V. Religion and Science[1]

Arguably, in the course of Western intellectual history, the rise of Christian theology and the development of modern science stand alone as the most influential and widespread among all the different ideas, theories, and developments since the beginning of recorded history.[2] When we think of the many fundamental ways in which Christianity and science have been responsible for shaping and molding and otherwise influencing the fundamental concepts, values, and structure of modern Western societies, it is difficult to argue with such an assessment. It is not surprising then that religion and science are frequently found to have been in conflict for control of the hearts and minds of men and women. In modern times, the scientific revolution stands alone in terms of both the breadth and depth of the social changes that have accompanied it. It is not a matter of simple hyperbole that the scientific revolution is called a revolution. Its changes have proven to be global; in contrast, the Protestant Reformation, as revolutionary as it might have proven to be, was a "domestic affair" among people in Western European countries.[3]

By examining two different historical "case studies" of major pivotal periods of conflict between religion and science, we can better understand the current relationship between religion and science. In the history of the relationship between religion and science, there are two periods that are most significant: one is the rise of modern science in the seventeenth century and the resulting conflict between Copernicus's heliocentric astronomy and the Roman Catholic Church, and the second is the development of Charles Darwin's theory of evolution in the late nineteenth century and the resulting conflict between evolutionists and fundamental Protestants. The conflict between Copernican astronomy and the Roman Catholic Church is one whose general nature is known to most people who have studied either the history of the development of Christianity or the history of

[1] Attention in this volume to the relationship between religion and science is not confined to this chapter. Readers should also examine Chapters III and VII for further discussion of the interplay between religion and science in the twentieth century.

[2] See, for example, Herbert Butterfield, *The Origins of Modern Science, Second Edition* (New York: Macmillan, 1957), pp. 175-90. Also see Alfred North Whitehead, *Science and the Modern World* (New York: Free Press, 1925), p. 2.

[3] See Whitehead, *ibid.*, pp. 1-2.

the development of modern science. The story is worth retelling, however, because, as the saying goes, the devil is in the details, or in this case, the science is in the details. These brief excursions into the history of the conflict between religion and science will provide the basis for understanding the relationship between religion and science in the twentieth century.

GALILEO GALILEI AND COPERNICAN ASTRONOMY

Contrary to popular belief, Galileo Galilei did not have a hand in actually formulating Copernican astronomy. He was, however, its most influential supporter and popularizer, and he did provide the first experimental evidence to support the new heliocentric view of the solar system. At the time, the new heliocentric cosmology was in direct conflict with the accepted and dominant Ptolemaic geocentric astronomy. In terms of explaining and predicting astronomical phenomena, such as the position of the planets, Copernican theory was immediately and imminently more successful than Ptolemaic theory. Committed to the Aristotelian notions of the "perfect" circular motion of heavenly bodies and their uniform speed, Ptolemaic astronomers had to appeal to the introduction of increasingly ad hoc and more complicated notions such as epicycles and deferents to explain the irregular motions of the planets. Of course, Copernican astronomy also struck at the heart of accepted and dominant Christian theology and its anthropocentric view of the unique importance of human beings. Several scholastics, including William of Ockham in the fourteenth century (most remembered now for wielding "Ockham's Razor," the law of parsimony), had maintained that it must be possible for God to create many different worlds and perhaps even many better worlds than this one given that God is omnipotent.[4] However, by the early seventeenth century, Christian theology was dominated by the anthropocentrism according to which this world and human beings were seen as occupying a unique and central part of God's perfect creation.

GALILEO AND THE CHURCH

The conflict between Galileo and the Roman Catholic Church covered a wide range of issues and occurred on several different levels. Most obvious perhaps is the matter of the content of the Ptolemaic theory versus the content of the Copernican theories.[5] One theory says that the sun moves around the earth, and the other says that the earth moves around the sun. This difference was certainly an important issue, but it was not the most important or fundamental one. In the spirit of trying to avoid a confrontation, the Church had taken the stand that the new Copernican theory could be used as an "instrumental aid" for making calculations easier in astronomy if it was not represented as being actually *true* about the world. Andreas Osiander had written an introduction to Copernicus's *On the Revolutions of the Celestial Spheres* in which he had maintained that the heliocentric theory made the calculations of the astronomers easier as they predicted the position of the planets (after all, they would not have to deal with the epicycles and deferents

[4] See John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991), p. 62.

