

# Evolution in the Catholic Tradition: Lecture I

## Science and Religion

The radii of knowledge have only pushed back and enlarged the circumference of mystery. We live in a world famous for its ability both to surprise and deceive us.  
(Wendell Berry, *Life is a Miracle*)

### Introduction

In these three lectures we will first consider the relationship between science and religion, then the theory of evolution and the position of the Catholic Church regarding evolution and lastly a look at the various biblical creation accounts and their theological message.

### Science

While science and religion use different methods, both science and religion strive to offer insights which enable us to understand ourselves and the world in which we live. In general, science restricts its exploration to that which is observable and testable. It attempts to understand what the material world is made of, how it works, how it can be modified, how it can be used and what might be predicted for the future. For example, the science of medicine tells us how our bodies are constructed; how the bodily systems act and interact; what foods, exercise or medicines might make them function better or longer; what tasks we can perform and what will happen to our bodies if they are neglected.

Unlike religion, which is based primarily on revealed truths and secondarily on reason (natural theology), science is based primarily on reason and secondarily, but importantly, on non-rational processes (intuition, luck, vision, imagination and “strokes of genius”). It restricts its scope of inquiry to verifiable facts about physical phenomena. Within its method it generally excludes consideration of ethics, values and ultimate meaning. Instead, it asks questions about what objects populate the natural world, how they came into existence, how they work and how they can be used to human advantage. To answer these questions it uses the rational processes of reproducible observations, controlled experiments and theoretical reasoning guided by mathematical logic. It is important to note that, in principle, science is always open to modify its theories based on new data.

A classical view of the scientific method (the inductive view) might be outlined as follows:

1. Observing and collecting data -- no analysis at this point; attempts to exclude all personal bias.
2. Forming a hypothesis based on the data -- intuition or imagination may be used; more than one hypothesis may seem possible to explain the data.
3. Testing the hypothesis -- use of experimentation to test the hypothesis to check for

error and see if similar data again produce the same results.

4. Development of a theory to explain the results of testing the hypothesis -- a theory attempts to “make some sense” of the data based on a tested hypothesis.
5. Making predictions based on the theory -- if the theory is correct, certain events should  
be predictable, if they always occur, they are testimony that the theory has some validity.

Given this outline, the scientific method is sometimes described as free from bias and certainly not based on such “non-scientific” sources like revelation and faith which characterize religious knowledge. Science is often characterized as concerned with the “facts” i.e., those things you can see, touch, smell, and measure. However, like most things in life that include human beings, *it is not quite that simple.*

There is, in fact, no direct route by logical reasoning from data to theory. Just as theologians have come to recognize that the Scriptures and all theological efforts spring from and are conditioned by human culture, so too scientists have come to realize that they live in a certain historical culture which includes all the scientific efforts of the past and current theories and assumptions which naturally influence how they view the world, specifically the world of science. For example, for over two thousand years scientists assumed that the earth was the center of the universe and this “theory” was the unchallenged basis of much scientific thought. This assumption endured because it provided a basis for theories that did in fact “make sense” of a good deal of observable phenomena..

Therefore, the scientific method often starts, not with the collection of data, but with a current theory or new concept perhaps related to a current theory linked to an act of creative imagination. Then it proceeds through the steps of collecting data, developing a hypothesis, etc. as outlined above. For example, Newton started with the creative insight that the moon was actually falling and then began to collect data to verify this insight logically and mathematically.

In the jargon of science, *all data are theory-laden.* There is no such thing as theory-free, neutrally-objective observation. Current theories that make up the scientific culture of a given historical era naturally and significantly influence the way science operates. For example, current accepted theories influence what scientists choose to study and the choice of variables considered significant to study. Current theories influence the form and the kind of questions that are asked, which in turn influence the kind of answers that are generated. Thus, theories can never be taken as literal descriptions of reality.

As a human endeavor, science also has to overcome a natural tendency to resist change. Thomas Kuhn in his work *The Structure of Scientific Revolutions* refers to the phenomenon of “masking”. Here the “dogmas” of current scientific thought tend to non-scientifically set the boundaries of truth even in the face of new data or new conceptual

systems. Scientists are busy people with numerous scientific projects that make demands on their time. It takes time to judge the veracity and/or usefulness of new conceptual systems. New systems of thought, using unfamiliar concepts and procedures take time to assimilate and account for all the data involved. So there exists a natural and understandable intellectual inertia which often results in scientists ignoring new scientific theories. This inertia is reinforced by the knowledge that there is no guarantee that the new systems of thought will work as well as the current ones. These are some of the human variables, there are many more.

Furthermore, as mentioned above, one of the commonly expressed characteristics of scientific knowledge is that it is “always open to modify its theories based on new data”. In general this is a fair statement. However, as noted above, there is often great resistance to a challenge to an accepted theory. Added to the natural resistance to change, individual scientists often have a huge psychological, emotional and professional investment in their particular theories, not to mention the economic stakes which are often involved, e.g. grants and academic positions. Therefore, new data that may falsify or change a theory can be judged to be insignificant or simply set aside as “unexplained anomalies”. Unfortunately there are even instances when new data that challenge current theories have been not only ignored, but corrupted and modified to fit current theories. This is another component in the human side of science.

It may be difficult for liberal Christians and nontheistic scientists to give any accolades to evangelical Christians, but it is true that some of the most ardent advocates for the abolition of slavery in the 19th century were evangelical Christians whose opponents were scientists who said the evidence showed that enslaved races were inherently inferior. By the middle of the 20th century scientists had changed and considered equality among the races as a fundamental principal. Now in the 21st century, the genome project has put the final stamp on the argument by revealing how inconsequential are the genetic differences among the peoples of our earth. Truth is where you find it no matter how embarrassing it is to those who feel that truth can only emanate from their particular profession or area of expertise. Intellectual humility has always been a rare virtue.

