INSTITUTE FOR THEOLOGICAL ENCOUNTER WITH SCIENCE AND TECHNOLOGY

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It's ordinary time in the liturgical calendar and time to come down from the heights of Easter and Pentecost and resume the life we normally lead. In the academic world, graduation and its attendant pomp are behind us. Now we are expected to assume the normal life we have — with time out for vacation of course. Until Advent we are stuck with ordinary time and ordinary work.

Yet it is "ordinary work" to which most of us are dedicated — the slow and uneven pursuit of God in our lives. These are our days and they are important. Very few of us will ever be famous, even if famous just for being well known. Most of our lives are not spent amusing or even educating people by way of television or movies. In short, most of us will never be famous, never have our faces looking back at us from the cover of national magazines. Yet our work is as important as any work going on in science or in theology.

We are trying as best we can to make sense out of the beautiful creation God has so lavishly (impossibly prodigally) scattered about us. Just think of one shoot of wheat — how much seed for the next generation it carries. Some environmentalists look into the future and see nothing but shortage: "We can't keep on having children. The internal combustion engine is the enemy of mankind. Oil is running out. The sky is falling." Others, however, see that these problems can be handled with goodwill and abstemiousness. Energy use in the United States can be cut back. We do waste a lot of energy each day merely advertising our presence in the world. That is indeed not necessary — God knows we're here.

Let us not forget the generosity of God that completely surrounds us and the surprises always lurking just around the bend. Without these life would lead to monotony and finally despair. We can contribute to the surprises found all around us. That indeed could be a vocation in itself — working to bring more surprise into the world. Are we capable intellectually of doing it. Yes, by giving ourselves as fully as we can to God, the author of all surprise. "There is only Christ; he is everything, he is in everything." That is the greatest surprise of all! God's blessings. Let's pray for each other.

Robert Brungs, S.J.

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ANNOUNCEMENTS

1. This is our new e-mail designation: *postigm@slu.edu* and *brungsr@slu.edu*. We have dropped the "wpogate." Until July 1 the system will forward our old mail address to the new one, but after that date you will not be able to get through with the old address. You may visit ITEST at http://ITEST.slu.edu. It has been somewhat updated with more material and information to come over the summer. We are planning to add articles from ITEST Bulletins (1986-1999) in their entirety. At a later date we will include articles from earlier bulletins (1969-1985) if they are still in print. Currently we have abstracts of selected articles from 1986-1990 on the Web.

2. Just a reminder if you are planning to join in celebrating ITEST's *30-Something Anniversary* in Chicago this summer: registration after June 1st is $150.00. Please do not forget the deposit of $25.00. This will be credited to you at the Celebration as a part of your registration. Attendance is not restricted to ITEST members and their families; all who are interested in participating in an enjoyable and beneficial week are most welcome. Contact us at the ITEST offices if you need extra brochures or invitations. We have additional copies on hand. Mark your calendar for August 1-5, 1999 for the meeting on *The Genome: Plant, Animal, Human*.

The conference planning sub-committee visited the Loyola Campus in April to make on-site arrangements for the meeting. The location, on Lake Michigan, is beautiful and the accommodations (meals and rooms) to our satisfaction.

3. Congratulations to long-time member and former ITEST board member, Dr. William S. Sly, MD, Research Physician and Scientist at the St. Louis University Medical School. In April Dr. Sly received the Peter H. Raven Lifetime Award from the Academy of Science in St. Louis for Service in Science and Medicine for fundamental contributions in genetics with broad applications to genetic diagnosis and gene therapy.

4. Just a reminder - Let us know if you have received an award or recently published; we will announce it in an upcoming bulletin. Also, the editorial staff, with proper reviewing, accepts papers for publication in the bulletin as well. Deadline for submission of articles for the Fall Bulletin is September 1, 1999.

5. The Interdisciplinary PhD Program in Health Care Ethics at Saint Louis University, St. Louis, Missouri will host a conference on Genetics and Ethics October 29-30, 1999. Among the presenters are: Karen H. Rothenberg, J.D., "Policy Challenges: Ethics, Legal, and Social Implications of Genetics"; Eric Green, M.D., PhD., "The Human Genome Project and its Impact on the Study of Human Disease"; Professor Ruth Chadwick, Ph.D., "Pharmacogenomics, Genetic Screening, and Health Care"; Professor Mary Briody Mahowald, Ph.D., "Genetics and Gender Justice"; plus 16 scholarly presentations. For information contact: Professor Gerard Magill, Ph.D., Center Director, 1402 S. Grand Blvd. St. Louis, MO., 63104 TEL (314)-577-8195; FAX (314)-268-5150 or e-mail: magill@slu.edu.

