Sunday Scientists Presentation
A Brief History of Science and Religion in the West
Sarah E. Fredericks

This article was published in the February 2005 edition of Covalence, the online bulletin of the ELCA Alliance for Faith, Science and Technology.

Abstract:

The history of science and religion in the Western world is a complex one, especially since science and religion as we think of them today were not distinct disciplines for much of history. This article traces a part of this intricate history beginning with the Ancient Greeks. It also highlights contributions made by Muslims in the Middle Ages, examines new ideas of the cosmos set forth in the 15th and 16th centuries, and outlines developments in natural history that set the stage for Darwin's theories. A contemporary schema, set forth by Ian Barbour, is suggested as one way to think about the various positions currently used to relate science and religion.

When people think of the history of science and religion in the West, two major figures commonly come to mind: Galileo and Darwin. While these figures are certainly important, focusing on them to the exclusion of other scholars and historical events can easily paint a misleading picture about the history of science and religion. Consequently, this article aims to demonstrate the diversity of relations between science and religion throughout history through examples chosen to balance the commonly known historical figures with more obscure, but no less important contributors to history. Contributions of the Ancient Greeks, Medieval Muslims, and new views of the cosmos and natural history will serve as examples of the changing relationship between science and religion with time, while Ian Barbour's schema will provide a framework with which to categorize these historical contributions.

The Ancient Greeks are widely regarded as important early contributors to the history of Western thought, so it is appropriate to begin with their views on the disciplines that would become science and religion. Before the fifth century BCE, a traditional system of magic and what we now call superstition was the dominant worldview of the Greek people. It was believed that various gods controlled weather disease and property, and that consulting oracles was a way to make important decisions and gather information on a particular topic.[1]

As debate became the dominant method of conveying information and convincing others of one's position, methods of proof, critical thinking skills and systematic thinking, all important components for modern science, arose. The Greeks also came to expect that

[1] G.E.R. Lloyd, *Magic, Reason and Experience*, Reprint Edition [1993] ed. (Cambridge: Cambridge University Press, 1979), 23-51.

nature should be uniform. These new ideas and methods of thought led them to encourage empirical research as a method of learning about the natural world, though little was actually done.[2]

As such ideas became prevalent, various positions developed between the traditional and new methods of thought. Some people wrote extensive treatises to convince people of the error of the old ways and the supremacy of the new. Other people stayed firmly on the side of old beliefs and practices. However, many people moved back and forth between the systems, using each when appropriate. For example, Herodotus believed that disease was a punishment from the gods, a firm part of the old worldview. Yet he advanced the ideas that everything has a particular nature, and that the interaction of these natures is predictable, ideas that encouraged the systematization of ideas about and investigations of the natural world.[3] This pattern of slow change from one set of ideas to another, with a long period where multiple ideas are held simultaneously, occurred again and again throughout the next 2000 years.

Moving ahead in history to the 4th century AD when Christianity was developing as its own religion, it is appropriate to look at the position of scholars on the investigation of the natural world. Augustine (334-430), a bishop of the church in Africa, was and still is an incredibly influential theologian. As Christians were trying to develop their own identity, understanding the relationship between Christian thought and Greek philosophy was a critical issue. Augustine was against the tendency of Greek philosophy to investigate the natural world because he thought Christians should focus on divine matters, not temporal knowledge. With this viewpoint, one should be motivated to investigate the natural world in order to glorify God, not to pursue earthly interests.[4] As we shall see, this was the prevailing attitude regarding the natural world until scholars began positing a universe in which God was not necessary, and then became one of a multitude of views.

Many histories of theology or philosophy skip from the ancient Greeks to the early leaders of Christianity like Augustine to the time of Thomas Aquinas in the 12th century. However, such a lineage is not appropriate in the history of science and religion, or for that matter, in the history of Western religion, because Muslim scholars played a large role in this history precisely during this often neglected period. Not only did they preserve documents of the ancient Greeks, they also advanced many of the theories and observations made by the Greeks and conducted experiments and controlled observations in a way to an extent that far surpassed the mere discourse about experimentation particular to the Greeks. This information, both theoretical and practical, was later used by many European scholars, often without crediting Muslim sources properly. To begin to correct this historical slight, I will look briefly at Muslim science of the early Middle Ages.

---

[2] Ibid., 103, 20, 224-25.

[3] Ibid., 28-32.

[4] David C. Lindberg, "Science and the Early Church," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), 26-27.

Medieval Muslims tended to focus on scholarly areas that were the most practical for them, including theology, law, astronomy, mathematics, technology, and medicine. Medicine and astronomy were two of the most important "sciences" for Medieval Muslims, and arguably the ones in which they made the largest advances. Discussions about sciences among religious scholars encouraged it to be separated from religious disciplines as knowledge shared by all people, without influence of culture.[5] Despite these firm theoretical boundaries between the disciplines, the choice of problems to work on and method of applying scientific knowledge were often affected by Islamic culture and norms.