This brief sketch is meant to address the popular “myth” that scientific knowledge is built on the secure foundation of unchanging facts as opposed to religion which is not. Science does not lead to certainty. Science, like theology, deals with a great mystery - the universe and all that is in it. To be sure, science uses different methods for its inquiry, but science is a human endeavor and its conclusions are always incomplete, tentative and subject to revision.

Science approaches the natural world as an integrated, interdependent whole, however scientists have typically divided their task of investigation into four disciplines:

Physics - the study of matter, energy, forces and motion. This included all material objects from the smallest quantum particle to the massive objects (stars, planets, galaxies) of the cosmos.

Chemistry - the study of atomic interactions, especially the study of chemical reactions and the formation of new materials.

Earth science - the study of the origin, the present state and the dynamic process of the Earth and other planets.

Biology - the study of living organisms.

## **Religion**

Religion concerns our relationship with God. Religion looks out on the same world as science, but asks different kinds of questions and uses different methods to address these questions. Furthermore, religion extends its inquiry beyond the observable world to seek the ultimate ground of all creation. It claims to see the world and human experience “in depth” in light an experience of the “Other” in some kind of revelatory event.

While the scientist seeks to grasp the world and observe and test the data it provides, design theories about how it works and devise means of using the world to human advantage, the religious person believes that he/she has been grasped by an ultimate reality, a reality that is personal, a reality that is the ultimate cause of all that is yet desires to create a personal relationship with humankind. This ultimate reality theists call God.

Unlike science, most religions are based on one or both of two sources: classic revelation (e.g. Moses, Jesus,) and natural theology (human reason). The first source elicits faith and does not lend itself to rational proof and scientific verification. However, while held in faith, the revelatory experience of God provides a matrix that “makes some sense” out of the mystery of human life and the universe. The second, human reason, also leads ultimately to faith, but uses human reason to detect “signals of transcendence”, (to use Peter Berger’s term) within the world of nature and human experience. Religion also uses reason to explain that religious beliefs, which are derived from attempts to interpret and speak about revelatory experiences, are credible, that is not contrary to reason. Faith cannot contradict reason.

Professionals involved in the study of science we call scientists, professionals involved in the study of religion we call theologians. The fundamental questions about the universe posed by scientists are “what is the universe made of and how does it work”, for theologians the fundamental questions about the universe are “why is there something rather than nothing and what is its ultimate meaning”, questions not answerable by the scientific method.

While scientists are open to the modification or rejection of their theories based on new data, theologians cannot hold open to modification or rejection the fact of the revelatory experiences on which their beliefs are based, for example, the revelation to Moses and in Jesus is unable to be “re-tested” by theologians in the way that scientists can re-test their experiments. One simply cannot go back to the original experience of Moses or walk again the roads of Galilee with Jesus.

However, it is important to note that the revelatory experience reveals a mystery (God's self communication) which is partial and eternally open to new understanding (and mistakes in understanding). What is revealed is not a set of eternal "facts" or "truths", but a person. And persons, whether divine or human, remain largely a mystery to those who interact with them. But the revelatory experience itself is a given, unrepeatable and therefore not subject to verification by human reason.

The claims of religious "knowledge" or religious "truths" must always be seen within the process of human experience. Consider the elements in the process of the human experience of revelation:

1) The reality that is revealed - e.g., God's self-communication in Jesus, 2) the human experience of this reality, 3) the interpretation of this experience and 4) the attempt to articulate or communicate the interpretation of the experience to others.

In the case of Jesus, the four Gospels communicate a fundamental agreement on what was experienced in Jesus, but they also reveal that the presence of God which was experienced in Jesus remained a mystery, that those who knew Jesus each experienced him in their own personal way which was dynamic (developed) and that there were various interpretations of this experience (the Gospel of John vs the Synoptics) which issued in a variety of final products (the Gospels) that try to communicate a fundamentally Jewish experience using first century Greek language and within the cultural context of the Hellenized world.

All that was said above about science having a human side, which often hinders its progress, can also be said of theology. Theologians are also human and they too resist change and new ways of expressing the mystery of God. And so it is well to remember that since the ultimate "object" of faith and theological investigation is God, the object of faith will, by definition, always remain a mystery. The theological task is always incomplete and tentative. Theology as science is best understood as a quest. Human words and concepts can never take hold of the mystery which theology endeavors to communicate.

While it is beyond the considerations of this lecture, it would no doubt be fruitful to apply the elements of the four step process of the human experience of revelation as described above to scientific investigation also.

## **Summary**

Perhaps we can summarize this brief and incomplete comparison of religion and science in this way. Religion espouses a particular view of the world based on certain beliefs grounded primarily in revelation and to some extent reason. Such a world view is not the result of the application of the scientific method. Foundational religious experiences (revelations) are not considered as falsifiable by new data. The content of these revelatory experiences are held in faith, but are understood as fundamental mysteries eternally open

to new understanding within certain parameters of belief based on the original revelatory experience. Within the Catholic tradition, it is a fundamental principle that there can be no contradiction between faith and reason.

In contrast science espouses a particular view of the world based on observable facts. It is a rational, empirical (from the Greek *empeiria* - experience) method by which views of the world are formulated, evaluated and modified when necessary. Scientific knowledge is, in principal, always open to be falsifiable by new data.

