

Science, Religion, and Nature in the Age of Galileo

Course Syllabus and Commentary

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Preface to the syllabus

Decades ago, Herbert Butterfield wrote in *The Origins of Modern Science* that “we now know that what was emerging towards the end of the seventeenth century was a civilization exhilaratingly new, perhaps, but strange as Nineveh and Babylon.”¹ The very novelty of the Scientific Revolution, therefore, meant caesura as much as culmination – and that break, Butterfield felt, was the single most significant moment since the rise of Christianity. The true origins of the modern world were not to be found in Renaissance secular individualism, but rather in the “radical nature of the changes that had taken place and the colossal possibilities that lay in the seeds sown by the seventeenth century.”² Butterfield had repositioned Jacob Burckhardt’s nineteenth-century claim that the Renaissance had lifted the veil “woven of faith, illusion, and childish prepossession, through which the world and history were seen clad in strange hues.”³ In the former’s vision, science displaced Renaissance. Western civilization’s great narrative was punctuated by the Greek discovery of philosophy, Christianity’s age of faith, the Renaissance’s recovery of antiquity, but a yet taller ridge was scaled by the new science of the late seventeenth century, with the accompanying connotations of modernity, reason, and secularism.

There was nothing much novel in Butterfield’s linkage between science and the modern age. Many eighteenth-century thinkers subscribed to the ideas that at least the latter part of the previous century had redefined the understanding of nature and propelled forward the triumphal march of reason, setting the stage, also, for the diminishing of religion. The radical Enlightenment’s hostility toward many aspects of

¹ Herbert Butterfield, *The Origins of Modern Science* (London, 1949), 149.

² Butterfield, *Origins*, 148.

³ Jacob Burckhardt, *The Civilization of the Renaissance in Italy*, trans. S.G.C. Middlemore (London: Penguin, 1990), 98.

European religious life arose from its claim that the foundation of a better society rested on human reason's power to dispel ancient superstition.⁴ Deep-seated, this notion has suggested a fundamental conflict between science and religion ever since – the flipside being science and the secular advance of modernity. After all, the French *philosophes* were enthralled with Robert Boyle, Isaac Newton, and the British empiricist tradition in general.⁵ Voltaire's popularizing exposition of Newtonian physics and his deist conception of a mechanistic nature ran consistently throughout his lifelong polemic with the Church, bearing the famous tagline “*écrasez l'infame.*” Somewhat differently, the *Encyclopédiste* Jean le Rond d'Alembert embraced science at the same time that he rejected the systematizing tendencies of seventeenth century rationalist philosophers like René Descartes, writing that the preceding century's taste for systems was “more suited to flatter the imagination than to enlighten reason.”⁶ D'Alembert's reference to a science of facts and empiricism nonetheless echoed an earlier manifesto, the *New Organon* (1620), in which Francis Bacon had identified the sense-based foundations of knowledge. More frequently cited than truly followed, Bacon's inductive view of science gestured toward the new horizons of the scientific enterprise – irrepressibly progressive, cumulative, and modern.

The triumphant myth of the Scientific Revolution is far less convincing today, as it has been subjected to close and recurring scrutiny. One excellent survey suitable for undergraduates quips in the opening that “there is no such thing as the Scientific Revolution, and this is a book about it.”⁷ In preparing this course, however, I have adhered to yet another caution, which I find to be as significant. Jonathan Sheehan, author of a recent study on the Enlightenment Bible writes, “For modern society, secularization always is and always must be incomplete. Even as religion seems to vanish from politics and public culture, it never ceases to define the project of

⁴ See Jonathan Israel, *The Radical Enlightenment: Philosophy and the Making of Modernity, 1650-1750* (Oxford, 1988).

⁵ Robert Torrance, *Encompassing Nature, a Sourcebook: Nature and Culture from Ancient Times to the Modern World* (Washington DC, 1999), 1102-1103.

⁶ Jean le Rond d'Alembert, “Preliminary Discourse to the *Encyclopedia*, in Torrance, *Encompassing Nature*, 1118.