Muslim doctors were aware of their debt to Greek physicians (Hippocrates, Diascoretes, and Galen) but knew that their methods went beyond their predecessors. In particular, Muslim doctors approached medicine with a practical, experimental flair as well as utilizing previously existing theories, procedures that lead to the extension of old or development of new theories. For example, studies on the diagnosis and treatment of smallpox, measles, diabetes and hay fever were conducted, and studies of anatomy were undertaken to correct Greek sources. Advances in hospital administration were also made by Medieval Muslims. For example, hospitals were frequently divided into separate units based on the patient's sex and communicability of their disease.

A deep sense of concern for others motivated by religious beliefs led to the availability of health care for all who needed it, an unusual condition in the Middle Ages. Interest in ethics prompted many ethical debates about health care which along with tests for physicians set standards for medical care.[6]

Muslims also developed technological devices to aid in surgery, but their technological advances were certainly not limited to the medical field. Clocks, pumps, irrigation systems, astronomical equipment and mechanical toys were just a few of the items which these scholars improved or developed.[7]

While medicine was certainly a practical field for the Medieval Muslims, as it is for any group of people, astronomy was the technical field which held the interest of the most scholars. Astronomy was an essential subject for two major reasons. First, the relationship between God and the world was described through a complex model of the solar system and heavens. Consequently, developing the mathematical models of Ptolemy to better understand the structure of the universe and laws governing the heavens was a high priority for Muslim astronomers. Secondly, accurate observational data of astronomical events was important to determine the direction of Mecca to locate the direction of prayer, the time of moonrise which determines prayer times, and the lunar cycles which determine holidays.[8]

---

[5] Ahmad Dallal, "Science, Medicine, and Technology: The Making of a Scientific Culture," in *The Oxford History of Islam*, ed. John L. Esposito (New York: Oxford University Press, 1999), 157.
[6] Ibid., 198-210.
[7] Ibid., 193-98.
[8] Ibid., 177-90.

Medieval Muslims made many more fascinating contributions to the history of science, though one of their most important was to do careful, systematic studies of the natural world, something the Greeks generally only discussed.

In the 12^{th} century there was a huge translation movement where documents preserved or written by Arabic scholars were translated into Latin and studied by Europeans. Eventually, this influx of ideas (along with other factors) led to an increased period of intellectual activity in Europe. Eventually, many methods of inquiry such as the hypothesis, as well as ideas informed by Aristotle such as the eternity of the world, were considered or adopted.

Christians in the Middle Ages tended to use natural theology, the precursor of what we now call science, for practical concerns such as determining holidays such as Easter and Christmas.[9] Christians were a bit less likely to pursue theoretical interests because of the influence of Augustine. Remember, he, a great Christian scholar, advocated that it is enough to know all things are created by God, and there is no need to attach selves to temporal knowledge for its own sake. Following these ideas, many Christians studied the natural world in order to glorify God. During the Middle Ages, it was thought that God encouraged the study of the external, visible world because contemplating this world enables one to better love God, and to gain dominion over the world. As an example of this use of natural theology to glorify God and support religious convictions, let us look at the changing concepts of the heavens in the 15^{th} and 16^{th} centuries.

Though the ancient Greeks proposed several descriptions of the workings of the heavens, the Ptolemaic system was most prevalent and was adopted by Europeans. This system placed the Earth in the center, with the moon, sun and planets moving around the earth on circular paths. Not only were celestial objects understood to travel on circular paths because this agreed with some commonsense observations, but also because this belief reinforced the basic worldview that celestial objects were closer to God than earthly objects, and thus must travel in circular paths since circles were the most perfect shape. The fixed stars (those that did not appear to move in the sky) were embedded in a sphere located beyond all of the other moving bodies.[10]

However, more careful observations made it clear that the planets did not move with perfectly circular orbits. In fact, they sometimes appeared to move backwards with respect to the direction they had been moving along. To make sense of these observations, epicycles, small circles centered on an orbit, were added to the model. Heavenly bodies were said to move around an epicycle which moved on a circular orbit, as shown in figure one. While this method somewhat improved the predictive power of the model, it was fairly difficult to calculate with, did not give great results, and was

---

[9] Robert Westman, "The Copernicans and the Churches," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), 77.
[10] Ibid., 78.

thought to be aesthetically ugly in its complexity, especially when multiple epicycles were added.[11]

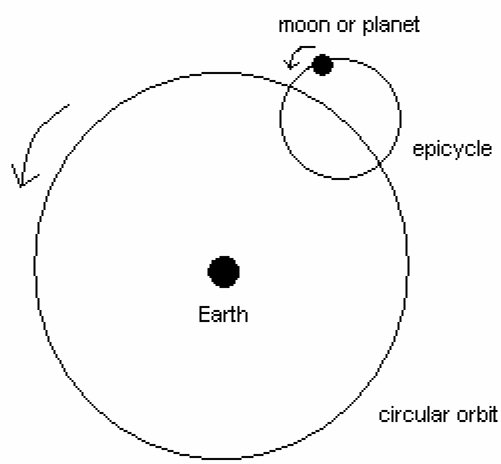

Figure 1. Epicycles were posited to adjust circular orbits to fit astronomical data. This picture is much simpler than the models actually used for calculations.