In short, science claims that scientific knowledge is subject to experience and can be demonstrated to be true, religious knowledge cannot provide concrete evidence of its claims and thus cannot scientifically demonstrate its claims to truth. Religion, however, claims that its knowledge is based on divine revelation and while not subject to the scientific method it is superior in its claim to truth because it is based on a higher reality than the observable world, namely the self revelation of God in human history. While religion would hold that religious faith is not the product of reason, nevertheless it also holds that its faith is “reasonable”. Faith cannot contradict reason.

### **How Do Science and Religion Relate?**

Since science and religion both offer an interpretation of the world and since each uses a different approach or method, there has long been a question of how these two world views relate to each other. There are, of course, different views on this relationship.

These views have been summarized by several authors into four distinct categories. Ian Barbour, a professional theologian and a professional physicist, in his excellent book, *Religion and Science: Historical and Contemporary Issues*, labels these four categories: Conflict, Independence, Dialogue and Integration. In like manner, John Haught, a Catholic professor from Georgetown University specializing in the area of science and religion, in his book *Science and Religion: From Conflict to Conversation* also uses similar labels: Conflict, Contrast, Contact and Confirmation. Michael Ruse in his work *But is it Science?: The Philosophical Question in the Creation/Evolution Controversy*, defines these same four positions as Warfare, Separation, Dialogue and Integration.

<b>Barbour</b>	<b>Haught</b>	<b>Ruse</b>
Conflict	Conflict	Warfare
Independence	Contrast	Separation
Dialogue	Contact	Dialogue
Integration	Confirmation	Integration

All of these four views of the relationship of science and religion are today held by various groups and individuals within our society. These views are not purely academic, because when people with differing points of view on the relation of science and religion focus on certain issues they sometimes end up competing in the public square for

recognition and the inclusion of their particular point of view in public policy, e.g. the evolution debate.

In a democracy we need dialogue to understand each other and fruitful dialogue depends on an understanding of the basis of our differing points of view. So we will examine each position as labeled by John Haught: Conflict, Contrast, Contact and Confirmation. Later we will see how the Catholic tradition views the relationship between science and religion and give some special attention to the famous case of Galileo.

## **Four Main Positions on the Relationship Between Science and Religion**

### **1) Conflict**

There are those in both the scientific community and the religious community who see no way to reconcile science and religion. Some scientists see science as giving a complete explanation of reality without recourse to the God of religion. On the other hand, certain religious groups maintain that since the Scriptures are the inspired Word of God and thus can contain no error, even scientific error, then in situations where scientific ideas do not correspond with a literal reading of the Bible, secular science must be wrong and biblical “science” must be right. The evolution debate is an obvious case in point.

It is interesting that these two opposing groups hold the same conflict position on the relationship between religion and science i.e., one is right the other is wrong. A listing of such conflicts is contained in Andrew White’s now classic book entitled *A History of the Warfare of Science with Theology in Christendom* written nearly a century ago. For our purposes, we will examine two major competing views about the nature of reality held by these two groups: Scientific Materialism and Biblical Literalism.

Scientific Materialism - This view is based on two assumptions or “beliefs” (1) the scientific method is the *only* guide to true knowledge and (2) matter and energy are the *only* fundamental realities in the universe.

The first assumption is about how we come to know reality. It implies that the path to true knowledge must begin with observations of empirical (sense) data. From these data a hypothesis is formulated and tested. A theory can then developed to explain the results of testing the hypothesis and predictions can be made based on the theory. For example, if fossils are found in ancient rock deposits that look somewhat like the modern horse and more recent fossils look even more like the modern horse, then a hypothesis can be proposed that horses have developed over time. The hypothesis is tested as more fossils are discovered. This testing can result in a theory that horses have evolved over time. If this seems so then it can be predicted that other animals could have evolved over time. The theory is then open to be validated or proven wrong based on new data. In science, theories are always tentative and open to be proved wrong with new data. The key here is the assumption that if knowledge does not come from sensible data that can be tested, then it is not true knowledge.

The second assumption is that matter and energy are the only fundamental realities in the universe. This assumption is often linked with a reductionist point of view. Reductionism in science holds that all scientific theories and laws can be reduced to the laws of physics and chemistry. Furthermore, it claims that reality can be explained by an examination of its component parts. In this view all things in the universe including the human mind, love, religious belief, altruism etc. can be explained by an analysis of the workings of the atoms and molecules that make up the physical world. In other words, human existence is explained as “nothing but” physics and chemistry in action. As Carl Sagan said: “Human nature is the result of apparently minor accidents in our immensely long evolutionary history.”

Biblical Literalism - While agreeing with scientific materialists that religion and science conflict, biblical literalists take a radically different view of how to understand the universe and the fundamental nature of all reality. Biblical literalists are loosely defined as those who understand the words of the Bible to be literally true without regard to subject matter or literary form. When the Bible is viewed to touch on any scientific subject (creation of the world, creation of mankind) then the Bible is “true science” and secular science, if it does not correspond to the letter of Scripture, is wrong.

For example, if the account in Genesis says the world was created in six days, for many literalists this means six, twenty-four hour days and if the Bible says that the whole world, except for Noah and the inhabitants of the ark, was destroyed by a flood, then if you could have viewed the earth from a spacecraft at that time, you would have seen the entire earth covered with water with only the ark and its inhabitants afloat on its surface. If the Bible says the sun stood still, then it did. For the biblical literalist the Bible as the Word of God means that it is inerrant throughout. This position has given rise to such movements as “creationism” and “creation science”.

Some in the literalist camp also believe that science itself is the enemy of religion. For them, science has emptied the world of values and meaning and thus science is an anti-religious force. (For a full treatment of this viewpoint see: *Understanding the Present: Science and the Soul of Modern Man* by Bryan Appleyard 1993.)

