise on the Tides”. Abandoned for years, this humble manuscript was revised into Galileo’s masterpiece.

²²Martínez, Rafael A. “What Does the Decree on Copernicanism Say?” *Interdisciplinary Encyclopedia of Religion and Science*, Web.

²³Van Helden, Albert. “Galileo Timeline.” *The Galileo Project*, Rice University, Web.

²⁴ "Urban VIII (Maffeo Barberini)." *Europe, 1450 to 1789: Encyclopedia of the Early Modern World*. Encyclopedia.com, 2004. Web.

The *Dialogue Concerning the Two Chief World Systems* cunningly layers support for the Copernican model within an affable discussion of the universe held by three friends over four days. Galileo conveys his beliefs through the perspective of a quick-witted Copernican scholar, Salviati, who debates the good-natured host and mediator, Sagredo, and the stubborn Aristotelian, Simplicio (whose resemblance to the Italian *sempliciotto*, or *simpleton*, could not have been coincidental).²⁵ He prefaces his work with a foreword describing the supposed hypothetical nature of the debate:

I have taken the Copernican side in the discourse, proceeding as with a pure mathematical hypothesis and striving to represent it as superior to supposing the Earth motionless - as against the arguments of some professed Peripatetics [Aristotelians].²⁶

Perhaps due to this clarification, or perhaps because of Galileo's good standing with members of the Church, he had little trouble getting the book through Roman and Florentine censors. By 1632, the *Dialogue* was widely available in Florence and copies had made their way to Bologna, Rome, and other Italian cities. Five months later, however, it had joined *De Revolutionibus* on the Index of Prohibited Books.²⁷ Pope Urban, still bitter from Tuscany's lack of support in several political conflicts, took the work as a direct insult.²⁸ Claiming to show both sides of the debate, Galileo had placed Urban's principal argument against Copernicanism - that evidence for

²⁵"Dialogue Concerning the Two Chief World Systems - Ptolemaic and Copernican." Encyclopædia Britannica. Encyclopædia Britannica, Inc., n.d. Web.

²⁶Galilei, Galileo. "Dialogue Concerning the Two Chief World Systems: Preface." Edited by S. E. Sciortino. Translated by Stillman Drake, The Mathematical Praeface, Dartmouth College, Web.

²⁷"The Text of Dialogue Concerning the Two Chief World Systems, 1632." Calendars Exhibit, 2008, Web.

²⁸Price, Mike. "Smithsonian Magazine." Galileo, Reconsidered, 11 Aug. 2008, Web.

heliocentrism is not exhaustive as God could have fashioned the universe in any way He saw fit - in the mouth of the character Simplicio. Although this was usually a reasonable Aristotelian defense, it was stated by a foolish, obstinate character ridiculed throughout the entire work.²⁹ Galileo was abruptly and forcefully called to Rome.

On the summons of the Inquisition, Galileo - now approaching 70 years old - passed through the gates of the Holy City for the final time in early February of 1633. As a special favor to the Grand Duke and on behalf of the aged and ailing professor, Urban allowed Galileo to reside at the Tuscan embassy instead of locking him in prison. Although Ambassador Niccolini ensured his guest every courtesy and comfort, Galileo awaited trial for two painful months at the mercy of those who would decide his fate. Finally, on April 12, 1633, Galileo was called before the office of the Holy Inquisition. The first of four subsequent hearings slogged through formalities before converging upon one unequivocal request: "That he explain the character of the book on account of which he thinks he was ordered to come to Rome".³⁰ Galileo, perhaps believing a confession would alleviate his condemnation, must have stunned the tribunal when he uttered his response.

With the said book I had neither held nor defended the opinion of the earth's motion; I show the contrary of Copernicus's opinion and show that Copernicus's reasons are invalid and inconclusive.³¹

²⁹Helden, Albert Van. "Galileo." Encyclopædia Britannica, Encyclopædia Britannica, Inc., 17 Jan. 2018, Web.

³⁰Linder, Douglas O. "Galileo's Depositions." Famous Trials, UMKC School of Law, Web.

³¹Linder, Douglas O. "Galileo's Defense." Famous Trials, UMKC School of Law, Web.