6. An Invitation and Call for Papers arrived from ESSSAT, European Society for the Study of Science and Theology for the Eighth European Conference on Science and Theology in Lyon, France April 14-19, 2000. The topic: *Design and Disorder: Perspectives from Science and Theology*. Anyone interested in preparing a paper for submission, may request guidelines from

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7, Place Saint Irénée,
F-69005 LYON, France

7. We are planning for the March and October, 2000 workshops respectively.

In March, 2000 we will sponsor a Saturday workshop in St. Louis (date and location to be announced) on one aspect of computer technology: virtual reality and its theological, social, philosophical implications for the Christian believer. This topic surfaced during discussions at the October, 1998 workshop on "The Family of the Future" and, as a result, the Board decided to give the topic a fuller "hearing." Although we are currently exploring possibilities for speakers, we would entertain any suggestions you may have in this area. Just call us at the ITEST offices as soon as possible.

8. In October, 2000, as a follow-up to our August, 1999 conference on "The Genome: Plant, Animal and Human," we will look at the theological issues emerging from biological advance. This workshop will follow the usual ITEST weekend format: Friday Evening to Sunday Noon at a location in the St. Louis area. St. Louis University has sold Fordyce Conference and Education Center, our meeting place for the past 30 years, along with the accompanying acreage, to a developer. We are actively seeking a similar facility in the area for our future workshops. Any suggestions?

9. We are omitting third renewal notices this year. If you haven't renewed yet and wish to be considered a member through 1999, please send your yearly dues ($45.00) to the ITEST offices. Only dues-paid members receive the proceedings and other benefits such as, special rates at conferences and discounts on ITEST publications.

SCIENCE AND THE CHURCH: A PLEA FOR DIALOGUE

[This essay by Archbishop Joseph M. Zycinski of Lublin, Poland is reprinted with permission from SCIENCE SECRETARIAT DAY at the PAX ROMANA CONFERENCE on at St. Albans, England on September 24, 1998. I wish to thank Archbishop Zycinski and the Secretariat for Scientific Questions for this paper.]

In his newest encyclical *Fides et ratio* John Paul II invites scientists to join philosophers and theologians in their search for perennial truth which transcends epistemological specificity of the one field of research and provides answers to the basic questions of human existence.[1] In this process of enriching cooperation, on the one hand, science can help theologians to free their discourse from common sense schemes and facile anthropomorphisms. On the other hand, theology and classically understood philosophy could help scientists to free their research programmes from the illusion of false absolutes and to open their vistas to moral and aesthetic values, so important for human beings. I would like to express my profound satisfaction that this papal plea finds an immediate answer in this collection of papers presenting the place of the scientist in the life of the Church. I am deeply grateful to all contributors who answered Prof. Hodgson's invitation and shared their experience, so important for the mutual dialogue between the Academy and the Church. The necessity for this dialogue is even more evident in the context of deep intellectual changes in the contemporary culture. At the beginning of our century physics was regarded as an ideal of scholarly discipline and its discoveries were supposed to answer all questions interesting for [the] human species. In the early 1930's, when Otto Neurath, a representative of the Vienna Circle, wanted to transform psychoanalysis into [a] scientific discipline he looked for its analogies with theoretical physics and tried to introduce mathematical formalism into psychoanalytic stories.[2] Sixty year later we could notice the opposite trend: in the critique of science inspired by postmodernism even physics is regarded as a collection of stories, fables and ballads.[3] In this new intellectual climate there is a special need for intellectual solidarity which could resist the simplifications proposed in the similar anti-intellectual framework. Between illusions of the bygone scientism and the challenges of the unfounded critique of science there is a place for the enriching dialogue between representatives of the scientific community and the Church proclaiming the truth of the integral human existence.