⁷ Steven Shapin, *The Scientific Revolution* (Chicago, 1996), 1.

modernity.”⁸ The process whereby Enlightenment thinkers translated the Bible into a cultural artifact – not displacing the revealed text from the entirety of European life, but transforming its meaning in the realm of scholarship and translation – offers insights for this course. If the secularization of eighteenth-century culture required the foil of religion, what can one say of the previous two centuries?

Given the so-called “culture wars” between secular and religious attitudes in American life, one might venture that interpretations of the Scientific Revolution have become especially relevant. In a February 3, 2006 online article for *Slate*, entitled “Galileo Groupies: The Unlikely Rock Star of Intelligent Design,” the journalist Peter Dizikes drew attention to the fact that Italian astronomer has been an inspiration to some intelligent design advocates who associate their own battles against a Darwinist scientific establishment with the seventeenth-century figure’s “thinking outside the box.” This is tantamount to equating Galileo’s dismantling of the Aristotelian heavens with the ID rebellion against evolution, on the basis that the latter is a likeminded rebellion against a blind establishment that will someday eat its words.⁹ It seems that those who decry the *Origin of the Species* and secularist science in general have identified with the very same figure long seen as a victim of religious obscurantism. With the seventeenth-century astronomer caught on both sides of a present-day firefight, it is especially appropriate to ask whether early modern historical perspectives might be relevant.

I developed this syllabus on the premise that current debates about science and faith in American society make this a crucially significant time for Trinity students to examine whether the expanding boundaries of early modern natural knowledge and the accompanying philosophical responses constituted – as Butterfield’s periodization implied – a secular leap into modernity. This proposed 200-level course will ask undergraduates to question “Whig history” explanations of how modern science emerged, but will also be attentive to rupture and disjuncture. To what extent was the Scientific Revolution as unique a phenomenon as Herbert Butterfield suggested in *The Origins of*

⁸ Jonathan Sheehan, *The Enlightenment Bible: Translation, Scholarship, Culture* (Princeton, 2005), ix.

⁹ Peter Dizikes, “Galileo Groupies: The Unlikely Star of Intelligent Design” (*Slate*, 2004), <http://www.slate.com/id/2135415>, (accessed February 5, 2006).

Modern Science? Were the ruptures as profound as to destroy one world and replace it with another, as Alexandre Koyré maintained?¹⁰

Historians' attitudes have shifted significantly in the past decades. One marked feature of changing perspectives is a diminished emphasis on identifying a distinct "science" taking shape in the seventeenth century, and a greater sensitivity to the wide range of activities that characterized the investigation of nature in the early modern period. This spectrum included natural philosophy, with its traditional reliance on the corpus of classical science, as well as artisanal crafts and magic. Under close scrutiny, many such practices are difficult to reconcile with modern definitions of science.¹¹

Accordingly, recent approaches have led to a greater appreciation of the complexities and contradictions of the Scientific Revolution. This includes the ways practitioners of sixteenth- and seventeenth-century science reconciled religious faith and the investigation of nature, how inconsistencies and differences persisted in determining the relative value of authority and observation, how knowledge was legitimated through display and collection, and how artisans were one of the principal sources for a practical approach to making natural knowledge.¹² Rupture and continuity marked the sixteenth and seventeenth centuries. Renée Descartes' contempt for the Dominican natural philosopher Tommaso Campanella, when the two met briefly in seventeenth-century Paris (a mechanical philosopher's scorn for a Renaissance *magus*), suggests the sort of antithesis between magic and mechanism commonly associated with the radical shift in world view accomplished during the Enlightenment. It is also apparent, however, that the relationship between the hidden and occult qualities of natural objects and phenomena remained a promising way of investigating nature well into the seventeenth century.¹³

¹⁰ See Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore, 1953). For an introduction to the history of science (and a work suitable for undergraduates) see: Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago, 2005).

¹¹ Bowler and Morris, *Making Modern Science*, 23-52.

¹² A sample reading list would include: Pietro Redondi, *Galileo Heretic* (London, 1988); Mario Baglioli, *Galileo Courtier: The Practice of Science in the Culture of Absolutism* (Chicago, 1993); David Freedberg, *Eyes of Lynx* (Chicago, 2002); Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (London, 1994); Pamela H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago, 2004).

