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GALILEO: REVELATION, SCIENCE, AND THE CHURCH

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Various science-religion conflicts have surfaced over the years, but perhaps the most prominent one today revolves around the evolution/creation debate. Comparing today's evolution/creation clash with other science and religion conflicts can be helpful in suggesting constructive ways of dealing with the tension. Comparisons have been attempted with a round-versus-flat earth dispute, but the evidence for such a conflict is minimal.[1] Probably the best and most well-known comparison is with the heliocentric/geocentric controversy involving Galileo.

The Galileo affair is often presented as good modern science versus bad religious dogma, or as good Copernican science conquering bad Aristotelian science; however, the issues were not nearly that clear cut. The conflict had to do with some obnoxious personalities, how the church responds under attack, obedience to church authority, and who or what has the authority to determine truth. The history of the Galileo affair presented here relies heavily on Charles Hummel's 1986 book *The Galileo Connection*[2] and a 2003 book chapter by David Lindberg.[3] A website on Galileo was also a helpful resource.[4]

To understand the Galileo conflict we will first outline the scientific and religious setting of the day. Next we will discuss Galileo's science and his relation to the church that led to the conflict. How the conflict itself centered around one of Galileo's books and led to his condemnation by the church will then be described. An epilogue to the conflict will be briefly mentioned. Finally, conclusions from this episode will look at sources of truth, interpretation of these authority sources, and what to do when the sources are insufficient or conflict. The paper to follow is from the perspective of a scientist, not a theologian or historian.

HISTORICAL SETTING

The Historical Setting: Scientific

The ancient Greek cosmology articulated by Aristotle (384-322 BC) envisioned separate terrestrial and celestial spheres with distinctly different properties. Terrestrial elements consisted of earth, water, air, and fire and motion was natural and directed downward. The aethereal celestial elements had distinctly different properties, being eternal, perfect, immutable, and incorruptible, and motion was in a perfect circle.[5] In this cosmology the heavens are not under the dominion of sin as the earth is. The apostle Paul perhaps alludes to the two part division in 1 Cor 15:40-41 where he speaks of terrestrial and celestial bodies.

Claudius Ptolemy (AD 100-170) later summarized the geocentric Greek cosmology with the sun, moon, planets, and fixed stars orbiting the earth, but with complicating factors. A deferent, or circular orbit not centered on the earth, was needed to explain the sun's orbit. Epicycles were needed to explain the planets' retrograde (backward) motion during part of their transit.

The Polish Nicolas Copernicus (1473-1543) found the Ptolemaic system too complicated, so developed a heliocentric system for more easily calculating the church's holiday calendar. Although a heliocentric model had first been suggested by the Greeks, Heraclides and

Aristarchus, they had not developed it mathematically. Copernicus described his model in the book *On the Revolution of the Celestial Sphere* and dedicated it to Pope Paul III, but it was only published at his death. Out of fear of a reaction, his student Osiander added a preface noting that the model was useful for calculations, but not necessarily true.

Copernicus' system was able to easily explain the retrograde motion of the planets and their differing speeds as dependent on their distance from the sun; however, it presented no unambiguous evidence in its favor and it had its problems. It violated common sense: if the earth was in motion, air would be left behind and objects would fly off into space. It was not supported by observation, for no stellar parallax[6] could be detected. In addition, it had the philosophical disadvantage of destroying Aristotle's physics and his earth/heavens dichotomy. The strength of the heliocentric argument rested on mathematics, which was regarded as a lower discipline and which few people were competent to evaluate.

As it turned out, Copernicus book evoked little negative response, since it was highly technical and little known. The tables made the astronomical calculations easier, but were not as accurate as the geocentric model.

Tycho Brahe (1546-1601), a Danish Lutheran, was granted the island of Hven on which to build the Uraniborg observatory where he made accurate measurements of the motion of heavenly bodies. In 1572 he observed a new star in Cassiopeia that displayed no parallax, and thus was part of the celestial sphere. This change in the heavens presented a problem for Aristotle's cosmology. Brahe's solution was a compromise model with the planets orbiting the sun, but the sun, planets, and moon all orbiting the earth.

The German Johannes Kepler (1571-1630) found from Brahe's data that the planetary orbits were not perfectly circular. He published his evidence for "imperfect" elliptical orbits in *The New Astronomy* in 1609. Ten years later his *Epitome* described the mathematical relationship between orbital period and distance from the sun (period squared proportional to distance cubed). This latter book was banned by Lutheran and Catholic churches, perhaps partly because Kepler questioned the bodily presence in the Eucharist.

In his *Mysterium Cosmographicum* Kepler indicated his use of theological principles in developing his cosmological model:

> There were three things, especially, whose causes, why they are the way they are, and not differently, I incessantly researched, the number, magnitude, and movement of the orbits. I was led to dare this by those beautiful harmonies of things at rest; that is, the Sun, the fixed stars, and the intervening space, with God the Father, the Son, and the Holy Spirit.

The Historical Setting: Religious

Before the time of Copernicus and Galileo, the Dominican Thomas Aquinas (1224-1274) synthesized Aristotelian natural philosophy and Christian theology. The Condemnation of 1277 took a step away from this synthesis by noting that Aristotle was wrong to place a limit on God. God had absolute power and could produce actions naturally impossible in the Aristotelian world view.[7] By the 16th century however, Aquinas' synthesis had become the official philosophy of the church.