[5] See James F. Harris, *Against Relativism: A Philosophical Defense of Method* (LaSalle, Ill.: Open Court, 1992), pp. 16ff.

in their calculations). The Church was willing to allow Galileo and others to *use* the Copernican theory and even to teach it to others so long as they did not represent it as being the correct and true account of the real world, but Galileo refused this "compromise."

The main source of the dispute was focused upon three fundamental and closely related issues.[6] The first issue, which was more fundamental and important than the content of the two different theories, was the matter of the status of scientific theories. Galileo was not willing to allow the difference between the two theories to be captured by simply calling the Copernican theory a "supposition" or a convenient "instrumental aid" for purposes of calculations. Galileo thought that scientific theories have observable consequences that can be deduced from the theories, and scientific theories thus tell us something about the world or predict something about actual, natural phenomena. Scientific theories are not "loose," "floating" theories that are unattached or unrelated to the "real" world of our sense experiences.

This view of the status of scientific theories follows from the second source of dispute between Galileo and the Roman Catholic Church. A scientific view of the universe includes the view that there are general laws and principles in terms of which individual and particular natural phenomena can be understood, explained, classified, and predicted. Furthermore, this view of the relationship between general laws and principles on the one hand and facts or states of affairs on the other is a universal and general view about the nature of the universe. Science does not provide us with a sporadic or episodic view of the nature of things. Alfred North Whitehead has described this modern, scientific point of view by claiming that it involves "a vehement and passionate interest in the relation of general principles to irreducible and stubborn facts."[7] These general principles were understood as mathematical in nature. In the seventeenth century – beginning with Copernicus through Galileo to Newton – mathematics was no longer viewed as a system of quaint games that mathematicians played just among themselves with no relevant consequences for the real world. In the seventeenth century, Copernicus, Galileo, and Newton used mathematics to formulate the abstract and universal laws and principles of science to demonstrate through precise formal reasoning how observable consequences would follow from these abstract, general laws and principles.[8]

The third area of major dispute between Galileo and the Roman Catholic Church, and perhaps the most fundamental and important, involved the importance of and the attention paid to those "irreducible and stubborn facts." The "scientific method" requires that theories be confirmed by data resulting from carefully controlled, regulated, documented, and repeated scientific experiments and observations. Galileo arrived at his commitment to the Copernican theory over the Ptolemaic theory not just because of the simpler mathematics involved. His many different observations with his improved version of the telescope provided the

[6] *Ibid.*, pp.17-22.
[7] Whitehead, *Science and the Modern World*, p. 3.
[8] *Ibid.*, pp. 54-55.

"irreducible and stubborn facts" as the bedrock for his claim that the Copernican theory was the correct one to be used to describe our solar system.

THE CHURCH VERSUS SCIENCE

This fundamental and irreconcilable difference about the proper method for arriving at claims about the natural world and the proper kind of epistemic warrant for such claims lies at the very heart of the difference between Galileo and the Roman Catholic Church. As I have described this difference elsewhere,

> On the one hand, there were the appeals to papal authority, church history, and Biblical accounts of cosmology, the authority of the history of philosophy and the evidence from "common sense." On the other hand, there were his own "scientific" observations and his use of scientific reasoning.[9]

Galileo took the observations that he made with his telescope to be confirming evidence of the Copernican theory. [10] It is on the basis of such scientific evidence rather than papal or biblical authority that scientific theories about the natural world should be judged, he insisted, and in 1610, he published *Sidereus Nunicus* (*The Starry Messenger*), in which he reported his astronomical observations. Galileo made his position about the relative importance of the Bible and science for attending to understanding and explaining matters of natural phenomena quite clear.[11] In such matters, the scientist is held to the higher standard of the "inexorable and immutable" laws of nature and, of course, the "irreducible and stubborn" facts. Such reasoning is what lies behind the often quoted remark of Galileo's that "the Bible tells us how to go to heaven, not how the heavens go."