Faced with a clash between scientific and spiritual beliefs yet unwilling to compromise either, Galileo sacrificed his personal integrity. His prosecutors, however, chose not to accuse Galileo of perjury nor question him further. Perhaps they understood the complexity of the situation - or perhaps they pitied him. The ensuing hearings continued much like the first; his apologies were ardent, describing his past offenses as riddled with “vain ambition, pure ignorance, and inadvertence”.³² Galileo’s final few statements were those of a forlorn, weary man, broken by the malice of his prosecutors. “I do not hold this opinion of Copernicus,” he claimed, “and I have not held it after being ordered by injunction to abandon it. For the rest, here I am in your hands.” The response of the inquisition was succinct.

We say, pronounce, sentence, and declare that you, the said Galileo, by reason of the matters adduced in trial... have rendered yourself in the judgment of this Holy Office vehemently suspected of heresy.³³

Galileo was discharged from Rome with the glaring brand of a heretic on his person and his *Dialogue*. He was kept in exile, away from his beloved Florence where his daughters anxiously awaited his return. But not even the Roman Inquisition could silence his continued works nor the legacy he would leave behind.

Galileo Galilei died, peacefully and on his own terms, in a villa tucked away in the hills of Arcetri.³⁴ His death was humble and his initial burial even more so, as Urban VIII had prohibited any formal dedication on consecrated ground. Instead, Galileo was entombed in a

³²Linder, Douglas O. “Galileo's Depositions.” Famous Trials, UMKC School of Law, Web.

³³Linder, Douglas O. “Papal Condemnation.” Famous Trials, UMKC School of Law, Web.

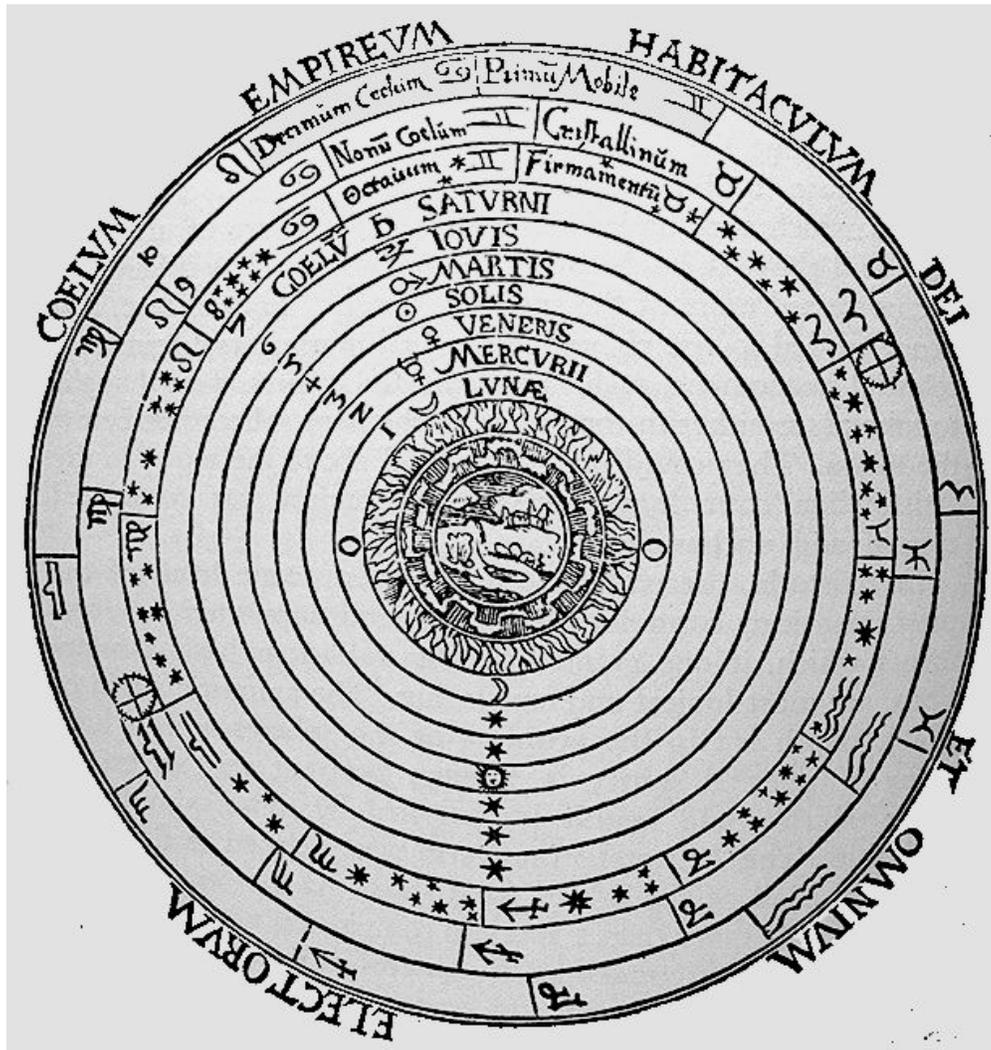
³⁴Magrini, Graziano. “Villa Il Gioiello.” Translated by Victor Beard, Scientific Itineraries in Tuscany, Museo Galileo, Web.