## **2) Contrast**

The contrast position holds that there can be no conflict between true science and true religion. Each asks different questions and uses different methods. Each has its own valid and clearly defined field of inquiry. They exist in a parallel situation. They are not competing explanations of the same subject matter.

In the Catholic theological /philosophical tradition God is seen as the primary cause - the object of theology - working through secondary causes - the objects of science. All that exists is dependent on the constant creative power of God, but the natural world is viewed as complete in itself. God is not called on to fill the “gaps” as an explanation for what we fail to grasp with our scientific minds. The explanations of the physical world are left

up to science, the gaps as seen as gaps in scientific understanding of the processes created and sustained by God as the first cause.

Adopting the contrast position scientists may be atheistic, agnostic, or theistic. Their religious beliefs do not impinge on their scientific studies. For example, the investigation of how a plant produces a flower does not depend on the ultimate question of how and why flowers came to exist. The theologian may say that the flower ultimately “springs from the hand of God” and shows forth in some way the splendor its creator, without being concerned about the mechanism of its flower production. In fact, the scientist and the theologian can be one and the same person. For example, it was Gregor Mendel (1822-84), an Augustinian monk, who conducted plant-breeding experiments in a monastery garden which were an important step leading to an understanding of the basic principles of heredity, the formation of species through hybridization and the modern science of genetics.

The lesson of the Galileo incident was that science was wrongly seen as invading the field of theology. We now freely admit that the Bible does not teach science, but rather theology. Therefore, the contrast approach urges us to put science and religion into separate compartments, thus avoiding unnecessary conflict. In this view, science deals with an examination of the natural world empirically (through sense experience), while the task of religion is to investigate the ultimate meaning that transcends the natural world of empirical research (through revelation and reason).

In the contrast position, science is ultimately concerned about how things happen and work in nature, religion is ultimately concerned about why there is something rather than nothing. Science is about physical causes, religion is about meaning. Science is in the problem solving business, the subject of religion is mystery. Science asks: What are we able to do? Religion asks: Ought we to do all that we are able to do?

### **3) Contact**

The contact approach admits that in fundamental ways science and religion are distinct. However, they do have points of contact. While we must not revert to a conflict position where science and religion compete with different answers to the same questions, nevertheless these two important fields of study do have important implications for each other. As Pope John Paul II said in his 1998 *Message to the Director of the Vatican Observatory*: “Science can purify religion from error and superstition...religion can purify science from idolatry and false absolutes. Each can draw the other into a wider world, a world in which both can flourish.”

In the real world it is not as easy or necessary to totally separate science and religion. For the scientist, religion grounds his study in ultimate meaning and purpose, for the theologian, science opens up the real world which is seen, theologically, as a meeting place for God and man. For example, natural theology is based on human reason being able to detect something of God by an examination of the physical world. Sunsets may give us a hint of the beauty and grandeur of God. Likewise, the process of evolution

revealed to us by science may point us toward a God who grants us and our world the freedom to grow in a relationship of love rather than a God who implements a step-by-step, predetermined “grand plan”. Such a view of the world may go a long way in helping us deal with the problem of natural and moral evil in the world.

In our day, scientists and theologians are more humble in their claims for knowledge. Both admit that they are dealing with a mystery, one a natural mystery the other a supernatural mystery. Gone is the naive 19th century glorification of reason. Gone also is the arrogant religious supposition of “having all the answers”. Science is also admitting the historical and cultural conditioning of scientific understanding. Science is no longer presented as so pure and objective as it was once portrayed. Scientific progress owes more to intuition, guesswork, luck and unexplained “strokes of genius” than was once admitted. Science also admits its “human side”. It can be inhibited by scientific prejudice, cultural restraints (grants), resistance to change and unexamined assumptions.

Science also speaks of “limit-situations” where science is limited in its ability to answer important questions pertaining to its field of inquiry. For example, the ethical questions concerning the use of nuclear energy, cloning, stem cell research and a host of other ethical questions concerning the use of science are beyond the scope of science as such. Science may be able to map out completely the origin, evolution and chemical make-up of human life, but when questions concerning the basis for human dignity arise, science needs help. E.O. Wilson, Richard Dawkins and other socio-biologists may say that we have genes that predispose us to treat others as equals for survival, but if we choose to override our predisposition toward equality (slavery) on what grounds do we object? If someone wants to create a “super race” on what grounds do we object? Could this not be part of the “natural process”? If “survival of the fittest” is the law of nature, can we help it along?

Theology, for its part, is now viewed as less subjective than Freud and others had led us to believe. Theological knowledge is now seen a true knowledge, but of another type than scientific knowledge. On the other hand, theologians are more aware of the impact of historical and cultural conditions on their theological pronouncements. When faith is expressed in words, the words always fall short of expressing what we believe. Theologians now understand better the three components of revelation: 1) the reality (God), 2) the experience (of Moses and in Jesus) and 3) the interpretation (the scriptures and theological traditions). Therefore, our faith based on this understanding of revelation recognizes that revelatory experiences are merely glimpses of the One Who reveals Himself. And that the interpretation of this experience expressed in theological statements is always in need of reformulation. Certainly the mystery of God calls us to an unending journey of discovery.

Both fields of study, while distinct in themselves in terms of methods and objects of investigation, are still companions in the quest for the truth about the nature of the universe and our place within it. Again the words of John Paul II: “Science can purify religion from error and superstition...religion can purify science from idolatry and false absolutes. Each can draw the other into a wider world, a world in which both can

flourish”. Science and religion need each other in their journey of discovery of the mystery of the universe. And since the universe is still unfolding and God is the eternal mystery, the quest reaches out into an infinite future. In this context, contact without conflict becomes a noble and necessary goal for the practitioners of science and religion.