The Galileo affair itself must be set in the context of the 16th century Reformation of Luther, Calvin, and others. The Society of Jesus (the Jesuits) was founded in 1539 by Ignatius Loyola and the Roman Inquisition (Holy Office) was set up in 1542 to combat Protestantism. These were the primary agencies of the Counter-Reformation along with an 18-year church council.[8]

The Council of Trent (1545-1563) reorganized and reformed the church in response to Protestantism and renewed the Catholic church's pastoral office. It approved the first Roman Index of Prohibited Books in 1559, which included the Bible in the vernacular. The Latin Vulgate was to be the only sacred and canonical text.

The Council defined its doctrines in a rejection of Protestant beliefs. For example, justification is not by faith alone, but by faith formed by works of love. The sacrament of penance involves works of satisfaction, as well as contrition and confession. The Council took a much stricter view of Biblical interpretation moving toward literalism to counteract the attacks of the Reformers.

The Council repudiated the Protestant notion that Scripture alone is the proper authority for belief. It recognized Scripture and unwritten apostolic traditions as equal sources of divine truth. The church alone had the right to determine the true sense and interpretation of scripture, in contrast to the "priesthood of all believers."

> "The Council decrees that, in matters of faith and morals ..., no one, relying on his own judgment and distorting the Sacred Scriptures according to his own conceptions, shall dare to interpret them contrary to that sense which Holy Mother Church, to whom it belongs to judge their true sense and meaning, has held and does hold, or even contrary to the unanimous agreement of the Fathers."[9]

The Council shut the door completely on any compromise to medieval doctrine. The Catholic Church had lost half of Europe as a result of a relaxed policy toward dissent and controversy, so it used the principles from the Council of Trent to move toward a centralized bureaucracy.[10] The Council intensely opposed Protestantism, but made major administrative reforms. The church was ready to fight or suffer for its faith. As a result Protestantism was slowed in its conquests.

The strongest defense of Catholicism against Protestantism coming from the Council was Roberto Bellarmino's *Disputations against the Heretics of Our Time*. He was a native of Tuscany who joined the Jesuits in 1560 and later played an important role in the Galileo affair.

As a result of the Protestant Reformation, the Catholic climate had changed. Giordano Bruno (b.1548) was burned at the stake by the Inquisition in 1600 for his claim of infinite universes, his threat to a literal sense of Scripture, his Arianism, and his magic. The Thirty Years' War (1618-1648) devastated Germany and ended in a truce drawing the political lines between Protestantism and Catholicism.[11]

GALILEO

Galileo: The Science

In this historical setting Galileo Galilei (1564-1642) of Italy became one of the founding father of modern science. He idealized a problem, put the physics into mathematical terms, and did experiments. His physics contributions included a description of falling bodies, pendulums, parabolic trajectories, inertia, and the time dimension, these in addition to his cosmological observations.

Unfortunately, Galileo had a knack for making enemies. He irritated the academic establishment with his satire about the Pisa university ordinance requiring professors to wear gowns at all times. He made an enemy of the Aristotelian, Giovanni Magini, when he got the position at the University of Padua that Magini wanted. He angered Cesare Cremonini by arguing against Aristotle's immutable heavens when a supernova displaying no parallax was observed in 1604. And more enemies were to follow.

Based on information coming from Holland in 1609, Galileo made a 9-power telescope that he used for spotting ships coming into the Venetian port before they could be seen with the naked-eye. With a later 20-power telescope he began amassing evidence for a new cosmology, but Cremonini refused even to look. Galileo discovered mountains and "seas" on the moon that were earth-like, breaking the terrestrial/celestial dichotomy. He discovered Jupiter's moons, showing that the earth was not the unique center of the universe. He recognized that the Milky Way was made up of myriad stars unknown to Aristotle. He observed the phases of Venus that would be impossible in a Ptolemaic system where Venus could never be on the opposite side of the sun. Galileo published these discoveries in *The Sidereal (Starry) Messenger*.

From the distribution of this book, Galileo became famous. In 1610 he took a prestigious position as the mathematician/philosopher for the grand duke of Tuscany, Don Cosimo de' Medici, although it meant leaving Padua and the safer Republic of Venice. Galileo's observations were confirmed by the German Jesuit Christopher Clavius, and Galileo was made a member of the prestigious Academy of Lynxes. During a visit to Rome, Galileo had a constructive audience with Pope Paul V and visited Cardinal Maffeo Barberini, a mathematician who later became Pope Urban VIII.

In 1611 Galileo discovered imperfections on the sun's surface and published this evidence against perfection in the heavens in *Letters on the Solar Sunspots*. The Jesuits initially confirmed his telescopic observations and treated Galileo as a celebrity, although they did not endorse his heliocentric interpretation. The Jesuit astronomer, Christoph Scheiner, preferred to interpret the dark objects as satellites and Galileo's denunciation of this explanation cooled his relation with the Jesuits.