¹³ See, for example: William Eamon, *Science and the secrets of nature : books of secrets in medieval and early modern culture* (Princeton, 1994); John M. Headley, *Tommaso Campanella and the Transformation of the World* (Princeton, 1997); Frances Yates, *Giordano Bruno and the Hermetic Tradition* (London, 1964).

It is not difficult for the triumphal myth to ring loudest – that Galileo’s elevation of sense experience and mathematics over Aristotle signaled a momentous shift in Western approaches to nature. In the wake of such momentous pronouncements, seventeenth-century science and reason can thus be said to have broken a long-enduring “Great Chain of Being”, reducing nature to mechanism, mathematical principle, and taxonomical order. One could also stress, however, that in the 1600s the sensible and empirical emphasis of Baroque science overlapped the historical and aesthetic ideals of Renaissance humanism. Despite respective claims to novelty, the latter both maintained deep continuities with Judeo-Christian attitudes toward nature.

While preparing the syllabus, I was reminded of the process that the French philosopher Michel Foucault described as the transition from one *episteme* to another – what he identified as a move away from the search for similitude in nature toward the elaboration of order and difference.¹⁴ Constructed thusly, the epistemic shift at the end of the Renaissance saw an animate nature give way to Descartes’s mechanical bodies and Robert Hooke’s corpuscles – passive and inert matter. There is a ring of Enlightenment myth making in subscribing too readily to the “disenchantment of nature.” Granted, not all aspects of early modern natural inquiry were so readily embraced by the eighteenth century, especially magic and astrology. Even in natural history, the encyclopedic efforts of an earlier generation of naturalists like Ferrante Imperato and Ulisse Aldrovandi were deemed of little use by the mid 1700s. As Paula Findlen has noted, however, “the novelty of Enlightenment natural history lay partially in the approach to nature but primarily in the rhetoric surrounding its creation.”¹⁵

I see the principal thrusts of this proposed course – science, religion, and secularism – as converging at an endpoint with the earth sciences. The emergence of modern geology is a useful contrast to astronomy in terms of its timeline, it being less possible to speak of a modern discipline in the early modern period. More to the point, the controversies that emerged as the Earth was disengaged from ancient cosmology and became the object of increasing study, posed serious questions.¹⁶ Debate revolved

¹⁴Michel Foucault, *Les mots e les choses. Une archéologie des sciences humaines* (Paris, 1966).

¹⁵ Findlen, *Possessing Nature*, 393.

¹⁶ Nicoletta Morello, “Nel corpo della Terra. Il geocosmo di Athanasius Kircher,” in Eugenio Lo Sardo, ed., *Athanasius Kircher. Il museo del mondo* (Rome, 2001), 179-196. David Gohau argues, for

around the nature and location of fossils and, ultimately, the age and origin of the Earth. Seventeenth-century investigation of fossils and stratigraphy – Robert Hooke and Nicolas Steno, for example – conformed to a biblical time scale, but not without strains. These rifts became even more apparent in the next two centuries, as the “Uniformitarianism” expounded by James Hutton and later by Charles Lyell suggested a vastly expanded timescale. This was done by arguing that geological features were the result of a cycle of slow, gradual changes.¹⁷ Georges Louis Leclerc, comte de Buffon, suspected in his *Les Époques de la Nature* (1780) that time had assumed terrifying proportions, signaling one of the most significant conceptual shifts wrought by science before the nineteenth century. Scanning the headlines for the ID versus evolution controversy only reveals it a hot topic today.

Received ideas presuppose that somewhere in the swirl of the European sixteenth, seventeenth, and eighteenth centuries the modern secular age emerged. Jacob Burckhardt saw it in the odd Borgia and Sforza that colored his vision of the Renaissance, Butterfield saw it in Newton, while Enlightenment thinkers frequently saw it in themselves. The latter were not always kind toward their predecessors, having a penchant for claiming originality, but they also established a link between science and modernity that shapes current understanding of faith and natural inquiry. In his last book, *Flesh in the Age of Reason*, Roy Porter eloquently described the process whereby a scientific appraisal of the body, sense, and cognition in the British Enlightenment reconfigured the Western understanding of the soul, mind, and body. Wary of the easily-mythologized grand narrative spanning from Greek rationalism to modern self, Porter argued nonetheless that the implications were profound, leading to the “demise of the soul” and the affirmation of