#### **4) Confirmation**

The confirmation approach goes beyond the contact approach which suggests that there should be contact between science and religion in the quest for understanding reality. It goes beyond it by suggesting that religion supplies the basis for the entire scientific enterprise. Religion has nothing to tell science about how to do its job, but religion offers science the vision of a finite, rational world that can be explored and known, a world that is created and sustained by a loving Being who gives meaning to all that exists.

What can emerge from this confirmation position is a new holistic approach to the exploration of all creation. This exploration will be based on the assumption that truth is one and at its heart mysterious. No single individual or group has the intellectual tools to approach all reality at once, it needs to be a combined effort.

And if religion can grant science that the only gaps in the evolution of the universe are the gaps in human knowledge, then science may indeed grant religion that when the gaps are filled, there still remains the question: why is there something rather than nothing? A question reserved for a religious answer.

Science searches for a unifying theory or a unifying principle within reality. Science operates on an implicit act of “faith” that the world it investigates is understandable, that it has reliable laws and that once discovered they persist. Religion on its own terms confirms this scientific “faith” in the over-all rationality of the universe. It holds that a reliable, purposeful, rational Creator is the ultimate ground of all reality and thus supports and confirms the scientific quest to make coherent sense of things.

Further, in a world of death, pain, and tragedy that test our faith in the intelligibility of the universe, religion encourages us to trust that death, pain and tragedy are not the final word. Religion calls us to hope in the face of the absurdities of life. If scientific materialism leaves us stranded in the cosmic backwaters of the universe as an accident of evolution without meaning, purpose or morality, it is here that religion can take us beyond the knowledge available through science and encourages us to trust that there is meaning and promise in the universe.

#### **Comments on the Four Main Positions**

##### **Conflict**

The two “belief” systems operating in the conflict position -- scientific materialism and biblical literalism -- lack credibility because of faulty assumptions. They can each be

classified as belief systems. Biblical literalism rests on certain beliefs about the inspiration and inerrancy of Scripture and is rightly criticized on those grounds by the discoveries of science. However, the two assumptions of scientific materialism, 1) that the scientific method is the only guide to truth and 2) that matter and energy constitute all reality do not qualify as scientifically verifiable statements. Interestingly enough, neither assumption is open to verification by the scientific method. The first assumption is an epistemological (how do we know) statement and the second is a metaphysical (concerning the structure of reality) statement and neither are within the realm of science.

First, you cannot prove by the scientific method that the scientific method is the only method of acquiring true knowledge. That is an argument chasing its own tail. It is an assumption about the nature of knowledge which lies outside the realm of science. Secondly, the assumption that matter and energy constitute all reality is a metaphysical question, again beyond the realm of science. It may be true that all that science can discover using its scientific method is matter and energy, but that does not rule out other types of knowledge which can discover and explore other kinds of reality. What results from these two scientifically indefensible assumptions is something called **scientism**, not science. Science in its own field, using its own method is certainly valid and valuable, but to extend its assumptions to all fields of knowledge is unwarranted.

It is also true that scientism is often coupled with atheism. It attempts to “prove” that science has eliminated the concept and the need for God to explain reality. This is possible only by granting the assumptions of scientism.

Biblical literalists, for their part, fail to understand that the concepts of inspiration and the inerrancy of Scripture do not demand a literal (in their sense) interpretation of Scripture. This position is called **biblical literalism**. There is no reason to believe that the Scriptures were designed to teach science or cosmology. The Scriptures may well have assumed the science and cosmology of their historical era, but they did not intend to teach either science or cosmology. Therefore it is important to note that in the conflict position we do not have science opposed to religion, but *atheistic Scientism opposed to Biblical Literalism*.

It has been the constant tradition in the Catholic Church from the time of St. Augustine that *truth is one* and scientific truth and biblical truth cannot contradict each other. This is so because the same God who reveals mysteries and infuses faith is the same God who bestowed the light of reason on the human mind and “God cannot deny himself, nor can truth ever contradict truth” (Dogmatic Constitution on the Church)

## **Contrast**

Historically the contrast position has been a giant step forward in viewing the relationship between religion and science. However, while it is most valuable in taking science and religion out of a permanent state of conflict, nevertheless it separates them too neatly into compartments. Science and religion should interact with each other. We simply cannot divide reality into two unrelated realms. To think that religion and science can operate

side by side without needing each other is unrealistic. If created things provide a “doorway” for human reason to approach the divine, as St. Paul claims and as natural theology posits, then we must know as much about the true nature of God’s creation as possible.

### **Contact**

This position is another significant step forward. It acknowledges that science and religion need to work together and share information. To repeat once more the words of John Paul II “Science can purify religion from error and superstition...religion can purify science from idolatry and false absolutes”. However fruitful this approach can be, it still lacks a unified, fully integrated approach to the mysteries of the universe.

### **Confirmation**

The confirmation position invites us to approach the relationship of science and religion in a unified, fully integrated way. As such it is probably an approach for the future. We will be fortunate if the majority of people can escape from the conflict position to the contrast position. The contrast position is most comfortable, but does not yield the rich benefits that could be gleaned from the integrated approach envisioned in the confirmation position. We look forward to the future with hope.

## **Science and the Catholic Tradition: Galileo**

In the popular mind the question of how the Church relates to science immediately brings to mind the celebrated case of Galileo. The quick conclusion is that the Church is or at least has been hostile to science. We shall review the Galileo case shortly, however, we must note that, in general, the Judeo-Christian tradition not only has supported science, but it can be argued that the concept of God revealed in the Old and New Testaments laid the foundation for successful development of science in the West.