Galileo waged a battle against the old Aristotelian science. Aristotle taught that celestial and terrestrial phenomena were essentially different, whereas here Galileo used earthly analogies to interpret heavenly phenomena. The new observations required a new kind of science with a less direct mode of proof for remote objects like comets and sunspots, enigmatic ideas like the earth's motion, and (eventually) invisible entities like atoms. His writings were not so much carefully reasoned scholarly articles, as popular books to influence public opinion and win debate.

Galileo: The Theology

Galileo's heliocentric cosmology called into question the anthropocentric purpose of creation, imperiled an understanding of Christ's ascension by advocating a moving earth, presented problems for the location of hell, and made rational creatures on other planets a possibility. This in contrast to the Bible's apparent statements that the earth was stationery (1 Chron 16:30; Ps 93:1; 104:5) and that the sun moves (Eccl 1:5; Isa 38:8; Josh 10:12-13; Hab 3:11). Over these issues Magini, who had lost the mathematics chair at Padua, drew the clergy into the conflict. Professors at Pisa led by Ludovico delle Colombe now attacked with theological as well as scientific arguments. Father Tommaso Caccini preached a sermon on Joshua's command for the sun to stand still, intimating that a moving earth is very close to heresy. The Pisan professors believed that natural science is incapable of determining the true world system with certainty, because the terrestrial viewpoint is insufficient; only the Creator knows the reality.

In 1613 Galileo's former pupil Benedetto Castelli discussed the Jovian moons with Cosimo's mother, the Grand Duchess who then challenged Galileo to defend his view that the Bible displays no objection to the heliocentric cosmology. Galileo's 1615 response in the *Letter*

to the Grand Duchess Christina used Augustine's long-accepted principles of Biblical interpretation. His letter was circulated in Rome and resulted in a strong reaction. Advice from a layman was not welcomed by the theologians and his principles of exegesis were deemed heretical.

This *Letter* affirmed Galileo's commitment to Scripture which he saw as above reason, not contrary to it. He believed that the Bible was fully true, as long as its true meaning was understood, for he recognized that the Bible used the common language and physical views of its time. Scripture was not a science text, so science was a legitimate path to truth apart from revelation, and science should be free from the control of theology. In discussing physical problems, one should begin from sense experience, not from Scriptural statements. Theologians, who want to reject scientific conclusions, must use scientific methods, not Scripture in their arguments. Galileo wanted to keep the church from making an article of faith out of a scientific issue. In this *Letter* he quoted the famous statement of Cardinal Baronius that the Holy Ghost uses the Bible to teach "how one goes to Heaven, not how the heavens go."

Galileo visited Rome in 1615 with the naïve thought that decisive scientific arguments would carry him to victory. He made his opponents look ridiculous and the Florentine ambassador was not pleased. Galileo was vehement and stubborn and very worked up. His arrogant, impetuous style stirred up trouble and made more enemies.

The Inquisition began an investigation into the heliocentric cosmology and rejected its essentials after only a few days' deliberations. They felt that Copernicus' book needed to be corrected, although it was not prohibited. Blemishes on the sun and moon defile the heavens and lessen man's hope.

In March 1616 Cardinal Roberto Bellarmino of the Holy Office told Galileo that the mobility of the earth was erroneous and the immobility of the sun was heretical because it contradicted the literal meaning of the Scriptures. If the heliocentric theory could be truly demonstrated, rather than just being a convenient mathematical construct to explain the data (i.e., save the appearances), one would need to carefully explain the contrary Scriptures. As a result of this need for demonstration, Galileo started using the tides as evidence for the Earth's motion. However, although the moving earth does produce tides, tides don't necessarily prove that the earth is moving. This poor evidence Galileo eventually abandoned in 1637.

To counter rumors going around in Rome, Galileo requested a letter from Bellarmino describing exactly what had happened. Bellarmino's May 26 letter states that Galileo did not have to publicly renounce his convictions, so he thought he could still use Copernicanism as a hypothesis. In addition to this letter, however, the Inquisition file contains another unsigned document dated 26 February 1616 ordering Galileo "to abandon completely the ... opinion that the sun stands still at the center of the world and the earth moves, and henceforth not to hold, teach, or defend it in any way, either orally or in writing." This document seemed to forbid all discussion, but Galileo later professed no knowledge of it.

Before continuing the major saga, Galileo made another enemy. In 1618 three comets appeared in the heavens. Father Orazio Grassi gave an account of them that Galileo bitterly attacked in *The Assayer*, published in 1623. In this case, Galileo's science was more in the wrong than Grassi's. It was enemies like Grassi and Chrisoph Scheiner (who interpreted spots on the sun differently than Galileo) who later helped bring about Galileo's trial. The Jesuits wanted to keep research within church orthodoxy.

Conflict: The Book

Pope Paul V died in 1621 and in August 1623 Maffeo Barberini became pope as Urban VIII. He was an intellectual and a moderate, an admirer and friend of Galileo, and a member of the Academy of Lynxes. He said that Galileo could write of the heliocentric system as hypothesis, so Galileo revived the battle for heliocentrism. In his discussions with Galileo, Urban expressed his belief that humans are incapable of achieving certainty regarding cosmological matters, for he felt that developing a working model doesn't prove it true. Urban argued that

> "God can, conceivably, have arranged things in an entirely different manner, while yet bringing about the effects that we see. And if this possibility exits, which might still preserve in their literal truth the sayings of Scripture, it is not for us mortals to try to force those holy words to mean what to us, from here, may appear to be the situation."[12]

Galileo explored the pros and cons of heliocentrism in his *Dialogue on the Two Chief Systems of the World* completed in 1630. He presented the cosmology as hypothesis, but he used all his arguments to show the truth of heliocentrism and refute the standard objections. In the *Dialogue* Sagredo asks questions in his Venice house, Salviati is a spokesman for Galileo, and Simplicio is a spokesman for Aristotle. Galileo used a number of arguments, including the poor argument from tides.