closet-sized room in the Santa Croce church, where his body remained for ninety-five years. It was not until 1737 that Galileo received his due; a monument was constructed - featuring a marble bust of the scientist flanked by the muses of Geometry and Astronomy - to commemorate the extraordinary life he had lived.³⁵ Galileo was awarded further posthumous validation in 1838 when his *Dialogue* was removed from the Index of Prohibited Books, and in 1992 when Pope John Paul II declared him formally innocent.³⁶ Time, it seems, has been kind to him. Time has also made the most apparent conflict that was constantly present in Galileo's life - the structure of the solar system - somewhat obsolete. But Galileo fought for more than just the correct model of the universe; he challenged the suppression of revolutionary thought by the establishment, the prohibition of free expression, and the surrender of personal integrity for personal liberty. He stood at the epicenter of a ferocious outpouring of conflicts, forced to publicly sacrifice his scientific views and personal credibility in exchange for his life. But Galileo never gave up his belief in the Copernican system nor the unique internal compromise he held between science and religion. *Eppur si muove* - and yet it moves.

³⁵Walwyn. Tomb of Galileo Galilei - Santa Croce Florence. 27 Oct. 2012, Web.

³⁶Cowell, Alan. "After 350 Years, Vatican Says Galileo Was Right: It Moves." The New York Times, The New York Times, 30 Oct. 1992, Web.