The genesis of the intellectual isolation

The long-lasting isolation between scientific, religious and humanistic cultures was by no means created by scientists. The founders of modern science were, in general, sensitive both to the metaphysical presuppositions of the adopted methods of research and to the social-cultural effects of their discoveries. Those who professed intellectual traditionalism could have been found much more easily among these representatives of art and philosophy who endeavoured to enlighten immature science by determining its moral and aesthetic goals. Sharing such an approach, many followers of Goethe criticized Newtonian optics by repeating arguments that the artificial conditions of laboratory observations destroy the natural beauty of light and strip physical phenomena of their natural charm. Similar objections presupposed that the new physics should contain the same moral and existential ingredients which belonged to medieval science. To justify this supposition it was not enough to quote authorities of the past and defend obsolete philosophical cosmology.

The present painful isolation is regarded by certain members of religious communities as a form of splendid and inevitable isolation. The perennial truth of religious doctrine is opposed by them to the ephemeral fluctuations of illusive scientific conjecture. Such an approach expresses nothing but a philosophy of easy resignation. One ignores in it the religious principles that define our attitude toward God who can be recognized in rational analysis of natural phenomena. This attitude, constituting the very essence of religious insight taught in both the Old and the New Testament, characterises the practice of the early Church as well as the contemplative insight of St. Francis of Assisi.

Sixty year later we could notice the opposite trend: in the critique of science inspired by postmodernism even physics is regarded as a collection of stories, fables and ballads.

A consistent and well-considered theological justification of Christian concern for natural science may be found in treatises worked out by the influential School of Chartres in the 12th century. It was William of Conches who categorically denied attempts to oppose theology and the study of nature. In his arguments, God the Creator of the human intellect and of the order of nature is to be glorified through our understanding of the natural order. Theological recognition of the importance of physical regularities was based on the Vulgate translation of the Epistle to the Romans (13: 1): *quae a Deo sunt, ordinata sunt* — whatever is from God, is ordered. For many reasons the Platonic picture of the cosmic order described in the *Timaeus* appealed to the imagination of theologians who belonged to the School of Chartres and inspired their works on the harmony of natural and supernatural values.

The beauty of this harmony was impressively depicted by Alain of Lille. In his description of nature, which is subordinate to the divine Mind that brings order out of chaos, we find the anticipation of both Blake's poetry of nature and St. Francis' cosmic mysticism.

In the religious hymns of the School, fascinating descriptions of nature unite both physical and theological perspectives. This integration does not yield uncritical physical theology, but instead provides a beautiful description of cosmic harmony that embraces aesthetic, moral and existential values. Germs and light, human love and physical laws are united together in Alain's philosophy of nature. His philosophical and physical descriptions disclose the theological dimension of nature presenting the physical world as the domain of the presence of the immanent God.

There are no reasons to mourn over the Aristotelian model of the cosmos as an organism. Its theological significance seems ambiguous, at least of those versions which located the throne of Lucifer in the center of earth.

The image of nature proposed by the Chartres School met violent opposition from some medieval scholars. William of Saint-Thierry, for instance, attacked the very idea of uniting biblical doctrine with the pagan philosophy of the *Timaeus*. In spite of the categorical protests of William's followers, the School provided intellectual patterns in which harmonious synthesis replaced the isolation of various cultural traditions. With these patterns of new harmony, the world of natural phenomena was no longer an agent of alienation. It appeared, on the contrary, according to Bernard Palisey's later comment, as the beautiful book of heaven and earth offered to every man."

The genesis of modern separation

In the process of evolution of modern science, deep metamorphoses occurred in the relationship between scientific and philosophical-theological component of scientific theories. When Copernicus worked on *De revolutionibus*, he was convinced that scientific truth finds its complement in religious teaching. Science and religion seemed for him two domains consistent in defining truth, basic human existence; he argued that it is [the] philosopher's duty "to seek the truth in all things, to the extent permitted to human reason by God." In his Preface to the *On the Revolutions*, this Polish astronomer expressed his belief in the basic unity of scholarly and religious cultures when he addressed the Pope and informed him: "in this very remote corner of the earth where I live, you are considered the highest authority by virtue of the loftiness of your office and your love for all literature and astronomy...".[4]