The book had to pass the censors before being published. Those censors favorable to Galileo lost out, but eventually after delays, revisions, and a new preface and conclusion the book was licensed and published in Italian in 1632.

Unwisely, Galileo put one of the Pope's arguments into the mouth of the inept Simplicio: the tide argument is a good one, but God can do things any way He chooses. Simplicio says that he

> "once learned from a man of great knowledge" ... God "would have the power and the knowledge to do this in many ways, some of them even inconceivable by our intellect." ... "excessively bold if someone should want to limit and compel divine power and wisdom to a particular fancy of his."

Conflict: The Condemnation

No sooner had the book been published than Urban ordered an investigation. The Pope felt that he had been deceived by Galileo, and his insubordination could not go unpunished. Galileo was not just dealing with mathematics, but with Holy Scripture, religion, and the Faith.

It was a bad time for the Pope. Europe was midway through the Thirty Years' War. The papacy was threatened by the Spanish who controlled half of the Italian peninsula. The pope was being criticized for political expediency in favoring the Protestant king of Sweden. And the horoscope predicted Urban's imminent death.

The 1633 trial was only indirectly about Biblical interpretation and cosmology. It was primarily about disobedience and flagrant insubordination. Galileo had apparently disobeyed Bellarmino's (unsigned) orders from 1616, and he made the Pope appear a fool. He was ordered to appear in Rome in winter at an age of close to 70. During the trial Galileo recognized that his arguments for heliocentrism were to compel conviction, but he didn't remember the (unsigned) injunction of 1616.

Galileo was not tortured, but it was promised. He was forced to recant his error by the Dominican judges. However, he begged off of admitting to deceiving anyone or to being a poor Catholic, for he was and intended to remain a good Catholic. After these changes he confessed, "I abjure, curse, and detest the aforesaid errors and heresies." In his recantation Galileo said that initially he thought either Ptolemy or Copernicus could be true, but after 1616 all my uncertainty

vanished; however, Galileo was still vehemently suspected of heresy. He plea bargained and received house arrest in Arcetri and was required to do salutary penance.

Epilogue: The Science

Galileo eventually published another book in Holland by Elsevier entitled *Discourses upon Two New Sciences*. He went blind in 1637 and died in 1642. Before his death he wrote, "in my writings there cannot be found the faintest shadow of irreverence toward the Holy Church ... none, not even the ancient Fathers, have spoken with more piety or with greater zeal for the Church than I."

Galileo intended to establish scientific inquiry within an unprejudiced framework where it could develop in harmony with a Christian worldview without being dominated by it. His judges did not want the "Church surrendering the power to expound the Bible's meaning to men who looked through telescopes",[13] but they completely lost their supremacy over science after the trial. Galileo intended no autonomy of science, but the sentence against him eventually resulted in exactly what he had feared.[14]

At least partially because of the Galileo affair, "the center of creative science moved northward to the Protestant countries."[15] The universe no longer appeared as a field of arbitrary divine action, but as an interpretable realm of law. Sir Isaac Newton (1642-1727) was born in England in the year that Galileo died and by 1687 had published the *Principia* in which he used the laws of gravitation to describe planetary motion in the new heliocentric system. Newton was deeply religious and much interested in theology, but his scientific findings were used by some as a means of deprecating Christianity.[16]

Not for another two hundred years did direct evidence for the earth's motion become available. Stellar parallax was finally observed in 1838 and in 1851 the Foucault pendulum was shown to swing in a constant (but seemingly changing) arc independent of the earth rotations.

However, a few people still promote geocentrism today: the earth is fixed in space and at the center of the universe. They believe it is unique and special as taught in the Bible and it was created before other parts of the universe. According to relativity, both geocentrism and heliocentrism could be correct depending on the reference frame.[17]

Epilogue: The Church

Bellarmino and Urban were initially supporters of Galileo. The clash with the church could have been avoided if Galileo had stayed in the independent Republic of Venice and he had treated his ideas merely as conjecture. In a time of growing absolutism, free speech was not defended by anyone, Protestant or Catholic. Judged by the standards of the day the Galileo affair was not a product of dogmatism or intolerance beyond the norm.

The church never actually declared heliocentric ideas heretical. Pope Benedict XIV authorized publication of Galileo's complete works in 1741 and in 1832 the *Dialogue* was removed from the index of banned books. Pope John Paul II commissioned a hearing about the Galileo affair in 1981 and gave an acquittal on 31 October 1992.