At this point in history, many natural theologians (those who studied the natural world) did so in their spare time for there were few full time jobs in natural theology. One such scholar was Nicholas Copernicus (1473-1543), a lawyer with free time in which he pursued astronomy. Copernicus disliked the Ptolemaic system because he found it imprecise and aesthetically displeasing. Furthermore, he felt that such an inelegant system detracted from the perfection and greatness of God for why would God create such an imperfect system? Copernicus was convinced that the circle was the most perfect form, and that the sun is an incredibly important symbol of God since the sun is the source of light as God is the source of all that exists. To emphasize these principles and to achieve greater predictive accuracy, Copernicus developed a heliocentric (sun centered) model of the universe. Truthfully, his system was not much simpler than the geocentric model he hoped to supplant, and was founded more on symmetry and his ideals than on observation.

Reactions to his model varied. Those with little mathematical experience thought his model was incomprehensible and useless. Those with a mathematical bent conceded that it was good for calculation and aesthetically pleasing. However, it is unclear whether Copernicus and his contemporaries understood the heliocentric model to be a true picture

[11] Ibid., 78-79.

of the world, or if they just used it as the best way to calculate the positions of heavenly bodies.

Though many scholars advanced astronomy during this period, Johannes Kepler (1473-1543) is the next major figure. Kepler was a German Lutheran who prepared for the clergy, but was encouraged to do astronomy by his duke. As Kepler was motivated by a desire to see God's work in the heavens, he quickly assented. In school, Kepler learned about Copernicus' new theory and immediately accepted this view for several reasons. He particularly liked it because it resonated with his idea of God's design of the world and the geometric nature of this view aligned with his understanding that geometry is connected to God's mind.[12] (Note that Kepler learned about the new system in school, evidence that it was accepted by the scholars of the day and not terribly controversial.)

Using Tycho Brahe's incredibly precise astronomical data, Kepler worked to further develop the Copernican system. Eventually he found that elliptical orbits actually fit the data much better than pure circles. However, the idea that ellipses, imperfect circles, would be used by God in creation was rather difficult for Kepler to accept, until he reasoned that ellipses indicated the fallen nature of the entire universe. Thus, he was able to make sense of his findings of the natural world given his religiously informed worldview.[13]

Galileo Galilei (1564-1642) is probably the most famous figure in the history of developing views of the universe and how they related to religious beliefs. Galileo was an Italian math professor. He was originally hesitant about disagreeing with any of Aristotle's ideas (the major way to understand the natural world during this time and supported by the church). However, Galileo enjoyed a successful early career that bolstered his confidence. In particular, he discovered a new way to calculate the center of mass of solids, and performed experiments in motion. Galileo also experimented greatly with his telescope, finding craters on the moon, new stars, and four moons of Jupiter, evidence that the universe was not as perfect as was previously believed, for if it was truly perfect according to the logic of the day, the moon would be perfectly spherical.[14]

In 1610, Galileo published his findings and came out slightly against the prevailing Aristotelianism. In 1615 Roman Catholic church officials decided that condemning Copernicanism was the best position to take regarding heliocentrism so that the "people in the pews" would not be confused as to what to believe. However, they did recognize the practical value of this method to calculate dates of holidays. Thus they did not formally ban all of Copernicus's work, but rather, called for a revision of the questionable

---

[12] Richard S. Westfall, "The Rise of Science and the Decline of Orthodox Christianity: A Study of Kepler, Descartes, and Newton," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), 221-24.
[13] Ibid., 223-24.
[14] William R. Shea, "Galileo and the Church," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), 118.

parts. In the same year, the Grand Duchess Christina, Galileo's patron challenged him to demonstrate that the Copernican system was not challenged by the Bible. Galileo developed a theoretical viewpoint on the matter and claimed we should begin all investigations with sense experience rather than from authority, and that God is known first through nature rather than the Bible. Galileo hoped this argument would reconcile the theology of his day with the scientific views he supported, but this was not to be the case.[15]

In 1616 Cardinal Bellarmine cautioned Galileo not to hold or defend the censored passages of Copernicus work, but Galileo did not receive any punishment for his previous work and was not asked to recant any of his ideas. In 1623, a new pope, Urban VIII, was elected. He had praised Galileo's telescope work in the past and was not as strongly against Copernican ideas. Consequently, Galileo thought he would have more freedom, especially when the Pope asked Galileo to present a hypothetical study of Copernicanism.