The dramatic events that followed the condemnation of Copernican theory in the process of Galileo resulted in both a new hierarchy of authorities and new approach to the relationship between scientific and religious values. The deplorable sentence of 1633 should not be thought of as a result of internal conflict between theology and science, but merely as a socially conditioned event that disclosed the supremacy of canon law over theological reflection in the post-Tridentine Church.[5]

The affair of Galileo can hardly be approached as a conflict between theology and modern science, because the new science presupposed important theological tenets. Both in his *Dialogue* and in *The Assayer* Galileo contended that the mathematical description of physical processes is possible because of the existence of the Divine Geometrician who determined the nature of physical phenomena. This vision of mathematics grounded in God is defended by Salviati, the port-parole of Galilean views, when in the *Dialogue* he follows Plato in arguing that the human intellect "is to participate in divinity" on account of its grasp of mathematical knowledge.[6]

The book of Scripture and the book of natural revelation are complementary. The experimental study of nature is necessary for our intellectual development because, as it was argued by Cardinal Baronius, the intention of the Holy Spirit is to teach us how one goes to heaven, not how the heavens go. Galileo repeats the Cardinal's statement in his letter to the Grand Duchess Christina of Lorraine. He goes back even further to the teaching of the early Church to quote Tertullian who argued: "that God is known first through Nature, and then again more particularly by doctrine; by Nature in his works and by doctrine in his revealed word."

After accepting such principles Galileo points out internal inconsistencies in the standpoint of these authors, who attempt to justify theologically their lack of confidence in modern science. Such a standpoint cannot be consistent, since on the one hand its adherents believe that God has endowed us with senses and intellect, while on the other hand they hold that the use of our cognitive powers should be suppressed. Rejecting similar inconsistency, Galileo defends the thesis of the essential unity between scientific and religious truth. This unity stems from the fact that "the Holy Bible and the phenomena of nature proceed alike from the divine Word," i.e., the Logos that is present both in the Gospel and in the mathematical conjectures of the Pythagoreans. There are no reasons to mourn over the Aristotelian model of the cosmos as an organism. Its theological significance seems ambiguous, at least of those versions which located the throne of Lucifer in the center of earth. Such an approach resulted in the model of a devil-centered universe, and its apology can hardly be based on theological premises. Only

a lack of creative imagination could have facilitated its categorical defense that nourished distrust toward new routes of human intellectual pursuit.

The opposition against the new direction of scientific thought stemmed not only from religious traditionalism but also from cultural humanism, the doctrine very influential in the time of the Renaissance. John Donne was not alone in his complaints when he lamented that the "new philosophy calls all in doubt" and eliminates even the element of fire from the cosmological picture of the world. Paintings that presented Copernicus in hell, chained to the throne of Lucifer, provide adequate testimony to the cultural protests against the scientific revolution which called into question the central position of Man in the universe. *A Cypress Grove*, published in 1623 by William Drummond, furnishes gloomy descriptions of the sickness unto death induced by rejection of the Aristotelian order and acceptance of the new science. "The new philosophy" destroyed the cozy universe in which everything was described in anthropomorphic terms akin to our natural intuitions. The image of volcanos erupting with anger and the picture of an alive earth giving birth to metals were replaced by an abstract mathematical description of the world, the world hard, cold, colorless, silent and dead.

It is interesting that this shocking new picture of nature received an approval in so short a period of time. At the beginning of the 18th century, in Alexander Pope's poems one can find a new vision of human culture based upon Newtonian physics. At the end of the same century, in 1794, two poets, Johann Goethe and Friedrich Schiller, met each other during a session of the Jena Scientific Society. The new alliance between modern science and humanist culture was particularly attractive for those humanists who did not try to understand the new physics, but were deeply satisfied with quoting Pope's compliments to Newton, which said that after Newton everything became clear end evident.

As a matter of fact there were many problems unclear in Newton and after Newton. Physicists as well as philosophers discussed them in detail. Even Goethe, like the last Mohican among the poets, tried to humanize the theory of optics by rejecting the views Newton had expounded in the *Opticks*. In this new cultural and intellectual climate, it was much easier to express one's admiration for modern science than to try to understand it. When Richard Bentley worked on his sermons in which Newton's *Principia* was to be discussed theologically, he consulted the mathematician John Craig, asking him what books should be read to understand the work. In response he received a bibliography consisting of 40 publications which were to elucidate the mathematical jargon used by Newton in his exposition of the tenets of the new physics. Bentley, a philologist, despaired after receiving the bibliography, in the short time that be had at his disposal it was impossible to read the books that Craig had recommended.