Next year marks the 400th anniversary of Galileo's use of the telescope to view the heavens. In commemoration a statue of Galileo will be set up in Vatican City to celebrate the International Year of Astronomy.[18]

The Galileo affair was not just scientific rationalism versus religious authority. All sides acknowledged the authority of the Bible. The conflict was as much within the church and within

science as between the two. Part of the problem was Aquinas' synthesis of church theology with the science of the day. Initially, the Galileo conflict concerned the new science versus Aristotle's science, but it was not as simple as that either, for the Aristotelians turned to theology when their science seemed to be losing.

CONCLUSIONS

Issues: Sources of Authority

A major issue in the conflict between Galileo and the church was the source of authority in deciding cosmological questions. Is the heliocentric hypothesis consistent with a literal reading of Scripture? Can the heliocentric theory be decided by an appeal to Scripture, or are the senses and reason also sources of authority? Did God through the Bible writers intend to convey information about cosmology, or was that peripheral to the Bible's purpose? Did God work through the language and popular conceptions of the day to convey his message? Ultimately, does one decide the heliocentric/geocentric debate based on revelation, tradition, the senses, and/or reason and who has the authority to decide?

The Bible writers do speak about learning of God from both nature and revelation (e.g., Ps 19; see also, Rom 1:20). Francis Bacon developed the "two books" approach. Ellen White emphasized the need to learn of God through both the Bible and nature (e.g., PP596-599), but with the Bible as the foundation for the study of science.[19] Jesus learned from "the Heaven-appointed sources; from useful work, from the study of the Scriptures and of nature, and from the experiences of life ..." (Ed77) These different sources of truth should not conflict, if one has a true understanding (Ed128).

Using the pre-modern worldview of the 17th century, Christians saw truth residing in authority sources such as councils and the Pope. Using a modern worldview, Christians discover truth from the Bible using reason, and scientists discover truth from nature using the senses and reason as part of the scientific method. Using a secular post-modern worldview, truth is found in relationships, stories, paradox, and an inclusive variety of sources.[20]

In a modern world view, the Christian or scientist would like rational explanations for the world. It gives control. This control can be good, for humans are to be stewards of the environment. It can also be bad as Eve found out in her search for knowledge, and as was true for the Babel builders who wanted knowledge and control of nature independent of the God of nature (PP119). The modern worldview presents problems for Seventh-day Adventists, because for example the senses and reason do not naturally lead to the geologic column being deposited in a 1-year world-wide flood. To arrive at that conclusion requires a different worldview.

Christians would agree with the secular post-modern worldview that truth can be found in a variety of sources, including relationships. They would agree that the Bible is written as a historical story. They would agree that human limitations may present seeming paradoxes in understanding such doctrines as the nature of Christ or creation. And they would agree that science is not the final source of authority. Of course, Christians would not agree with the post-modern denial of the Bible as the primary source of authority. How then does one go about faithfully interpreting these different authority sources?

Issues: Interpreting Sources of Authority

Both nature and the Bible provide data that is fixed, but both sets of data require interpretation. Both require faith as well as reason in understanding them.

Biblical interpretation

The discussion in this section is partly based on a paper by David Tyler, entitled "The Impact of the Copernican Revolution on Biblical Interpretation."[21] He is a conservative member of the Intelligent Design community and the Biblical Creation Society in England. Tyler suggests that the Galileo conflict was eventually dissipated by recognizing that Bible authors accommodated their writing to the understanding of their listeners. He does not believe, however, that this principle of accommodation applies to evolution theory as it does to the heliocentric theory. Evolution is based on more than just the appearance of things, and it addresses the big issues like purpose, meaning, design, origins, historical time, and evil. Following are several principles that Tyler suggests for interpreting the Bible's statements related to nature, with examples taken from his article as well as elsewhere:

1. Interpretations of the Bible need to recognize that human finiteness necessitates God's revelation being adapted to our limitations. – The Bible does not present misinformation or errors, but may use metaphor and the language of appearance. It provides phenomenological descriptions in everyday language, rather than scientific language. The Bible may speak of a stationery earth and allude to a moving sun, but even with our heliocentric understanding today we still speak of the rising and setting sun. The Bible speaks of rabbits appearing to chew the cud (Lev 11:6) and treats bats as birds (Lev 11:19), and for practical purposes that is satisfactory.[22] The heavens have windows that can be opened (Gen 7:11; Mal 3:10); a grain of wheat dies in the ground (John 12:24); and insects have four legs (Lev 11:21-22). Biblical writers did not necessarily correct every cultural misunderstanding such as being "smitten by the moon" (Ps 121:6)[23] or in the story of the rich man and Lazarus (Luke 16:10-31; see also COL263). However, God did correct Jacob's erroneous idea about animal breeding (Gen 30:37-42; 31:10-12). These examples of accommodation are not an attempt to twist God's words, nor do they sacrifice a high view of Biblical inspiration.

2. In understanding the details of Scripture, a study of nature can help change and improve our interpretation. – Copernicus, Kepler, Galileo, and others have changed our interpretation of the Biblical references to a stationery earth and a moving sun. The concept of created kinds being fixed species was the common understanding in the early 1800s, but a study of nature has altered that interpretation of the Bible. Research since the time of George McCready Price's interpretations has changed the Adventist understanding of geological features such as glaciation, age of the solar system and earth, and the flood boundaries. More generally, the evidence of senses and reason required a change in Biblical interpretation about what the first coming of the Messiah would be like and about what happened in 1844.