In 1632 Galileo published *Dialogue Concerning Two Principle Systems of the World* which posited that reasoning from nature can show one model of the heavens is more likely to be true than another. This piece also demonstrated Galileo's argumentative, abrasive nature and lack of political savvy. Not only was this work not terribly well argued, its pro-Copernican message was presented as a dialogue between three characters: Salviati, who took Galileo's side, Simplicio, who took the side of Aristotle and the Pope, and Sagredo, intelligent lay person convinced by Salviati by the end of the dialogue. This method was a bad idea politically.Not only was Galileo making fun of the Urban VIII through the naming of characters and the simple statements Simplicio made, but he did not follow Urban's suggestion to be hypothetical.[16]

Galileo was brought to trial, and forced to abjure his work. As punishment he was placed under house arrest. While this was a stiff sentence, it certainly was not as bad as what many who challenged the papacy received, particularly when it is realized that by this point, Galileo was quite sick and would not have been able to travel anyway.[17] It is important to note that Galileo's trial and punishment was primarily for his direct challenge to Biblical authority and antagonistic behavior since Catholic church was still responding to the Reformation and could not afford more challenges to its authority.

Immediate results of the "Galileo affair" were varied. Generally, the closer to Rome, the more of an impact these events had on scholars. For some, the Galileo affair reinforced their anti-Copernican tendencies,[18] but others, including Descartes, practiced self-censorship, emphasized their allegiance to the Catholic Church, altered previously publish works to assert that the earth is at rest and claimed that their ideas were hypothetical. Still others avoided participating in debates about the Copernican theory or

---

[15] Ibid., 126-28.
[16] Ibid.
[17] Ibid., 130-31.
[18] A.C. Crombie, "Mersenne, Marin," in *American Council of Learned Societies Dictionary of Scientific Bigography*, ed. Charles Coulston Gillispie (New York: Charles Schribner's Sons, 1975), 411, J.L. Heilbron, *The Sun in the Church: Cathedrals as Solar Observatories* (Cambridge, MA: Harvard University Press, 1999), 180, 84, 87.

suggested that such works were mathematically useful, but not true descriptions of the world.[19] Other scholars ignored the condemnation of controversial works and continued their studies.[20]

In conclusion, the revolutionary part about Galileo's work was that he proposed putting investigations of the natural world before Biblical authority. A popular idea of the history of science and religion often portrays the next few centuries as a steady increase in the separation between secular and theological ideas, prompted by Galileo and continued by Newton. However, a more accurate picture reveals that scholars from the time of Galileo held various positions about the relationship of science and religion, and that many studied the natural world to glorify God or to deepen understanding of religious subjects.

One excellent example of this slow process of change is found in the work of Isaac Newton (1642-1727). Newton is famous for his laws of motion and method of calculating gravitational force, and many understand his ideas as the beginning of a mechanistic world view in which motion of objects is controlled entirely by natural laws. However, Newton himself did not understand the universe to be mechanized to the point God was not needed. Rather, Newton expressly posited God as a part of his system who set the universe in motion according to the laws he discovered and was frequently involved in the universe through the realignment of planetary orbits as they disintegrate, among other acts.[21]

During the time of Newton, many scholars including Marin Mersenne, Robert Boyle, and William Harvey drew on religious beliefs in support of their work on mechanistic theories of the universe. Despite the commingling of mechanistic views and belief in God, as people increasingly understood God's action to be described by mechanical laws, there was a clearer target for people who wanted to study the universe without God. Pierre Simon LaPlace (1749-1827) was one of the first to publicly take such a stand when

---

[19] A.C. Crombie, "Descartes, Rene Du Perron," in *American Council of Learned Societies Dictionary of Scientific Bigography*, ed. Charles Coulston Gillispie (New York: Charles Schribner's Sons, 1975), 52, Rene Descartes, "Discourse on the Method of Rightly Directing One's Reason and of Seeking Truth in the Sciences [Abridged] [1637]," in *Descartes: Philosophical Writings*, ed. Elizabeth Anscome and Peter Thomas Geach, 38, 45, Westfall, "The Rise of Science and the Decline of Orthodox Christianity: A Study of Kepler, Descartes, and Newton," 224. Paolo Galluzzi, "Galileo contro Copernico," Istituto e museo di storia delle scienze, Florence. Annali, 2:2(1977), 128-129 as quoted in Heilbron, 187.Giorgio Tabarroni, "Montanari, Geminiano," in *American Council of Learned Societies Dictionary of Scientific Bigography*, ed. Charles Coulston Gillispie (New York: Charles Schribner's Sons, 1975), 484.
[20] John E. Fletcher, "Astronomy in the Life and Correspondence of Athanasius Kircher," *Isis* 61 (1970): 53,59, William L. Hine, "Mersenne and Copernicanism," *Isis* 64 (1973): 18-19, John L. SJ. Russell, "Catholic Astronomers and the Copernican System after the Condemnation of Galileo," *Annals of Science* 46, no. 1989 (1989): 372.
[21] Jacques Roger, "The Mechanistic Conception of Life," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), 284, Westfall, "The Rise of Science and the Decline of Orthodox Christianity: A Study of Kepler, Descartes, and Newton," 229-34.