Regardless of the fact that the objective value of Bentley's philosophy seems at least dubious, his attempts to create a new synthesis of scientific, philosophical and theological truth inspired a new style of intellectual openness to novel scientific theories and brought creative revisions to the traditional image of the world. This style was particularly fostered by Robert Boyle, the English chemist, physicist and theologian. When dying in 1691 Boyle expressed in his will that each year a series of sermons should be preached to interpret new scientific discoveries from the standpoint of Christian faith. Some historians repeat the witty comment that nobody thought seriously about a conflict between religion and modern science before Boyle suggested reconciling them. The overactive search for scientific confirmation of religious beliefs led to the skeptical denial of earlier theological interpretations and to the acceptance of the philosophy of deism, then in vogue. The main problem for theology arose, however, not from overrating new scientific theories but rather from ignoring them and combining theological insights with the outdated Aristotelian cosmology.

The book of Scripture and the book of natural revelation are complementary. The experimental study of nature is necessary for our intellectual development because, as it was argued by Cardinal Baronius, the intention of the Holy Spirit is to teach us how one goes to heaven, not how the heavens go.

Scientists' research and philosophers' amazement

In the evolution of modern science, the new scientific patterns brought by the growth of relativistic cosmology and quantum mechanics contributed to overcoming the earlier illusions of epistemological empiricism. One of the features of nature that arouses particular interest of theoretical physicists is its susceptibility to mathematical description. This feature seems even more intriguing when we realize that very often certain branches of mathematics were developed with absolutely no regard to their practical application. Appolonius of Perga, for instance, presented in 200 B.C. his theoretical analysis concerning the cross-sections of a cone. This was, however, of no interest to astronomers of that time, as they were convinced that planets were revolving circles and epicycles. It was only 18 centuries later that Johannes Kepler discovered that orbits of planets are elliptic in shape and that their mathematical description can be found in Apollonius' works. Similar situation emerged in case of non-Euclidean geometries, matrix theory or group theory. At the desk, man created a new language, treating it in purely theoretical categories, and then it unexpectedly appeared that nature conducts a

dialogue with us using this particular language. If we discovered an African tribe and found that its members recited fragments of Joyce's *Ulysses*, such fact could not be considered obvious and natural. Perhaps the people who do not know English or are always critical about Joyce, would not find anything strange about that situation; a sequence of English or English-like words would be for them only an unintelligible jabber. A similar situation occur among humanists who express their astonishment that possibility of mathematical description of physical processes should be of major cognitive importance.

The mathematical character of nature by no means concerns such trivial facts adding together all consecutive sunsets or different colors of rainbow. It manifests itself in a non-chaotic character of certain physical processes. The universe might have been a sequence of uncoordinated events, and then it would have been impossible to distinguish in it the stable relations and universal laws that are easily described in simple mathematical formulae. If, for instance, in Newton's law of gravity the d[en]ominator had a coefficient 2.001 instead of 2, our physics would have appeared much more complicated. If, in addition to the mass of bodies, when measuring the gravitational potential, we would have had to consider a progressive or reactionary character of societies in which the research was being done, the complication would have been still greater. It is not difficult to imagine a world in which the laws of physics would change together with political declarations or moods of overly sensitive people. So far, however, our world has been a world of relative stability and order, in spite of difficulties with mathematical description of our evolving emotions or of the motion of leaves blown by the autumn wind.

When describing such a passion Albert Einstein wrote: "What a deep conviction of the rationality of the universe and what a yearning to understand, were it but a feeble reflection of the mind revealed in this world, Kepler and Newton must have had to enable them to spend years of solitary labor...