example, that Descartes’ *Principes de la Philosophie* (1644) framed studying the physical creation of the earth in a way that ruptured the closed universe of the ancients, and applied the principles of ‘mechanical’ philosophy to the earth. See David Gohau, *History of Geology* (London, 1990) 37-46. David Oldroyd, while recognizing the significance of the mechanical philosophers, argues for the perseverance of older ‘organic’ theories in many approaches to the earth, including those in Athanasius Kircher’s *Mundus Subterraneus*; see David Oldroyd, *Thinking About the Earth: A History of Ideas in Geology* (London, 1996), 43-50.

¹⁷ Bowler and Morus, *The Making of Modern Science*, 103-127. See especially Paolo Rossi, *The Dark Abyss of Time: The History of the Earth and the History of Nations from Hooke to Vico* (Chicago, 1984).

the mind as constituent of self.¹⁸ Perhaps this reveals a secularizing aspect of early modern science? I intend to raise the question, even if the answer will be incomplete.

I assume that the syllabus largely will speak for itself in terms of assignments and sequence. I should say that its formulation was part an interdisciplinary conversation aimed at introducing the topic of secularism across the college curriculum, using the different perspectives of history, philosophy, and political science. I have benefited greatly from the insights of my colleagues this year. One realization has been that as a cultural historian, mine is in many ways an oblique approach on the question of secularism. Beyond considering the formation of early modern scientific societies, and planning to ask students to consider what about these might be deemed secular, my tack steers me toward culture, belief, and natural inquiry. Finally, the title “Science, Religion, and Nature in the Age of Galileo”, which is admittedly meant to attract attention in the competitive market of a small liberal arts college, is definitely not aimed at perpetuating a *great men in science* view. Instead, I hope that the all-too-frequently distorted episode of Galileo’s trial might be rendered at once complicated, problematic, and instructive of fundamental transformations in European life.

¹⁸ Roy Porter, *Flesh in the Age of Reason: The Modern Foundations of Body and Soul* (New York, 2003), 27.

Syllabus: Science, Religion, and Nature in the Age of Galileo

Brief Course Description

After four centuries, the astronomer Galileo Galilei's trial before the Roman Inquisition endures as a symbol of the clash between science and religion. Undoubtedly, the rise of early modern science in seventeenth-century Europe provoked its share of battles, but the whole story defies simple explanation. This course will lead you to consider the origin and extent of the apparently irreconcilable differences between world views. How wide was the rift between science and religion before the Enlightenment? You will be encouraged to explore this complex relationship in historical context, by weighing the coexistence of scientific curiosity and intense faith, and also by considering the religious response to the expanding horizons of knowledge. The course will highlight investigations of the heavens and the earth, and will include a detailed look at Galileo's trial. A number of broader themes will also be the focus. Among these are the understanding of God and nature, authority (classical and scriptural) versus observation, the wide range of knowledge-making practices, the persistence of magic, and the influence of power and patronage. The class seeks to present a rich and exciting picture, looking forward as well to the influence of rational thinking and scientific inquiry on the making of modernity.

This course will be especially useful to students of history, science, and religion, and also those who wish to gain greater historical perspective on religious and secular thinking today. It is an introductory course that does not assume specific prior knowledge and welcomes undergraduates from different disciplines.

Books and Reading

Sour Maria Celeste, *Letters To Father*

Maurice Finocchiaro, *The Galileo Affair: A Documentary History*

Galileo Galilei, *Starry Messenger*

Malcom Oster, *Science in Europe, 1500-1800: A Primary Sources Reader*

Stephen Shapin, *The Scientific Revolution*

Robert Torrance, *Encompassing Nature: Nature and Culture from Ancient Times to the Modern World*

**Additional reading posted as .PDF files on the Trinity Blackboard site*

Course Objectives

- Develop a critical understanding of the relationship between science and religion
- Develop the ability to think as a historian
- Develop the skills of oral communication, writing, and critical thought
- Foster an environment where ideas might be shared and discussed openly