he reportedly said to Napoleon Bonaparte “I have no need of that hypothesis” when referring to the absence God in his system of the universe.[22]

Though a tendency from the time of LaPlace was to divorce the study of God from the study of the natural world in its physical processes, such division did not occur in the study of biological processes for several centuries. Clergy and lay people were generally the main players in the study of the living world until the mid to late eighteenth century. Many of these people were motivated by their religious beliefs to demonstrate qualities of God through examples in the natural world. These natural historians (the precursors to geologists, biologists, and related fields) of the seventeenth, eighteenth and nineteenth centuries are important in the history of science and religion because they demonstrate that ideas of God influencing the world persisted a long time after Newton, even among those we would call scientists today. They are also important in their own right as an often over-looked portion of the history of science and religion in the popular mind. Finally, they set the tone for Darwin’s work.

Natural historians tended to use basic Biblical ideas and knowledge about the natural world to elaborate knowledge of early world history. With time, people relied less on the Bible as a main resource for knowledge as they relied more heavily on direct observations of the natural world. As evidence of this trend, we will examine the popular flood research of the time, as well as the studies of species migration and development of human races that were sparked by flood research.

Thomas Burnett (1635-1715), a member of the Anglican clergy wrote *A Sacred Theory of the Earth* in 1681. Burnett was motivated to write this piece by his reading of the Biblical flood story and his observations of mountains. He saw mountains as a terrible aberration of what the perfection of the earth could be. He thought that before the flood, the earth was perfectly spherical and consisted of a crust of earth over water. This crust of earth dried up and cracked, and God brought water up through the cracks, forming clouds and rain at an appropriate time to devastate the planet and destroy the people. During the cracking of the earth, and deluge that followed, the earth acquired its rough topography. While Burnett focused on God’s influence in the flood, his work set the stage for thinking of the formation of the earth in a series of natural events.[23]

Burnett is just one example of many people who were fascinated with the story of the flood. Janet Brown, a contemporary historian, has produced an excellent summary of flood research, and this next section is heavily indebted to her work. Brown writes that as the Bible was taken more literally in the 16^{th} century, it was more important to

---

[22] 256-257, Ronald L. Numbers, *Creation by Natural Law: Laplace's Nebular Hypothesis in American Thought* (Seattle: University of Washington Press, 1977), 124-32.

[23] John Hedley Brooke, *Science and Religion: Some Historical Perspectives*, *The Cambridge History of Science Series* (New York: Cambridge University Press, 1991), 7-10. Martin J. S. Rudwick, "The Shape and Meaning of Earth History," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), 305.

understand the Biblical stories in order to understand God.[24] At first, people studying the flood tried to figure out practical details of this story, particularly focusing on the ark. For instance, they wondered how many animals could be on board. At this time, not many animals (only a few hundred) were recognized by Europeans, and so they did not have a hard time believing that all of the animals could fit on the ark. Instead, they focused their energies on drawing up floor plans of the ark, with notes about which animals probably were located in particular places.

As there was increased communication with other lands due to rising speed of ships, and the exploration of the Americas, the number of animals known to Europeans vastly increased. At this point, other questions became very pressing for those interested in ark research. Namely, it was difficult to understand how thousands of species might fit on one ark, how Noah and his small family could take care of them, what the animals would eat, and how wastes could be disposed of. Rather than investigating these questions in detail, people decided that all these questions must have answers since the story is written in the Bible. Consequently, it must be our limited human knowledge that prevents us from understanding this historical event. With this rationalization, people now shifted their focus and began to try to understand the flood itself.

In particular, they wondered how animals could have spread out after the flood. Two basic types of theories arose. In the first, more faithful to the literal Biblical story, animals somehow managed to move from the mountain where the ark landed to the entire earth, even if it required a reindeer moving through a desert, or another migration equally hard to accept. The second type of theory, evaded this problem by understanding that each animal was created where it lived today, a theory that bypassed the Biblical story altogether.[25]

Another focus of natural historians related to flood studies was the examination of fossils. Fossils that looked like sea creatures had been found far from the sea. People wondered if these fossils were in fact remains of once living creatures or if they were rocks that looked like a creature but were not. Robert Hooke (1635-1703) posited that fossils must be organic since they are so similar to organic things today, otherwise God would be fooling us.[26] George Cuvier (1769-1833) took Hooke's work and more examinations of fossils and concluded that some organisms have become extinct due to catastrophes. Cuvier proposed that the last evidence of such a catastrophe was the flood recorded in the Bible. He proposed that this Biblical story was an account of an historical, but not divine event, a proposal that moved against the popular view. From this and other evidence, Cuvier proposed that the world is much older than the 6000 years suggested by some Biblical literalists.

With increased study of fossils and geology in general, the idea that the world was older than 6000 years became more and more popular among scholars. However, long into

---

[24] Janet Browne, *The Secular Ark: Studies in the History of Biogeography* (New Haven: Yale University Press, 1983), 2-3.