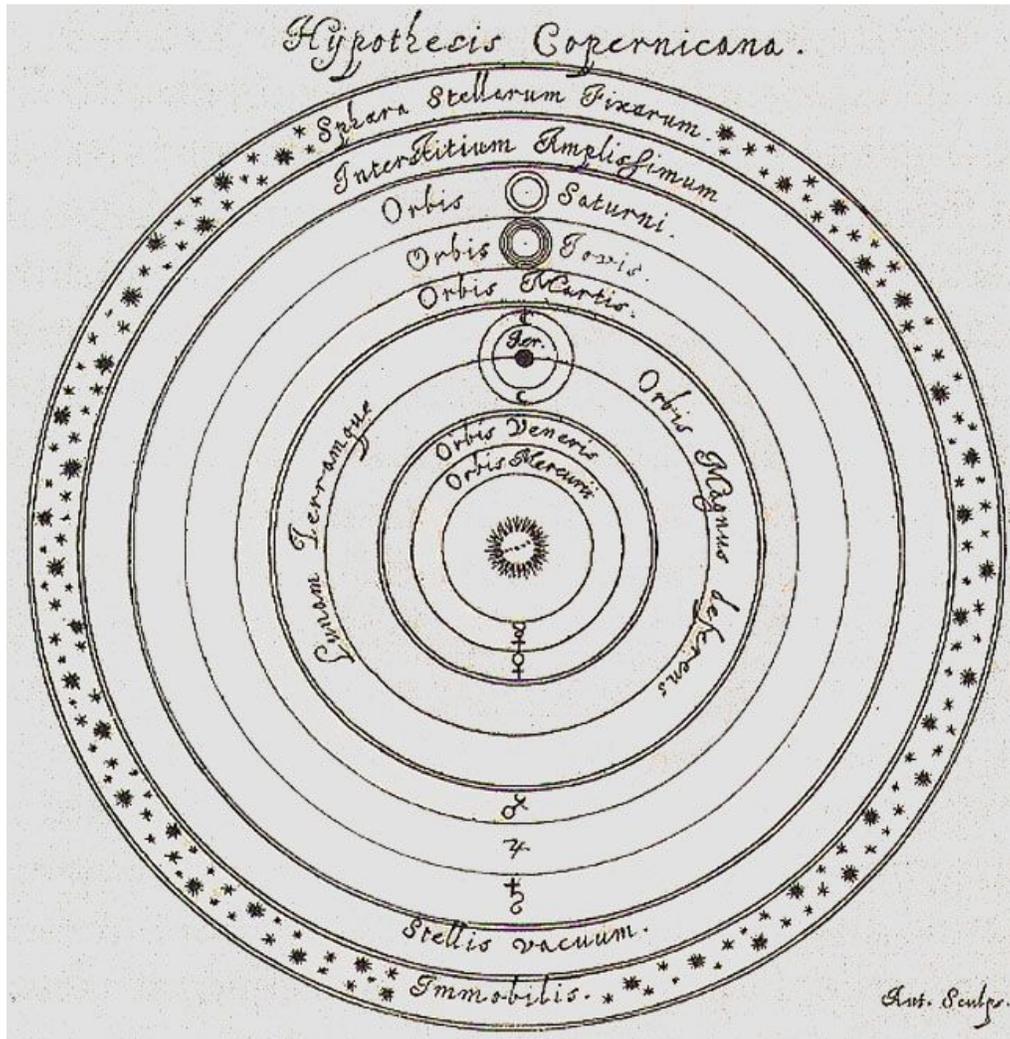
Appendix I



The Aristotelian model of the universe, in which the static Earth is surrounded by perfect concentric spheres that cannot interact with each other. Radiating from the center, the orbits are as follows: the moon, Mercury, Venus, the sun, Mars, Jupiter, Saturn, the fixed stars, sphere of the Prime Mover.

Source: Mastin, Luke. "Cosmological Theories Through History ." *The Physics of the Universe*. N.p., 2009, www.physicsoftheuniverse.com/cosmological.html.

Appendix II



The Copernican model of the universe, in which the sun lies at the center of the planetary orbits and Earth occupies its correct - though more humble - place. Copernicus's order, also radiating from the center, is as follows: Mercury, Venus, Earth, Mars, Jupiter, Saturn, the fixed stars.

Source: Mastin, Luke. "Cosmological Theories Through History ." *The Physics of the Universe*. N.p., 2009, www.physicsoftheuniverse.com/cosmological.html.

Appendix III

Figures 1-3 illustrate Galileo's observations of the universe and were originally published in *The Starry Messenger*. Source: Sobel, Dava. *Galileo's Daughter: A Historical Memoir of Science, Faith, and Love*. Walker & Company, 1999.

“With the aid of the spyglass, [the universe] may be observed so well that all the disputes that for so many generations have vexed philosophers are destroyed by visible certainty, and we are liberated from wordy arguments.”

Galileo, *Sidereus Nuncius (The Starry Messenger)*



Figure 1: A log of Jupiter's movement and its four largest moons - dubbed "Cosmica Sidera" (Cosimo's Stars) by Galileo.