There are several fundamental reasons why this is so:

1) Creation itself is not sacred, therefore it is not a sacrilege to investigate it. For most primitive religions, for many religions of highly developed ancient civilizations and even for some of the more sophisticated Greek philosophers of the 7th-6th centuries BC “all things are filled with the gods” (Thales of Miletus 6th century BC). The gods were in nature whether it was the sea, the wind, the trees, the sun and moon or whatever. And therefore, who was willing to investigate the gods to see why the sea and wind raged, or trees grew and gave fruit or the sun and moon rolled through the heavens? Nature was more properly worshiped than investigated.

While Thales and the Greeks who followed did attempt to explain the natural world in natural rather than exclusively supernatural terms, it was only when Yahweh, the God of the OT, was seen to be the creator of nature and not part of it, that nature could be totally

free to be investigated. In the OT no images were to be made of God, e.g. the Golden Calf was an abomination. God was “above” and distinct from His creation.

2) Since God, the creator of the world, is rational, the world itself must be open to rational understanding. A rational Creator will create a rational world. Natural theology, which claims that the existence of God can be known through reason, investigates nature to discover the “footprints” of the Creator as encountered in His creation. To apply human reason in an analysis of the world is, in a way, to search for God.

3) In the Genesis creation myth, mankind is given dominion over nature. Nature is there to use for the benefit of mankind. Science is the tool of coming to understand and use nature for the good of human kind.

For these, and other reasons, many contend that the Judeo-Christian tradition laid the groundwork for Western science and was a fundamental cause of its success compared to science in the East.

## **Galileo**

In considering the Galileo Case it has been said that there are no excuses, but there are explanations. From our modern perspective we may find it easy to assess this incident as one of ecclesiastical ignorance versus scientific good sense. However, if we could travel back in time to the 17th century, we no doubt would also have judged Galileo’s proposals to be an affront not only to our religious sensibilities and our scientific sensibilities, but to our commonsense as well.

Let us try, all too briefly, to describe circumstances prevailing at the time of Galileo. From the beginning of time most inhabitants of the earth “knew” by simple observation that the sun rose and the sun set. Even today we speak of beautiful sunrises and sunsets. There was some confusion about what held up the earth, some said it rested on a large turtle, others like the ancient Hebrews talked of large pillars. In any event, it was assumed that the earth was at the center of the universe. Even the early scientists like Aristotle not only accepted commonsense experience of the movement of the sun, but the acceptance of the earth as the center of the universe also made mathematical sense of the movements of the heavenly bodies.

Later in the 2nd century AD, the geographer and astronomer Ptolemy of Alexandria, following Aristotle, developed a similar geocentric (earth centered) model of the universe. The Ptolemaic system described the Earth as the center of the universe, surrounded by ten glassy spheres. Seven of these were thought to carry the seven heavenly bodies, the eighth carries the stars, a ninth was invisible, but turned all the others, and a tenth was the abode of God. With a few variations the Ptolemaic system could account for all known astronomical phenomena observable up to and including the era of Copernicus.

However, it was a Polish priest, Copernicus (1473-1543), who set into motion the dissolution of the Aristotelian-Ptolemeic worldview which had held sway for over 2,000 years. While studying in Italy, he became acquainted with the heliocentric (sun-centered) proposals of the Pythagoreans which prompted him to reevaluate the Ptolemaic geocentric system. In his work entitled, "*On the Revolution of the Heavenly Spheres* ", Copernicus proposed a heliocentric model. He claimed:

- 1) The sun rather than the earth was the center of the universe
- 2) The earth rotated once every day and circled the sun once every year
- 3) The stars were further away from the earth than was the sun

Several things operating in these claims were new to the science of astronomy:

- 1) The views were based on observation rather than on an interpretation of ancient philosophical or scriptural texts
- 2) The authority of Aristotle (384-22 BC) had been challenged
- 3) The earth was displaced as the center of the universe

Technically, of course, he was wrong. The sun is the center of the solar system, not the universe. But what was significant for his era was that what he proposed defied the commonsense experience of humanity from time immemorial, challenged the venerable geocentric model of Aristotle and Ptolemy and set the stage for conflict with biblical literalists.

Why did Copernicus make his claims? Answer: because it made the mathematics simpler. For his contemporaries that was not reason enough. Why challenge commonsense? Why challenge the ancient Aristotelian-Ptolemeic system that still "worked"? Why challenge a literal approach to Scripture and risk confusing the simple faith of the Christian people?

Immediate clashes with the scientific and theological world were avoided when a friend, a Lutheran theologian Andreas Osiander, alarmed that the proposed system might appear to contradict Scripture, wrote an unsigned preface to the book, without Copernicus's knowledge, which stated that heliocentrism was only a theory, a theory which would merely account for the movements of the planets more simply than geocentrism did. He also disclaimed that any motion was being ascribed to the earth. No reference was made to the implications of this theory for a literal reading of Scripture. Thus, promoted as a theory and with no direct reference to Scripture, Copernicus met with no immediate opposition from the Church. In fact, he got permission to dedicate *On the Revolution of the Heavenly Spheres* to Pope Paul III.

It was not until about a half century later and ten years before Galileo that the work of Copernicus was given serious scientific consideration. It was Johanne Kepler who, influenced by Copernicus and aided by the work of Danish astronomer Tycho Brache, again published a heliocentric work largely because it fit in with his mathematical

conception of the universe. Kepler met with opposition from his fellow Protestants and thus he sought protection from the Jesuits, who had a great respect for science.