[25] Ibid., 23.

[26] Ibid., 9-10.

19th century Biblical chronology was used to date the age of the human species. One of the main questions about the human species at this point was how the human races arose, an idea connected to the flood research about the diffusion of animal species. Two major positions emerged. The first, more traditional approach held that humans are all one species, but that races arose due to climatic and cultural differences which caused the original race to degenerate into the many races we have today. The advantage of this position is that it adhered to the Biblical idea of one race. However, Europeans knew of ancient Egyptian artwork 3400 years old that clearly distinguished races. Consequently, many wondered how distinct races could have formed in the time between the creation of the human race 6000 years ago to this artwork 3400 years ago, particularly since the races have now been static for 3400 years.[27]

The second position held that human races arose separately, mostly based on the evidence from Egypt. The disadvantage of this view is that it ran counter to prevailing Biblical interpretations and to the theological concepts of creation and salvation.

Closely connected to the idea of the diffusion of species and development of races in humans is the idea of evolution. It is important to note that many people were talking about changes in the natural world long before Darwin came along. For example, through the fossil record, people understood that some species had become extinct long ago.

One of the most famous evolutionists before Darwin is Lamarck (1744-1829). From his examination of the fossil record, Lamarck believed God gave a power to organisms which allows them to progress. This progression occurs as an organism develops habits to deal with its environment and eventually passes on these traits through heredity. Almost all members of the scientific community were convinced that species were fixed and so condemned Lamarck and his ideas.

However, not everyone advocated the fixity of species. Robert Chambers, a natural scientist and the biggest proponent of evolution in the English speaking world, published *Vestiges of the Natural History of Creation* in 1844. In this text, Chambers posited that changes in the natural world and of species are laws, not facts. He suggested that if Newton's laws could indicate divine activity then so could laws of living organisms. Chambers thought that God did not produce each species individually, but rather through general laws that God set in motion since this idea allows God to be more powerful and not have to do so much work. Although this text was critiqued by almost all reputable scientists, it was very popular and spread ideas of evolution.

Charles Darwin (1809-1882) is undoubtedly the most famous scientist who worked on the idea of species change. Many works have been written about the development of Darwin's ideas and the history of their reception by the scientific community and the general public. I do not wish to examine these ideas in detail, but rather prefer to briefly outline the main points of Darwin's theory and then the reasons it was controversial.

---

[27] David N. Livingstone, "Preadamites: The History of an Idea from Heresy to Orthodoxy," *Scottish Journal of Theology* 40 (1987).

Natural selection is one of the central tenants of Darwin's *Origin of Species*, published in 1859. Natural selection is the idea that too many individuals are in each generation, so there is competition due to scarcity of resources. Any variation that occurs in individuals may offer a competitive advantage to certain individuals, and thus survival and reproduction is not random with respect to the environment, but rather is linked to the particular traits of an individual. These variations are heritable and the environment can be thought to select certain traits that are adaptive. However, natural selection is not the only factor discussed by Darwin, nor the only one necessary for evolution as he describes it. Sexual selection, the idea that animals may pick a mate based on a particular trait, is also an important principle. This may go against natural selection, as when birds select mates with long tails that restrict movement. Sexual selection may also support natural selection, as when mates are picked based in part on strength, a characteristic that may help them to survive predatory attacks. Additionally, a population may drift toward a certain type based on the original distribution of traits. Finally, traits may be correlated with others that are selected for. Consequently, some traits may come to predominate even if they are not adaptive themselves. It is also important to note that not all changes are adaptive; however these probably do not last as long as the advantageous changes.[28]

In 1871 Darwin published *Decent of Man and Selection in Relation to Sex*. This book was incredibly controversial because it applied evolution to the human species, and furthermore, humanity was not seen as being specially created by God. Until about 1875 most scientists rejected Darwin and there was an incredible variety of responses from the broader community. After scientists began supporting Darwin, more and more members of the general public did as well.

Responses to Darwin were incredibly varied: Some people rejected him on scientific grounds, some on religious grounds. Some religious people did not have a problem with his ideas because they already had a clear understanding of predestination. Others thought evolution could be the mechanism by which God creates and interacts with the world. Still others ignored his work. Finally, others objected to Darwin's work not for it itself, but because of the social conclusions some people drew from his ideas – that only the fittest people should survive, and others should be neglected or killed to strengthen humanity.[29]

---

[28] Darwin, Origin of Species.Charles Darwin, *The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*, reprint of first, published in 1859 ed. (New York: Bantam Books, 1999).