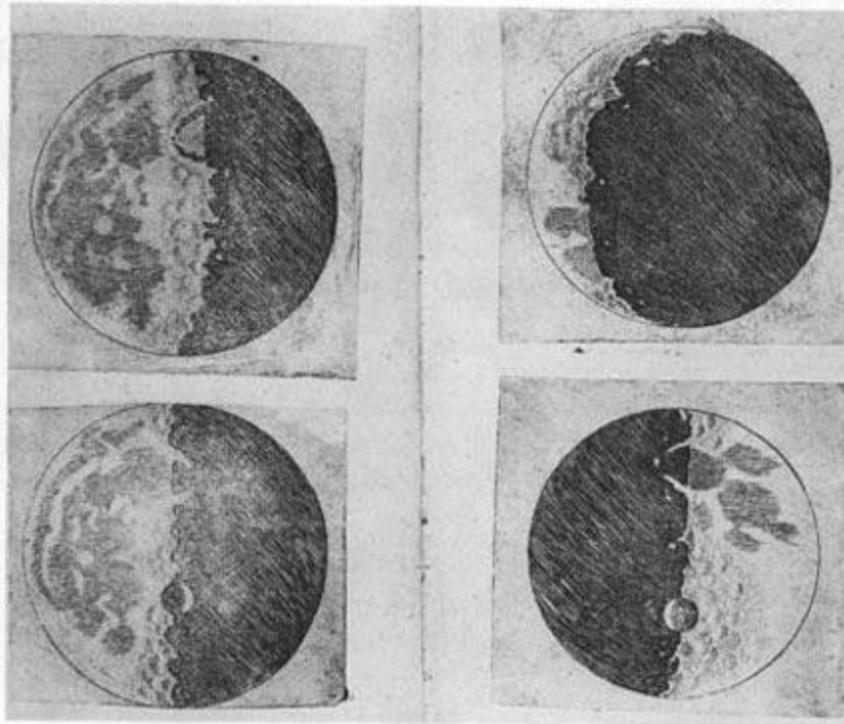


Figure 2: Assorted drawings of the moon, showing a ragged surface that was contrary to Aristotelian thought.

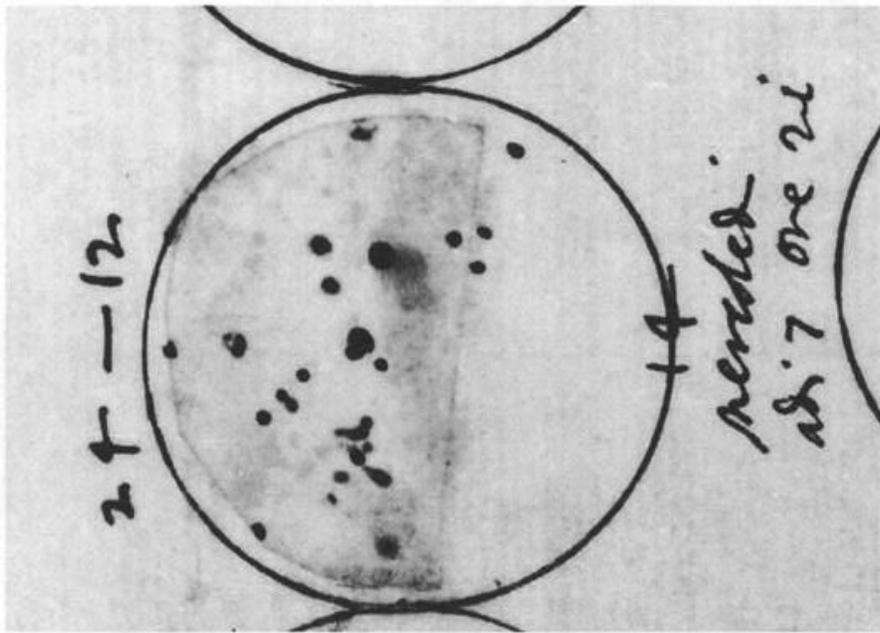


Figure 3: A sketch of traveling sunspots evidencing the Earth's orbit around the sun.

Bibliography

Primary

Galilei, Galileo. "Dialogue Concerning the Two Chief World Systems: Preface." *The Mathematicall Praeface*. Trans. Stillman Drake. Ed. S. E. Sciortino. Dartmouth College, n.d. Web. <<https://math.dartmouth.edu/~matc/Readers/renaissance.astro/7.0.0.html>>.

This website from Dartmouth provided an English translation of the preface from Galileo's *Dialogue Concerning the Two Chief World Systems*. I was able to find Galileo's direct declaration that his work was written entirely in the hypothetical, a key piece that showed his respect for and willingness to cooperate with the Catholic Church.

Galilei, Galileo. "Letter to Benedetto Castelli." *Interdisciplinary Encyclopedia of Religion and Science*. Trans. Antonio Faravo. N.p., n.d. Web. <<http://inters.org/Galilei-Benedetto-Castelli>>.

The Interdisciplinary Encyclopedia of Religion and Science contained several translated copies of letters Galileo sent to his colleagues; this particular web page featured his correspondence with Benedetto Castelli concerning the ways he felt the Copernican system was compatible with Holy Scripture.