GALILEO AND THE INQUISITION

Following the publication of *The Starry Messenger*, the conflict between Galileo and the Church intensified. In 1616, the Roman Catholic Church branded Copernican heliocentric astronomy as "false and altogether contrary to the Holy Scripture," *On the Revolutions of the Celestial Spheres* was placed on the Index of banned books, and the teaching of Copernican theory in any form was prohibited.[12] In 1624, Galileo received a license from the Church to write a book comparing Ptolemaic and Copernican theories on the condition that he not take a position favoring one or the other in the book. When Galileo published his *Dialogue on the Two World Systems* in 1632, the book clearly made a strong, convincing case on

[9] Harris, *Against Relativism*, p. 19.

[10] Galileo observed that the surface of the moon was rough with mountains, much like the surface of the earth, and not a "perfect sphere" as Aristotle (and Ptolemy) had claimed. He also discovered the "stars" of Jupiter, the smaller, orbiting bodies of Jupiter that proved to be the moons of Jupiter, and he correctly predicted their orbits and positioning. He was the first to observe sunspots and, perhaps most importantly, the phases of Venus caused by the sun's reflected light as the planet orbits the sun – a direct piece of evidence that was predicted by the Copernican theory.

[11] See Galileo Galilei, "Letter to Madame Christine of Lorraine, Grand Duchess of Tuscany, Concerning the Use of Biblical Quotation in Matters of Science," in *Men of Physics: Galileo Galilei, His Life and His Works*, translated by Raymond J. Seeger (Oxford: Pergamon Press, 1966), p. 271. Also, see Harris, *Against Relativism*, p. 20.

[12] See Jerome Langford, *Galileo, Science, and the Church* (New York: Desclee, 1966), pp. 97-98.

the basis of scientific evidence for the Copernican heliocentric theory. Galileo was put on trial for heresy by the Inquisition in 1633, made to sign a "confession" for his sins, and, finally, sentenced to house arrest in his home near Florence, where he remained until his death in 1642, the same year in which Isaac Newton was born.

GALILEO AND SCIENCE

For understanding the contemporary, twentieth-century relationship between science and religion, the most interesting and important aspect of the conflict between Galileo and the Roman Catholic Church is the struggle for authority over matters having to do with the physical world and natural phenomena. Galileo insisted that the Bible and the Church have no authority over such matters and should not seek to assert authority over such matters. The Church, of course, took the position that theology trumps science.

A very significant element for analyzing and evaluating the lessons to be learned from this conflict for the twentieth century is the fact that we now know that the "best scientific evidence" that Galileo presented in support of the Copernican theory in his *Dialogue on the Two World Systems* in 1632 was either very weak, misinterpreted, or just plain wrong.[13] Scientists now know that the connections Galileo drew between sunspots and the earth's tides and the Copernican theory were not justified. In a sense, by today's standards, Galileo was a champion of bad science.

The important point, however, is that bad science is still science because of the *method* of investigation and the *method* used for arriving at certain claims about the nature of the physical world. The scientific method does not guarantee that its use will not result in mistakes; on the contrary, there are opportunities for various kinds of mistakes at every stage of a scientific inquiry. However, the scientific method is the only method that includes as a part of the method itself a mechanism for identifying and correcting its mistakes.[14] Since science is an ongoing, public method conducted by members of a scientific community, any individual's mistakes are always open to the scrutiny of the entire community over an indefinite period of time. Indeed, the only reason that we now know about the mistakes that Galileo made is because of the work of other scientists.

We should therefore remember Galileo as a champion of the scientific *method* and of science generally rather than simply as a defender of Copernican astronomy. Galileo saw, perhaps even more clearly than Copernicus, the importance of accounting for individual, particular natural phenomena in terms of a general theory based upon abstract mathematical laws and principles. He destroyed the old "two world view," according to which the heavens were separate and distinct from the causal and natural explanations that apply to natural phenomena on earth. In this sense, he paved the way for Newtonian mechanics and for the possibility of a truly general cosmology. Galileo insisted – upon the pain and threat of possible excommunication, torture, and even death – that in matters pertaining to the natural world, there is no higher authority than science based upon careful empirical

[13] See William R. Shea, *Galileo's Intellectual Revolution* (New York: Science History Publications, 1972), pp. 174ff.; William Wallace, *Galileo and His Sources* (Princeton: Princeton University Press, 1984), pp. 308ff.; and Harris, *Against Relativism*, pp. 20ff.

[14] See Harris, *Against Relativism*, Chapter VII.

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