Then came Galileo, born 21 years after the death of Copernicus. He began with the study of medicine at the University of Pisa in 1581. He later gave up medicine for mathematics. He was appointed professor of mathematics at Padua in 1592. Acting on hearsay about the invention of a telescope in Holland, he developed his own and improved its magnifying power to twenty times. With his newly invented telescope, Galileo studied the heavens and announced in 1610, in a small book entitled *The Starry Messenger*, that the moon was not perfectly smooth, the Milky Way was composed of countless stars and that Jupiter had four moons. He also discovered that Venus exhibited phases and so it must be rotating around the sun, not the earth. Therefore, following in the mathematical tradition of Pythagoras, Copernicus and Kepler, Galileo worked out his own, more refined heliocentric system. In 1613 he published his "*Letter on Sunspots*" in which he publicly announced his acceptance of the Copernican theory, even though he could not actually prove it in its entirety.

In 1614, Galileo, unfortunately, moved the discussion into the theological arena where he felt compelled to answer the charge that this "new science" was contrary to certain passages in Scripture. His friend Cardinal Barberine (later Pope Urban VIII) asked him if he could resolve the apparent contradictions between Scripture and the Copernican system. The conflict with the Church now centered around the inerrancy of Scripture as literally interpreted, not the scientific validity of Galileo's theories as such (which still lacked complete proof).

Meanwhile a Carmelite friar, Paulo Antonio Foscarini, had written a small book in which he maintained that the Bible could be interpreted in ways that allowed the Copernican system to be taught.

On February 19, 1616, two of Galileo's propositions were submitted to the Holy Office by the Inquisition to discern their orthodoxy. These were:

- 1) The sun is the center of the world and hence immovable of local motion
- 2) The earth is not the center of the world, nor immovable, but moves according to the whole of itself.

On February 24, 1616, the qualifiers (experts) of the Holy Office found the first proposition to be philosophically unsound and formally heretical because it contradicted Scripture. The second was found to also be philosophically unsound and at least erroneous in faith. It was here that the mistakes were made. Other theologians of the time would have been more open to a non-literal interpretation if the heliocentric model was correct.

The next day Pope Paul V was notified of the judgment and he directed Cardinal Bellarmine to warn Galileo to abandon his opinions or at least not teach or defend them. If he refused he was to be imprisoned. However, Bellarmine wrote to Foscarini and

admitted that if his and Galileo's theories were proven, there would be no objection to their holding Copernicus's heliocentrism. In that event, the relevant passages of Scripture would have to be interpreted in a non-literal way. Non-literal interpretations of Scripture were common, especially in the works of the early Fathers of the Church (first four centuries). However, if Galileo could not prove his theories, the literal interpretation of Scripture was to be preferred, for obvious reasons. The Copernican system could be taught as a mathematical hypothesis, but it could not be taught that the earth actually moves.

In any event, on March 3, in the presence of Bellarmine and two Dominicans from the Holy Office, Galileo submitted. Important in the years to come was the fact that the two Dominicans had in their possession an injunction from the Holy Office prepared to be served on Galileo if he did not submit. Since he did submit, it was taken back to the Holy Office, *unsigned*, and simply inserted in the files. Later this document became very important because it explicitly ordered Galileo to abandon the Copernican system and not "to hold, teach, or defend it in any way whatever." Two days later Copernicus' book *On the Revolution of the Heavenly Spheres* and Foscarini's book were put in the Index of Prohibited Books "until corrected". No mention was made of Galileo. The matter rested for 16 years.

In 1623, Galileo's long time friend Cardinal Maffeo Barberini had become Pope Urban VIII. Galileo met with him to discuss a new theory in which he proposed that the tides were caused by the rotation of the earth under them, rather than by the attraction of the moon. He also requested permission to continue his evaluation of the Copernican system. The pope warned him about his "tidal theory", but apparently gave him permission to do a comparative study on the Ptolemaic and Copernican systems.

In 1630, Galileo completed a draft of his comparative work, which he entitled the *Dialogue Concerning Two Chief World Systems*. He submitted it for approval to the censor, a Dominican named Niccolo Ricciardi. Ricciardi had some reservations about the document because it mentioned the "tides theory" and because it clearly favored the Copernican system. However, after suggesting changes which Galileo accepted, he approved the *Dialogue* for publication in 1632.

A large part of the blame for the scenario that followed should be laid at the feet of Galileo himself. For in the *Dialogue*, not only did he portray the defenders of the venerable Aristotelian/Ptolemaic tradition as fools, he even named one of the characters in the *Dialogue*, *Simplicio* (Simpleton) and made him the mouthpiece for Pope Urban's personal views on cosmology which, of course, did not coincide with Galileo's. For no apparent reason, he insulted the very person he needed as a friend.

On June 16, 1633, Pope Urban ordered Galileo interrogated in the full assembly of the Congregation of the Holy Office. All the officials who had taken part in the investigations of 1615-16 had died. Using Galileo's file from the Holy Office, the prosecutor came across the injunction (unsigned) which he assumed had been served on Galileo in 1616. On that basis Galileo was judged to have violated the injunction of

1616. On June 22, 1633, the sentence of the inquisitional court was passed declaring that Galileo renounce his errors before the Inquisition.

Affirming that he had indeed taught the Copernican system the question remained did he *believe* it. Upon direct questioning Galileo replied in the negative. He was made to formally swear that he did not subscribe to the Copernican system and ordered not to treat in any way “of the mobility of the earth and the stability of the sun”. His *Dialogue* was prohibited from sale and reading. As punishment, Galileo was subject to permanent house arrest, although he was able to live in comfort and continue his studies. In fact, he published one of his greatest works, *Discourses Concerning Two New Sciences* in 1638 while under house arrest. His *Dialogue*, however, remained banned until 1822.