[29] A. Hunter Dupree, "Christianity and the Scientific Community in the Age of Darwin," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986). Frederick Gregory, "The Impact of Darwinian Evolution on Protestant Theology in the Nineteenth Century," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986), Ronald L. Numbers, "The Creationists," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David C. Lindberg and Ronald L. Numbers (Berkeley: University of California Press, 1986). William J. Astore, "Gentle Skeptics? American Catholic Encounters with Polygenism, Geology and Evolutionary Theories from 1845 to 1875," *Catholic Historical Review* 82 (1996). R. Scott Appleby, "Exposing Darwin's "Hidden Agenda": Roman Catholic Responses to Evolution, 1875-1925," in *Disseminating Darwinism*, ed. Ronald L. Numbers and

Rather than focus on the intricacy of the responses to Darwin's work, I chose to devote more time to the events preceding Darwin's work to better illustrate the diverse history of science and religion. From this exposition, we saw that the age of the planet had been lengthened from the literal biblical picture for some time due to geological studies, that the fixity of species was generally assumed, but it had been challenged by Lamarck and Chambers, and that the origins of the human race was a major problem for scholars in the nineteenth century. All of these ideas helped set the stage for Darwin, though Darwin did break from these ideas in that he did not posit his laws as a way to describe God's action in the world, or base his theories on Biblical knowledge, either as revealed knowledge, or as an ancient historical report of physical events. It was this removal of God from the system, along with details of his theory that were not always immediately reconcilable with theological ideas, that made his theories so controversial.

In the twentieth century, many new ideas have become prominent in science and religion discussions. Since this is a historical article, and history of these newer ideas is still very much in process, I will not discuss these at length. Some of these ideas include: One, how can we imagine the God human relationship given quantum mechanics? Two, how should we act given the ability of humanity to so dramatically affect the natural environment? Three, how can or should technology be used in medicine, communications, to change standards of living, for defense or other applications? Four, what does it mean to be a person given new psychological and neurological studies as well as studies of the other great apes, and what does this say about our place in creation and relation to God?

One trend in the history of science and religion is to formally study how the two disciplines relate. A part of this study is often the development of schemas for how science and religion interrelate. There are a great abundance of these schemas, and while they can be helpful in discussing science and religion, I think it is much more exciting to deal with the issues and problems that emerge in this interdisciplinary arena. Consequently, I don't spend a lot of time debating which schema is best. As with any human categorization, they all have their faults. However, Ian Barbour's is as close to a standard as we have, if only because it has been around the longest and is an elegant way to discuss the relationships between science and religion. Thus, let us look to Barbour's model as a way to categorize the historical information presented above.

Barbour's schema outlines four ways of relating science and religion: conflict, independence, dialogue and integration. In the conflict model, science and religion are distinct disciplines that both seek the truth about the world, and are taken as the only valid form of understanding by their adherents. In independence, both science and

---

John Stenhouse (New York: Cambridge University Press, 1999), Jon H. Roberts, "Darinism, American Protestant Thinkers, and the Puzzle of Motivation," in *Disseminating Darwinism*, ed. Ronald L. Numbers and John Stenhouse (New York: Cambridge University Press, 1999), Jon H. Roberts, *Darwinism and the Divine in America: Protestant Intellectuals and Organic Evolution, 1895-1900* (Madison, Wisconsin: University of Wisconsin Press, 1988). James R. Moore, *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870-1900* (Cambridge: Cambridge University Press, 1979).

religion have totally different things to investigate and talk about and use different methods to do so in its limited area. There is no reason for the two to meet. Dialogue starts from general characteristics about science or nature, often positing that when science can no longer answer questions, religion can begin to answer as God is posited as the reason or ground of answers. For integrationists, the content of theology and science is thought to be integratable in some meaningful way. There are three basic positions of integration. Natural theology posits that the existence of God can be inferred from design of nature. Theology of nature suggests that sources of theology are generally not touched by science, but scientific theories and knowledge can help reformulate particular theories such as creation and the concept of a person, and the relation of people to other kind. Systematic synthesis is a position where both science and religion contribute to a metaphysical scheme such as process philosophy.[30]

In the examples mentioned above, we have seen several types of Barbour's schema. The traditional system of early Greeks, the position of Medieval Christians, as well as Newton, Copernicus, and some natural philosophers had a position somewhere in the integrationist camp though this classification may be a bit forced since there was no other clear option for many throughout history given the fundamentally integrated nature of the disciplines now distinct. Other Greek philosophers, Medieval Muslims, and Galileo formally advocated a separation model while LaPlace advocated a model of independence. Though not discussed in detail in this article, the conflict model is adequately displayed in many vocal biblical literalists who reject evolution and in scientists who refuse to acknowledge that religion has merit. While the history of science and religion has included people and incidents that represent a range of viewpoints, several trends can be seen from this brief overview: the increasing demarcation of disciplines, movement away from acknowledging the influence of religious beliefs on one's scientific study, and movement away from explicit references to God in theories describing the natural world.

]

[30] Ian G. Barbour, *Religion and Science: Historical and Contemporary Issues: A Revised and Expanded Edition of Religion in an Age of Science* (New York: Harper Collins Publishers Inc., 1997), 77-106.