Galilei, Galileo. "Letter to the Grand Duchess Christina of Tuscany." *Internet Modern History Sourcebook*, by Paul Halsall, Web. <<https://web.stanford.edu/certainty/readings/Galileo-LetterDuchessChristina.pdf>>.

This excerpt from Galileo's essay "Letter to the Grand Duchess Christina", originally written in 1615, expounds on his defenses against religious arguments - particularly relating to the Book of Joshua.

Galilei, Galileo. "The Starry Messenger." Rochester Institute of Technology, n.d. Web. <<https://people.rit.edu/wlrgsh/Galileo.pdf>>.

Galileo's *The Starry Messenger* documented his observations of the universe as seen through a telescope. Although it didn't disprove the Aristotelian model, it provided examples of Galileo's pro-Copernican slant and an insight into his thought processes.

Linder, Douglas O. "Galileo's Defense." *Famous Trials*. UMKC School of Law, n.d. Web. <<http://www.famous-trials.com/galileotrial/1013-defense>>.

This website provided a translated transcript of the defense Galileo provided during his trial. It includes recantations of the Copernican model, apologies for his past ignorance and arrogance, and pleas against the tarnishing of his reputation; at the end of his trial, Galileo was more concerned with his autonomy than his integrity.

Linder, Douglas O. "Galileo's Depositions." *Famous Trials*. UMKC School of Law, n.d. Web. <<http://www.famous-trials.com/galileotrial/1006-depositions>>

From the same website as above, this specific page provided a transcript of Galileo's trial - including the prosecution and sentence. This showed more directly the mindset of the Catholic Church and how they viewed the renegade scientist.

"The Text of Dialogue Concerning the Two Chief World Systems, 1632." *Calendars Exhibit*. N.p., 2008. Web. <<http://www.webexhibits.org/calendars/year-text-Galileo.html>>.

This website contained the entire text of Galileo's *Dialogue* and included a basic summary of the characters involved and the Copernican/Aristotelian arguments. It also discussed the aftermath of the *Dialogue's* publication and the retribution of the Catholic Church.

Secondary

"Aristotelian Physics." *How Things Move* (n.d.): n. pag. *State University of New York at Oswego*. Web.

<http://www.oswego.edu/~dristle/PHY_206_powerpoints/How_things_move3t.pdf>.

This website provided the resources from a Physics-206 lecture on Aristotelian physics at Oswego University. It discussed how Aristotle's hypotheses differed from what has been proven today and how Galileo challenged the established worldview.

CO Now LLC, Chicago, IL (reg):. "The Council of Trent - Session 4." *The Council of Trent*.

N.p., n.d. Web. <<http://www.thecounciloftrent.com/ch4.htm>>.

From this website, I was able to find the decree made by the Council of Trent that prohibits individuals who are not members of the church from personally interpreting the Bible. This was important to Galileo, as it was one of the arguments against scriptural support of the Copernican model that his opponents used against him.

"Cosmic Engine: Early Models of the Universe." *Commonwealth Scientific and Industrial*

Research Organisation. Australia Telescope National Facility, 21 June 2017. Web.

<<http://www.atnf.csiro.au/outreach/education/senior/cosmicengine/classicalastronomy.html>>.

This website detailed the differences between the many theories portraying the structure of the universe - particularly the Aristotelian and the Copernican model. It was interesting to see what the different philosophers regarded as explicit scientific evidence in the 4th century BC as compared to today.

Cowell, Alan. "After 350 Years, Vatican Says Galileo Was Right: It Moves." *The New York Times*, The New York Times, 30 Oct. 1992, Web.

<<https://www.nytimes.com/1992/10/31/world/after-350-years-vatican-says-galileo-was-right-it-moves.html>>.

This twentieth-century New York Times article places the life of Galileo in context and describes the posthumous recognition he was given, including the sanction of the *Dialogue* and the admission of Pope John Paul II that Galileo was innocent.

"Dialogue Concerning the Two Chief World Systems - Ptolemaic and Copernican."

Encyclopædia Britannica. Encyclopædia Britannica, Inc., n.d. Web.

<<https://www.britannica.com/topic/Dialogue-Concerning-the-Two-Chief-World-Systems-Ptolemaic-and-Copernican>>.