Online Resources

The Galileo Project

<http://galileo.rice.edu/index.html>

Interdisciplinary Documentation on Religion and Science

<http://www.disf.org/en/>

Institute and Museum of the History of Science (Florence, Italy)

<http://www.imss.fi.it/index.html>

Early English Books Online

<http://eebo.chadwyck.com/home>

**Course documents and images on the Trinity Blackboard site*

Class Assignments and Grading

General Participation 15%

(Based on attendance, and contribution to discussion)

Exercise 1 (with 5-page written response) 15%

Exercise 2 (with 5-page written response) 15%

Exercise 3 (5-page written response) 15%

Longer interpretative paper on science and religion (8-10 pages) 20%

Final Exam 20%

Course Schedule and Outline

(**BB**: readings on Blackboard site)

Part I Science and Religion in the Classical, Medieval, and Renaissance Contexts

Week 1

T Introduction

Th How do science and religion differ?

Read: **BB**

- 1) Ernst Mayr, *This is Biology*, (24-64)
- 2) Ian Barbour, *When Science Meets Religion*, (1-38)
- 3) Bowler and Morus, *Making Modern Science* (1-78, 103-163, 319-365, 487-513)

Week 2

T Philosophers and Physicians in Antiquity

Read: Torrance, *Encompassing Nature*

- 1) Selections from the Hippocratic Corpus
- 2) Plato: *Phaedrus, Gorgias, Timaeus*
- 3) Aristotle: *Physics, Metaphysics, On Generation, On the Parts of Animals*

Th Early Christianity

Read: **BB**

- 1) Augustine, *Confessions* (on astronomers)
- Torrance, *Encompassing Nature*
- 1) St. Ambrose, *The Six Days of Creation*

Week 3

T Reason and Faith in the Middle Ages

Read: Torrance, *Encompassing Nature*

- 1) Maimonides, *The Guide for the Perplexed*
- 2) St. Thomas Aquinas, *On the Power of God*
- 3) **BB** Selection from Daston and Park, *Wonders and the Order of Nature*

Th Science and Nature in the Renaissance

Read: Torrance, *Encompassing Nature*

- 1) Petrarch, *The Ascent of Mount Ventoux*
- 2) Nicolas Cusanus, *Of Learned Ignorance*
- 3) Giovanni Pico della Mirandola, *Heptaplus*
- 4) Selections from Paracelsus
- 5) Giordano Bruno, *Concerning the Cause, Principle, and One*

Week 4

T **Class Exercise 1**: Was the medieval synthesis of reason and faith successful? (Or, alternately, was the Renaissance “scientific”?)

Students hand in written response and present their arguments orally.

Part II The Scientific Revolution

Th The Copernican Revolution

Read: Oster, *Science in Europe*

- 1) Copernicus, *On the Revolution of the Heavenly Spheres* (with preface by Andreas Osiander)

Week 5

T Medicine, Science, Technology and Exploration

Read: Oster, *Science in Europe*

- 1) Andreas Vesalius, *On the Fabric of the Human Body*

- 2) Garcia d'Orta, *Colloquies on the simples and Drugs of India*
- 3) **BB** Selection from Anthony Grafton and Nancy Siraisi, *New Worlds, Ancient Texts*

Th Was there a Scientific Revolution?

Read: Shapin, *The Scientific Revolution* (all)

Part III The “Galileo Affair”

Week 6

T No Class (Trinity Days)

Th Galileo’s *Starry Messenger*

Read: 1) Galileo, *Starry Messenger* (all)

[In-class exercise (counts toward participation grade): Students “announce” a scientific discovery and make a dedication.

Week 7

T The Two Books

Read: Finocchiaro, *Galileo Affair*,

- 1) *Letter to the Duchess Christina*

Th 1615-16 Proceedings

Read: Finocchiaro, *Galileo Affair*

- 1) Complaints, letters, and depositions between 1615-1616
- 2) Galileo’s letters to the Tuscan Secretary of State
- 3) Cardinal Bellarmine’s Certificate

Week 8

T The Condemnation of 1633

Read: Oster, *Science in Europe*

- 1) Galileo: *Assayer, Dialogue*

Finocchiaro, *Galileo Affair*

- 1) Later Inquisition Proceedings (1633)

Th Defense and prosecution closing arguments – was Galileo guilty?