3. Strict literalism is not always the best Biblical interpretation. – The Council of Trent emphasized the more literal interpretations of Scripture to counteract the attacks of the Reformers. According to the church, Jesus' statement at the last supper, "this is my body" (1 Cor 11:24) was to be taken literally, in contrast to Zwingli's rejection of the literal transubstantiation and Luther's modified version of consubstantiation.[24] A literal interpretation of the Bible's reference to a stable, non-moving earth provides the only reasonable understanding of Christ's ascension to heaven and the location of hell.

In addition, when the Bible speaks of literal events, they are still subject to misinterpretation. Some churches today believe a much more literal interpretation of an eternally burning hell than Seventh-day Adventists do. Jesus first advent was very literal, but not at all

what the Jews were looking for (DA667). God is a literal personal being, more literal than we are, but still beyond our finite comprehension.

Scientific interpretation

Several lessons can also be learned from the Galileo affair about scientific interpretations of nature:

1. The Bible presents the broad principles, but not necessarily the technical details. – Scripture suggests new interpretations of nature. These general principles formed the Christian environment in which modern science developed and upon which it is based. These principles govern our understanding of nature, e.g., the origin and design of life.

The Bible may also give some technical details, such as binding the Pleiades (Job 38:31), but divinely revealed answers to technical questions are not its primary purpose. In Galileo's quote of Baronius, the Bible is to teach "how one goes to Heaven, not how the heavens go." Using the Bible for technical detail or scientifically advanced concepts is questionable. The "paths of the seas" in Psalm 8:8 is probably not referring to the ocean currents as Maury seemed to think. Modern traffic congestion is not necessarily being predicted by Nahum (2:3-4). The "circle of the earth" is not necessarily referring to a spherical globe. (Isa 40:22) Some well-meaning Christians have predicted no synthesis of organic compounds or never stepping on the moon. Others have used the Bible as a springboard for questionable scientific interpretations such as the Paluxy trackways or pleochroic haloes.

2. Scientific interpretations should not be drawn quickly or carelessly, especially from weak scientific evidence. – Galileo had no direct evidence for the earth's motion. He overstated his case, recognizing no evidence for the other side and forcing all the evidence into his view. He had a dogmatic faith in math, and missed the fact that science is more inductive than deductive and that compatibility is different than proof. He was wrong about Grassi's arguments on comets, about his tide argument, and about rejecting elliptic orbits. And he, along with Copernicus, Brahe, and Kepler dabbled in astrology which had been condemned by the church in 1277.

3. Convincing others of new scientific interpretations requires good people skills. – Not only did Galileo have science problems, but his people relations left something to be desired. He was sarcastic and vitriolic and had a caustic pen. He was egotistical and feisty, vehement and stubborn, and made numerous enemies. He betrayed the pope's trust by appearing to disobey orders and by making the pope appear a fool. Perhaps, aggressive promotion is necessary for those with new ideas such as Luther or Jones (and Waggoner), but Jesus presented a good balance. (DA260-261)

4. Interpretations embodied in simplified scientific models eventually take on a reality of their own. – Mathematical models of the earth orbiting the sun were simpler for calculations, but that did not necessarily mean they were closer to the truth. Osiander said the models were only for calculational purposes. However, with time the heliocentric model came to be accepted as reality. Similarly, the quark model of the nucleus began as only a convenient way to organize the plethora of subatomic particles, but now quarks are considered to be real particles in their own right. Likewise, earth history models today are used as convenient ways to organize the data, but eventually begin to appear real in and of themselves.

5. Current natural science interpretations (models) are best challenged by research and developing better models. – Initially, the heliocentric model was not as good an explanation for the available data as a geocentric model. Not until long after Galileo death was direct evidence

available for the earth's motion. Although it was tried, the final truth about the correct cosmological model was not arrived at by vote or by the suppression of bad ideas. Just pointing out problems, exceptions and assumptions or rejecting a bad model was not enough. Today, scientists usually recognize the tentativeness and limited applicability of their models, but only modify or discard them as better explanatory models become available.[25]

Issues: How to Deal with Conflicts between Authority Sources

What then does one do when interpretations of the various truth sources – revelation, tradition, senses, or reason – appear to disagree? How are the different authority sources integrated? How does one deal with the uncertainty? What source has the final word? Here are suggestions on how to maintain the foundational authority of the Bible while dealing with conflicts:

1. Ask the appropriate questions – The 16th century church wanted to know how to maintain its authority and refute Protestantism, whereas Galileo wanted to find cosmology answers. Blackwell[26] says that Galileo's trial

> "was not about science and the Bible but about authority, power, and obedience. Concern for truth had evolved into concern for authority and power; critical debate was replaced by suppression of thought; astronomy and Biblical exegesis gave way to legal injunctions and court judgments."

The 1st century Jews wanted to gain independence from the hated Romans, and expected a Messiah as a temporal deliver. Thus, they asked Jesus inappropriate questions. Jesus provided evidence, but not what the rulers wanted.

Today it is tempting to try to find detailed technical answers from the Bible about origins. Although the Bible was not intended for that, it does provide answers about the big issues important for life: God's character, revelation as the ultimate source of knowledge, an original perfect creation, a purpose for life, humans in God's image, free choice, absolute good and evil, a fallen world, judgment and justice, mercy, the incarnation, linear time and a future restoration.