Works Cited

Appleby, R. Scott. "Exposing Darwin's "Hidden Agenda": Roman Catholic Responses to Evolution, 1875-1925." In *Disseminating Darwinism*, edited by Ronald L. Numbers and John Stenhouse. New York: Cambridge University Press, 1999.

Astore, William J. "Gentle Skeptics? American Catholic Encounters with Polygenism, Geology and Evolutionary Theories from 1845 to 1875." *Catholic Historical Review* 82 (1996): 40-76.

Barbour, Ian G. *Religion and Science: Historical and Contemporary Issues: A Revised and Expanded Edition of Religion in an Age of Science*. New York: Harper Collins Publishers Inc., 1997.

Brooke, John Hedley. *Science and Religion: Some Historical Perspectives*, *The Cambridge History of Science Series*. New York: Cambridge University Press, 1991.

Browne, Janet. *The Secular Ark: Studies in the History of Biogeography*. New Haven: Yale University Press, 1983.

Crombie, A.C. "Descartes, Rene Du Perron." In *American Council of Learned Societies Dictionary of Scientific Bigography*, edited by Charles Coulston Gillispie, 51-65. New York: Charles Schribner's Sons, 1975.

———. "Mersenne, Marin." In *American Council of Learned Societies Dictionary of Scientific Bigography*, edited by Charles Coulston Gillispie, 316-22. New York: Charles Schribner's Sons, 1975.

Dallal, Ahmad. "Science, Medicine, and Technology: The Making of a Scientific Culture." In *The Oxford History of Islam*, edited by John L. Esposito. New York: Oxford University Press, 1999.

Darwin, Charles. *The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*. reprint of first, published in 1859 ed. New York: Bantam Books, 1999.

Descartes, Rene. "Discourse on the Method of Rightly Directing One's Reason and of Seeking Truth in the Sciences [Abridged] [1637]." In *Descartes: Philosophical Writings*, edited by Elizabeth Anscome and Peter Thomas Geach.

Dupree, A. Hunter. "Christianity and the Scientific Community in the Age of Darwin." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 351-68. Berkeley: University of California Press, 1986.

Fletcher, John E. "Astronomy in the Life and Correspondence of Athanasius Kircher." *Isis* 61 (1970): 52-67.

Gregory, Frederick. "The Impact of Darwinian Evolution on Protestant Theology in the Nineteenth Century." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 369-91. Berkeley: University of California Press, 1986.

Heilbron, J.L. *The Sun in the Church: Cathedrals as Solar Observatories*. Cambridge, MA: Harvard University Press, 1999.

Hine, William L. "Mersenne and Copernicanism." *Isis* 64 (1973): 18-32.

Lindberg, David C. "Science and the Early Church." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 19-48. Berkeley: University of California Press, 1986.

Livingstone, David N. "Preadamites: The History of an Idea from Heresy to Orthodoxy." *Scottish Journal of Theology* 40 (1987): 41-66.

Lloyd, G.E.R. *Magic, Reason and Experience*. Reprint Edition [1993] ed. Cambridge: Cambridge University Press, 1979.

Moore, James R. *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870-1900*. Cambridge: Cambridge University Press, 1979.

Numbers, Ronald L. *Creation by Natural Law: Laplace's Nebular Hypothesis in American Thought*. Seattle: University of Washington Press, 1977.

———. "The Creationists." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 391-423. Berkeley: University of California Press, 1986.

Roberts, Jon H. "Darinism, American Protestant Thinkers, and the Puzzle of Motivation." In *Disseminating Darwinism*, edited by Ronald L. Numbers and John Stenhouse, 146-72. New York: Cambridge University Press, 1999.

———. *Darwinism and the Divine in America: Protestant Intellectuals and Organic Evolution, 1895-1900*. Madison, Wisconsin: University of Wisconsin Press, 1988.

Roger, Jacques. "The Mechanistic Conception of Life." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 277-95. Berkeley: University of California Press, 1986.

Rudwick, Martin J. S. "The Shape and Meaning of Earth History." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 296-321. Berkeley: University of California Press, 1986.

Russell, John L. SJ. "Catholic Astronomers and the Copernican System after the Condemnation of Galileo." *Annals of Science* 46, no. 1989 (1989): 365-86.

Shea, William R. "Galileo and the Church." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 114-35. Berkeley: University of California Press, 1986.

Tabarroni, Giorgio. "Montanari, Geminiano." In *American Council of Learned Societies Dictionary of Scientific Biography*, edited by Charles Coulston Gillispie, 484-87. New York: Charles Schribner's Sons, 1975.

Westfall, Richard S. "The Rise of Science and the Decline of Orthodox Christianity: A Study of Kepler, Descartes, and Newton." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 218-37. Berkeley: University of California Press, 1986.

Westman, Robert. "The Copernicans and the Churches." In *God and Nature: Historical Essays on the Encounter between Christianity and Science*, edited by David C. Lindberg and Ronald L. Numbers, 76-113. Berkeley: University of California Press, 1986.