Students work in teams, beginning with an in-class session, to prepare their arguments (using also the online resources identified on the syllabus).

Week 9

Spring Break

Week 10

T What did women know about science?

Read: Sour Maria Celeste, *Letters to Father*

- 1) Selected letters

Th **Class Exercise 2: Defense and prosecution closing statements**
Students present closing arguments

Part IV Secular trends

Week 11

T **Science's Manifesto: Bacon's *New Organon***

Read: Oster, *Science in Europe*

- 1) Bacon: Preface and Aphorisms (*New Organon*)

Th **Science and Utopia:**

Read: **BB**

- 1) Bacon, *New Atlantis*
- 2) Tommaso Campanella, *City of Sun*

Week 12

T **Practitioners and Sites of Knowledge**

Read: Oster, *Science in Europe*

- 1) Thomas Sprat, *History of the Royal Society*
Early English Books Online (<http://eebo.chadwyck.com/home>)
- 1) Student search for Margaret Cavendish, Duchess of Newcastle

BB

- 1) Daston and Park, *Wonders and the Order of Nature*, 215-253.
- 2) Findlen, "Inventing Nature: Commerce, Art, and Science in Early Modern Cabinets of Curiosities," in Findlen and Smith, eds., *Merchants and Marvels*

Th **Protestantism and Science in Seventeenth-Century England**

Read: Oster, *Science in Europe*

- 1) Robert Hooke, *Micrographia*
- 2) Robert Boyle, *Of the Excellency and Grounds of the Corpuscular Philosophy*
- 3) Isaac Newton, *Mathematical Principles of Natural Philosophy*

Week 12

T **Science and Religion, Body and Soul**

Read: **BB**

- 1) From Roy Porter, *Flesh in the Age of Reason*,
Oster, *Science in Europe*
- 1) John Ray, *The Wisdom of God Manifested in the Works of Creation*
Torrance, *Encompassing Nature*,
- 1) Thomas Hobbes, *Leviathan*
- 2) Ralph Cudworth, *The Digression Concerning the Plastick Life of Nature*
- 3) John Locke, *Essay on Human Understanding*

Th **Science and Religion in Seventeenth-century France: Descartes and Pascal**

Read: Torrance, *Encompassing Nature*

- 1) Descartes, *Meditations on the First Philosophy*
- 2) Blaise Pascal, *Pensées*

Week 13

T Sciences of the Earth: the Origins of Geology

Read: Oster, *Science in Europe*

- 1) Georgius Agricola, *De Re Metallica*

BB

- 1) Robert Hooke, "Lectures and Discourses of Earthquakes," in *Posthumous Works*

Torrance, *Encompassing Nature*

- 1) Robert Fludd, *History of the Macrocosm and Microcosm*

Th Geology Continued: Sacred and Secular History

Read: Torrance, *Encompassing Nature*

- 1) Thomas Burnet, *The Sacred Theory of the Earth*
- 2) James Hutton, *Theory of the Earth*
- 3) Georges Louis Leclerc de Buffon: *Natural History, The Epochs of Nature*

BB

- 1) Dan Smail, "In the Grip of Sacred History" *American Historical Review*

Week 14

T Class Exercise 3: Interpreting a Disaster

Students reconstruct a seventeenth-century natural disaster using contemporary accounts

Read: **BB**

- 1) Giulio Braccini, *The Eruption of Vesuvius* (translation by Sean Cocco)
- 2) Pietro Castelli, *Of the Eruption that Occurred on Vesuvius*
- 3) Giovanni Battista Manso (letters; translated by Sean Cocco)
- 4) [Visual source: Domenico Gargiulo]

Th Are there final causes in nature?

Read: Torrance, *Encompassing Nature*

- 1) Baruch Spinoza, *Ethics*
- 2) Gottfried Wilhelm von Leibniz, *On Nature Itself*

BB

- 1) Voltaire, *Miscellaneous Letters and Lisbon Earthquake*

Week 15

T Conclusion and Review