This article traced Galileo's most famous work from its conception to the decree that placed it on the Index of Forbidden Books. It also highlighted the agitation felt by the Catholic Church at that time; Copernicus's book took seventy years to make the Index, while Galileo's took nine months.

Diaz, Michael. "Galileo Galilei." *International Space Hall of Fame*. N.p., n.d. Web.

<<http://www.nmspacemuseum.org/halloffame/detail.php?id=108>>.

This website touched on Galileo's contributions to modern astronomy and the scientific method, as well as his title "The Father of Modern Science".

Helden, Albert Van. "Galileo." *Encyclopædia Britannica*. Encyclopædia Britannica, Inc., 17 Jan. 2018. Web. <<https://www.britannica.com/biography/Galileo-Galilei>>.

This biographical article chronicled in detail Galileo's early life, including his time as a professor and court philosopher. It also described his fall from the grace of the Catholic Church and the controversy that surrounded his publication of the *Dialogue*, making these complex aspects of his life easier to grasp.

"How Galileo Proved Spots Were on the Sun." *Stanford Solar Center*. N.p., 13 Aug. 2008. Web. <<http://solar-center.stanford.edu/sunspots/galileo1.html>>.

This article describes Galileo's use of sunspots as support for the Copernican theory. Although it's focus is on the science and mathematical proof behind his argument, it demonstrated the brilliant nuances of Galileo's defense.

Joshua. King James Bible. N.p.: n.p., n.d. *Bible Hub*. Web. <<http://biblehub.com/joshua/10-13.htm>>.

Through this website, I was able to find the Bible verses that Galileo's opponents used to discount the Copernican theory. They were mostly concerned with Joshua 10:13, in which the sun is ordered to stand still in the sky.

Lienhard, John H. "No. 166: Galileo's Experiment." *The Engines of Our Ingenuity*. University of Houston, n.d. Web. <<https://www.uh.edu/engines/epi166.htm>>.

This website described Galileo's famous experiment in which he dropped two balls off the Leaning Tower of Pisa. It was one of the first examples of experimental evidence disproving Aristotelian thought.

Magrini, Graziano. "Villa Il Gioiello." *Scientific Itineraries in Tuscany*. Trans. Victor Beard. Museo Galileo, n.d. Web. <<https://brunelleschi.imss.fi.it/itineraries/place/VillaGioiello.html>>.

From this website, I found information concerning Il Gioiello (The Jewel) in Arcetri, the house where Galileo lived up until his death. It also illustrated the the disgrace Galileo was treated with after his death and how, even posthumously, he was a symbol of repressed revolutionary thought.

Martínez, Rafael A. "What Does the Decree on Copernicanism Say?" *Interdisciplinary Encyclopedia of Religion and Science*. N.p., n.d. Web.
<<http://inters.org/decreed-copernicanism>>.

This article explained the 1616 Anti-Copernican edict and its effects on Galileo and his reputation. It also described Galileo's "Treatise on the Tides" that directly led to significant polarization within the Catholic Church.

Mastin, Luke. "Cosmological Theories Through History." *The Physics of the Universe*. N.p., 2009, Web. <<https://www.physicsoftheuniverse.com/cosmological.html>>.

This website is dedicated to explaining complex physics theories to the public and was exceedingly helpful in explaining the differing views of Aristotle and Copernicus. It also provided me with the two diagrams I used in Appendix I and II.

Naess, Atle. *Galileo Galilei: When the World Stood Still*. N.p.: Springer, 2010. Print.

I was able to read portions of this biography, specifically concerning Galileo's time spent in the service of Cosimo II and the suppression of Copernicanism by the Catholic Church. It crafted a brilliant commentary on the difficulty of overcoming the blindness of personal opinions and beliefs.

Pogge, Richard W. "Lecture 16: "The Starry Messenger: Galileo Galilei & the Telescope." *Astronomy 161*. N.p., 4 Oct. 2007. Web.
<<http://www.astronomy.ohio-state.edu/~pogge/Ast161/Unit3/galileo.html>>.

This website provided me with an outline of several astronomy lectures from Ohio State University that featured Galileo's observations of the universe. It detailed his various discoveries, including the moon's topography, phases of Venus, and sunspots, and how he used each as evidence for a heliocentric universe.

Price, Mike. "Smithsonian Magazine." *Galileo, Reconsidered*, 11 Aug. 2008, Web.