2. Allow time and openness to search for answers. – The 17th century church's approach to resolving the Galileo conflict seems to have worked poorly. The church and its leaders were *under attack* by Protestantism and other local circumstances, so they used a hasty "fortress approach"[27] to deal with Galileo. In this fortress mode the church had the final word, rather than the Bible. Under less stressful conditions, the preferred, but slower "search approach" would have been more productive. It was 200 years before definitive scientific evidence was available for the earth's motion.

The resolution of the conflict required a culture that encouraged exploration and research. It required a safe haven and a support group. The closest Galileo had for this was his daughter Virginia, Sister Maria Celeste.[28] This open exploration was not best done in a setting of a general lay audience or students, but such is what Galileo tried to do by writing to the masses in the common language.

3. Don't force untenable answers to gain a shaky concordance between science and theology. – It is better to live with contradictions than dishonest security. Science and theology each throws light on the other, but it is detrimental either to misconstrue scientific data to force concordance with Scripture or to misconstrue Scripture to force concordance with scientific data. Aquinas' attempt to bring concordance between the church's theology and Aristotelian science displays similarities to dogmatic or premature attempts to bring concordance between modern creation/flood theology and current biological/geological observations. Expecting no change in the celestial sphere because God created a perfect universe is similar to expecting evidence for a fiat creation of matter because God created a young earth. Tying the Sabbath to a technically

defined 6-day creation provides another illustration of the problem of linking theology to contemporary science. (See appendix.)

Theologians do just as poorly at making scientific statements, as scientists do at making theological statements. The 17th century church had the right to make theological decisions (although they were not equivalent to biblical statements); however, the church was not in a position to make scientific pronouncements. Today it is appropriate for the church to state its belief in a literal 6-day creation, a world-wide flood, and a bodily resurrection, but can run into trouble in trying to define or explain them in current scientific terms. Supernatural events are not explainable naturalistically.[29]

4. Remain humble with the tentative answers. – In contrast to Galileo's arrogant approach, the search for answers is best done in humility with respect for others and the church's policies. It is a process of building bridges, of working with people, rather than antagonizing. "Know-it-alls" are unpleasant to live with and God "does not impart to us power to vindicate ourselves." (DA407) A recognition of one's own imperfections make it harder to point the finger, for as Solzhenitsyn said, the "line between good and evil runs through the heart of every individual." Limitations make it easier to be sympathetic of others' weaknesses and to share Christianity:

> "We draw people to Christ not by loudly discrediting what they believe, by telling them how wrong they are and how right we are, but by showing them a light that is so lovely that they want with all their hearts to know the source of it."[30]

We earn the respect and trust of others by being honest with the evidence, and lose it with snide remarks, dogmatism, and haughtiness. A humble witness means admitting a lack of complete answers, rather than giving poor answers or easy solutions that don't work. Ad hoc answers are like the fig tree with leaves but no fruit (Mark 11:13, 14). Presenting both sides of an issue decreases the risk of a later crisis of faith, when listeners find out "the rest of the story." One who recognizes their limited understanding will offer a process and community for discovery, in contrast to one who has all the answers and wants to offer a finished product.

5. Don't expect to get all the answers. – Galileo was a long way from understanding cosmology. Human limitations mean that reality presents us with paradoxes. Light is both a wave and a particle. God knows the end from the beginning, but yet we have free will. Jesus was both divine and human – both Creator and created. And the Christian life involves paradoxes: rest under a yoke (Matt 11:28-30), becoming first by being last (Matt 20:16), exaltation by being humble (Matt 23:12; Luke 9:48), life through death (John 12:24-25; 2 Cor 4:10,11), strength through weakness (2 Cor 12:5,7-10), wisdom by becoming fools for Christ's sake (1 Cor 1:20-21), and conquest by yielding (Rom 6:16-18).

Although there is one reality, we each have our own limited perception of it. The six blind men of Hindustan were all touching the same elephant, but each had their own model of it. Thus it is important to look at all the data for "truth can afford to be fair." (CWE35)

Christians as well as scientists may want answers and certainty and concordance that are not available. It is better to live with fewer answers that are right, than try to answer everything. Wanting clear cut answers and the resulting control is a strong temptation. Eve fell for it. This is what the Babel builders wanted after the flood – a monument to their wisdom, a natural explanation for the flood, and safety in control over their lives. (PP119) We too would like to explain God's actions with science, to bring the infinite within finite human understanding. But might there be limits to trying to explain creation and the flood using science? Our trust in Him must be based on much more than scientific proof.

Human limitations of knowledge require a leap of faith. Plenty of evidence is available for belief, but not proof. G. K. Chesterton suggested that one often finds truth with logic, only after finding it without logic. Anselm expressed it as "faith seeking understanding." In mid-life Allan Sandage, the famous astronomer, took this leap of faith from the evidence for design in nature to the God of the Bible.

6. The answers are personal, as well as factual. – Jesus, not just a creed, is "the way the truth, and the life." Galileo thought that facts were sufficient to convince, but humans need the personal touch and the appeal to emotions, as well as evidence and logic. In the play *Twelve Angry Men*, the jurors became convinced of the defendant's innocence based on much more than just the facts.