Technically, Galileo was able to recant his Copernican position under oath because he was not actually able to demonstrate the earth’s motion as being absolutely certain. Most scientists now agree that the earth’s motion was not made clearly manifest until Bessel’s measurements of stellar parallax in 1838 and Foucault’s experiments with the pendulum in 1851.

While Galileo could have avoided confrontation with the Holy Office by declaring the claims in the *Dialogue* as only a theory to make the mathematics of the universe simpler and later by not entering the theological arena, certainly the Holy Office could have acted differently. As Pope John Paul II said:

“Galileo had much to suffer...from the men and agencies of the Church...From the Galileo affair we can learn a lesson...the error of the theologians of the time, when they maintained the centrality of the earth, was to think that our understanding of the physical world’s structure was, in some way, imposed by the literal sense of Sacred Scripture...In fact, the Bible does not concern itself with the details of the physical world, the understanding of which is the competence of human experience and reasoning.” (1979 & 1992 Address to the Pontifical Academy of Science)

Looking back on the entire affair, there are certainly no excuses, but there are explanations. First, the Church was in the furor of the Reformation and following the reform Council of Trent in 1545, the interpretation of Scripture had taken a more literalist trend in reaction to the Protestants. Secondly, there was pastoral concern that this new science not cause scandal or confusion to the ordinary Christian in terms of the common interpretation of Scripture. It certainly needed some careful explaining. Thirdly, nearly the entire scientific community and the Protestant Churches viewed Galileo’s work as highly questionable if not scientifically and theologically untenable.

Earlier in this lecture (see pp. 2-5) we considered the human side of scientific and theological research. We observed the truism that in human affairs there is a natural and unavoidable resistance to change. New ideas, especially revolutionary new ideas, which challenge long held scientific and theological assumptions will always meet with resistance. Looking back hundreds of years this resistance may seem reprehensible, but

at the time it is inescapable. The form that this resistance takes can be rightly condemned as unexcusable - the case of Galileo - but the resistance itself is explainable.

To sum it up: The Church, more specifically, the Holy Office made a mistake. The issue was not science as such, but the scientific challenge to the religious issue of biblical inerrancy. Given the historical circumstances of the time and the ancient scientific and theological assumptions accepted by all for centuries, it is not surprising that the Galileo incident took place. Unexcusable perhaps, but explainable.

Historians tell us that the Galileo incident actually did very little to hinder the advance of science, especially in the Catholic countries of Italy and France. In fact, the 1633 condemnation of Galileo by the Holy Office was not even published in France. Furthermore, the French Jesuits, in a public statement at La Fleche in 1642, declared that there was no scientific demonstration available that would prove the Copernican view (adopted by Galileo) to be in error. And Fr. Fabri, a respected mathematician, stated that “if conclusive evidence were to be found in favor of Copernicus’s system, the Church would make no difficulty about recognizing that the (conflicting) passages (of the Scriptures) were to be taken in a metaphorical sense” (*The Evolution of Science*, Guy Metraus and Francois Crouzet eds., p. 303). Here Fabri echoes Bellarmine in the openness of certain Church theologians and scientists to a non-literal interpretation of Scripture if actually warranted by scientific data.

Historically, the Church has certainly erred from time to time in confusing science with theology, but history shows that the Church has proven to be more of a supporter of science than a critic. In fact, it is notable that some of the most significant scientific contributions have been made by Catholic priests -- Fr. Copernicus on heliocentrism, Fr. Mendel in genetics and Fr. Lamaitre introducing the “Big Bang” theory. And, of course, laymen like Descartes, Galileo and Darwin came from within a Christian religious heritage. Neither Christianity itself, nor the Catholic Church in particular could by any stretch of the imagination be labeled as an enemy of science.

In closing, here are two quotations from modern popes on the value of science:

Pope John XXIII, *Pacem in Terris*, 1963 -- “Our age rejoices, and justly so, in the remarkable progress that has been made in scientific and philosophical knowledge.”

Pope John Paul II, *Address to the Pontifical Academy of Science*, 1981 -- “I have already (1979) had the opportunity to tell you how highly the Church esteems pure science: It is ‘a good worthy of being loved, for it is knowledge and therefore perfection of man in his intelligence...It must be honored for its own sake, as an integral part of culture’”.

Note too the existence of the Pontifical Academy of Science composed of scientists from all over the world, who consider and report to the Holy Father on scientific issues.

## **A Final Note**

In 434 BC the Greek philosopher Anaxagoras posited that the sun was “just” a ball of fire floating in the air. Anaxagoras also learned that on the day of the summer solstice the noonday sun in the Egyptian city of Syene (near the current Aswan Dam) cast no shadow in a well. However, at the same time in Alexandria some 500 miles away the sun cast a shadow of 7 degrees. Assuming the earth was flat, he interpreted his trigonometric calculations as indicating that the sun was 4,000 miles above the earth. For his efforts he was banned for life from the city of Athens, not so much for his audacious calculations or miscalculations, but because he claimed the sun was “just matter” and not a god pulled across the sky by Apollo in a golden chariot - which everyone “knew to be true”.

However, nearly 200 years later, another Greek, the mathematician Eratosthenes looked at the same data and concluded that the 7 degree difference indicated that the ground sloped differently relative to the sun at the two locations. Assuming that the earth was round, in the tradition of Pythagoras, he calculated the radius of the earth to be slightly less than 4,000 miles. Relative to modern calculations, he did not miss it by far.

The lesson here: Both science and religion can make mistakes. However, the questions they ask are so important to the human enterprise that patience, understanding, and cooperation are the only helpful ways to operate. Confirmation rather than Conflict is the key to a successful future.