<<https://www.smithsonianmag.com/science-nature/galileo-reconsidered-7931973/>>.

This Smithsonian publication brought up new questions considering Urban VIII's motives for bringing Galileo to trial. It considered that, along with Urban's discontent with the treatment of the Aristotelian theory in the *Dialogue*, the pontiff used Galileo to punish the Grand Duke of Tuscany for political reasons.

Scott, Michon. "Cesi and the Linceans." *Strange Science*. N.p., 26 Mar. 2017. Web.

<<https://www.strangescience.net/lincean.htm>>.

This article discusses the highly esteemed Lincean Academy and Galileo's induction in 1611. It also covers how the academy continued to back Galileo, even after his falling-out with Urban VIII and his loss of face during the trial.

Sobel, Dava. 8 Jan. 2018.

I was able to correspond directly with Dava Sobel, author of *Galileo's Daughter*, on the subject of Galileo's impact on the various conflicts he embodied. She provided valuable insight and directed me to other sources that also discussed Galileo's lasting legacy.

Sobel, Dava. *Galileo's Daughter: A Historical Memoir of Science, Faith, and Love*. Walker & Company, 1999. Print.

I found this biography to be the most valuable resource in my analysis of Galileo's conflict with the Catholic Church. It covered the life of Galileo in such extensive detail and directed much of my research. I also came to realize that Galileo represented numerous conflicts, not just the best known strife between science and religion.

"Tomb of Galileo Galilei" *The Tombs of Santa Croce*. N.p., 27 Mar. 2014. Web.

<<http://www.italiantribune.com/the-tombs-of-santa-croce/galileo-galilei>>

This article describes the honors Galileo was finally awarded almost 95 years after his death - the construction of a tomb in Santa Croce as a commemoration of the impact his life and works had on the world.

"Tommaso Caccini." *The Galileo Project*. Rice University, n.d. Web. <<http://galileo.rice.edu>>.

This article discussed Tommaso Caccini, one of Galileo's most vocal opponents. It showed the response Galileo's works ignited in the Aristotelian community and their retaliation as well as some of the religious arguments they used.

"The Trial" *Scientific Itineraries in Tuscany*. Institute and Museum of the History of Science, Florence, Italy, 16 Jan. 2008. Web.

<<https://brunelleschi.imss.fi.it/itineraries/itinerary/TheTrial.html>>.

This article discusses the impact Galileo had on the discipline of science, both immediately and in the long term. It focuses primarily on the period of time surrounding his trial, including the 1616 Copernican edict that was indirectly caused by his "Treatise on the Tides".

Tyson, Neil deGrasse. *Death by Black Hole*. W W Norton & Co Inc, 2014. Print.

I had read *Death by Black Hole* several months before choosing Galileo as my topic of research, so was able to incorporate some of the discussion it covers on the science/religion conflict more seamlessly into my paper. Tyson beautifully describes the relationship between God and scientific theories from a unique viewpoint I was unable to find elsewhere.

Tyson, Peter. "Galileo's Big Mistake." *PBS*. Public Broadcasting Service, 29 Oct. 2002. Web.
<www.pbs.org/wgbh/nova/earth/galileo-big-mistake.html>.

This PBS article described the mistake Galileo made in using the evidence of the moving tides as support for the Copernican theory. As the effects of gravity hadn't yet been realized, he mistakenly discounted the power of the Moon on the waters of Earth.

"Urban VIII (Maffeo Barberini)." *Europe, 1450 to 1789: Encyclopedia of the Early Modern World*. Encyclopedia.com, 2004. Web.
<<https://www.encyclopedia.com/people/philosophy-and-religion/roman-catholic-popes-and-antipopes/urban-viii>>.

This article follows the life of Maffeo Barberini and the subsequent papacy of Urban VIII. It was extremely helpful to see the friction with Galileo grow from a different perspective.

Van Helden, Albert. "Galileo Timeline." *The Galileo Project*. Rice University, n.d. Web.
<<http://galileo.rice.edu/chron/galileo.html>>

While this entire website - a compilation from Rice University - was extremely beneficial in my research, the most useful page was a timeline that traces Galileo's life. It helped me follow the chronology of a man who seemed unable to sit still.