The Bible provides many personal examples of loyalty and obedience in spite of difficulties, questions, and limited knowledge. Job said, "Though he slay me, yet will I trust in him: but I will maintain (margin: prove, or argue) mine own ways before him" (Job 13:15). In spite of needing to bow in the house of Rimmon, Naaman said he would "offer neither burnt offering nor sacrifice unto other gods, but unto the Lord." (2 Kings 5:17-18) Peter threw in his fishing net, even though it didn't make any sense to fish during the day. (Lk 5:4-10) Even though the Gadarene demoniacs couldn't answer doctrinal questions, they could tell what Jesus had done in their life. (Mark 5:19; DA340) Although we usually think of Thomas as a doubter (Jn 20:24-29; DA806-808), he was willing to follow Jesus to death when He went to raise Lazarus (Jn 11:16; DA527).

APPENDIX

The Sabbath and Science

The seventh-day Sabbath is important for many reasons, but keeping the Sabbath based on scientific evidence, or trying to use science to defend the Sabbath are not beneficial.

We keep the Sabbath, not because of science, but because the Sabbath is a symbol that:

1. Humanity is to worship the Creator (Ex 20:11; Rev 14:6-7), not the creation -- the creature or beast of Rev 14:9. A Christian tends towards this wrong kind of worship, if he accepts Scripture based on the scientific evidence. Instead we accept *sola scriptura*.
2. God is wiser than humanity (1Cor 1:17-31, especially v.25). We can worship on the seventh day, even if we do not understand exactly how or what God created during those 7 days of creation. For example, if the 4th commandment is the seal of God with His name, dominion, and authority, it seems that His dominion is the entire universe … created in 7 days.
3. We need rest (Heb 4:1-11) because of our limited abilities. We must rest from trying to explain everything in the natural world, including all the details of how God created and flooded this earth. For example, how does one understand the suggestion for fiat creation of the stars (Ps 33:6-9) that contrasts with the current scientific theory of stellar evolution over millions of years.
4. God is Lord of time, as He is Lord of all else. He owns all time (Ps 90:4; 1Tim 1:17; 2 Pet 3:8), but especially the seventh day of the week (Gen 2:2-3).
5. God is a personal God who set aside a time to be with us. As a friend we spend time with Him out of love, not from a forced allegiance or fear of punishment (Isa 28:21; Lam 3:33;

Eze 18:32; 33:11; Hos 11:4,8; 2 Pet 3:9). Sunday laws will be a final test because, by contrast, their observance will be forced. (GC592, 604ff, see also 493)

It is probably not useful to use science to defend the Sabbath. The Sabbath can't be scientifically defined based solely on:

1. The sun – There was no sun on the first three days of creation. There will be no need for the sun in the new earth (Rev 21:23; 22:5), although we will still worship on the Sabbath (Isa 66:22-23).
2. The rising/setting of the sun – The earth is a sphere, so the sun doesn't rise and set during part of the year above the Arctic Circle. In addition, gradually traveling around the earth (e.g., as in Around the World in 80 Days) would result in the traveler upon arriving home keeping the Sabbath on a different day than those who had remained at home. (see 3SM 317-319) The dateline has become an issue on Tonga.[31]
3. The earth's rotation – We will keep the Sabbath in heaven independent of earth's rotation. Or closer to home, Sabbath for an astronaut on the moon or on the space station would not be directly related to the earth's rotation.
4. A constant 24 hour cycle – Joshua's long day and the sun moving backwards on Hezekiah's sundial would seem to have disrupted the 24-hour cycle. Violent action during the flood may also have changed the earth's rotational cycle.
5. An exact 24 hour cycle – The earth's rotation is slowing due to tidal friction, so the cycle has changed by a few milliseconds per century. As a result, eclipse records of 2500 years ago are off by 6 hours from current expectations.[32]
6. Absolute time – No absolute time frame is possible. Relative motion and strong gravitational fields affect the flow of time.

The Catholic Church during the Counter-Reformation and the Pharisees in Christ's days worked at defining things that were better left to individual judgment. Everyone agrees which day of the week is the seventh day. No more is really necessary; in doing more, one appears to "protest too much." Ultimately, a Christian should rest his belief on what God says in the 4th commandment, not on his own senses, his own reason, or his own arguments. As C. S. Lewis said, "No doctrine of that Faith seems to me so spectral, so unreal as one that I have just successfully defended in a public debate. For a moment, you see, it has seemed to rest on oneself".[33] To try to improve on God's wording in the 4th commandment by using scientific definitions gets close to adding words to the Bible (see Rev 22:18).

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[24]MacCulloch, pp. 139-140; see also Walker, p. 446.
[25]Dorn.
[26]Blackwell, p. 177.
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[28]D. Sobel, *Galileo's Daughter: a Historical Memoir of Science, Faith, and Love* (Penguin Books, 1999).
[29]Natural events are repeatable such as the rain or the birth of a child. Supernatural events are non-repeatable, such as the resurrection, or fortuitous, such as the stopping of the Jordan River. God controls all these events, but miracles are either non-repeatable or fortuitous, and not directly amenable to scientific explanation.
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