This element of relative stability and order, rationality and harmony, appears both amazing and mysterious. It is because of its presence, a variety of physical processes can be described with identical mathematical formulae, no matter whether the processes take place in Moscow, Peking or New York. As the recent studies of chaos point out even apparently uncoordinated "chaotic" processes can be described mathematically; contrary to earlier opinions "it turns out that an eerie type of chaos can lurk just behind a facade [of] order — and yet, deep inside the chaos lurks an even eerier type of order."[7]

The musing of scientists upon the harmony and mathematical character of nature share some elements with mystical experiences. Certainly, the experience of such harmony does not exclude the awareness of the existence of violent disharmony and of laws of jungle in nature. The disharmony may be, however, explained by pointing to its immediate causes. The harmony leads us to a secret reality of rational structures which escape the attention of laymen but evoke passionate interest of specialists. When describing such a passion Albert Einstein wrote: "What a deep conviction of the rationality of the universe and what a yearning to understand, were it but a feeble reflection of the mind revealed in this world, Kepler and Newton must have had to enable them to spend years of solitary labor... It is cosmic religious feeling that gives a man such a strength. A contemporary has said, not unjustly, that in this materialistic age of ours the serious scientific workers are the only profoundly religious people."[8]

The development of modern theoretical physics, the cosmological analyses concerning the so-called anthropic principle or the fluctuation of quantum vacuum, all show the harmony of the universe. The harmony described in the language of mathematical symmetries is much more expressive in modern handbooks of physics than in Leibniz's metaphysical comment, on the preestablished harmony. This results in opinions that all discoveries in theoretical physics are in fact discoveries of hidden symmetries which in a different language were already described by Plato or the Pythagoreans.[9] In the context of similar opinions, the question arises whether the mathematically described order of nature cannot be treated as a manifestation of God's immanence in our world. Such [an] approach has been particularly developed in the works of Teilhard de Chardin who, in his *Hymn of the Universe*, writes about the Divine as "that which in everything is above everything." This formula joins the traditional doctrine of God's immanence and transcendence. In another fragment of this hymn, the French Jesuit writes of God who is "so much remote in ... immensity and so much deeper in the intimacy of... indwelling than all things else" and who unites "together the immensity of the world and the intimate depths of my being."

When approaching nature as a field of discovering God, who is the closest although infinite, Teilhard wrote in *Le Milieu Divin* about "divinity appearing at the heart of the universe." This philosophy raised as many objections as fascinations. When the widely know reviewers suggested to consider Teilhard's *Phenomenon of Man* a book of the century, Sir Peter Medawar replied in *The Mind* that the book was nothing but a collection of nonsenses evoking in its readers a feeling of disgust.[10] Many reasons could be given to explain such a great divergence of opinions. The presentation of optimistic hypotheses as basic truths, connecting poetry with scientific theories and overdone speculations, is [are] not the least important. Such features could highly impede the apprehension of these elements

of Teilhard's philosophy which seem to be most valuable and inspiring. These elements contain both mathematical description of cosmic order and the mystical experience of cosmic beauty. The synthesis of these two factors discloses a possibility of bridging the gaps that exist between the humanities and the natural science, between technological pragmatism and religious contemplation.

In our search for the hidden unity of nature, it is easier to contemplate the beauty of an autumn pasture than to recognize the amazing beauty of Einstein's field equations. These two distant fields of experience contain the same element of enchantment by a mysterious harmony that manifests itself both in the subtle poetry of everyday situations and in the sophisticated simplicity of mathematical relations.

The recognition of the reality of the former would result in a half-truth if we completely ignore the amazing psychological force of the latter type of experience. It has been the very experience that fascinated the Hellenic admirers of logos and inspired Kepler's comments on symmetry of snowflakes; its expression may be found in the Old Testament's Book of Wisdom and in Plato's ontological investigations.

At the beginning of Western rational thought, Hellenic philosophers raised the ultimate questions of the arche, substance, basic principles of being. Philosophy, continuing the tradition of pre-Socratic wisdom, became an important element that unifies various cultures end epochs in the same search for rational explanation of the human world. Philosophical and theological searching for ultimate presuppositions of the scientific interpretation of the world create a new perspective of unity between domains that were separated because of simplifying theories of knowledge. In this new perspective, as it was stressed by John Paul II, "the Church [...] calls upon herself and the scientific community to intensify their constructive relations of interchange through unity. [...] Each of you has everything to gain from such an interaction, and the human community which we both serve has a right to demand it from us."[11]

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SCIENCE VERSUS RELIGION
A CONFLICT OF IDEAS OR A CLASH OF WILLS

Dr. Richard J. Blackwell

[This paper was originally presented at the March, 1994 ITEST Workshop on Secularism vs Secularity. It is reprinted here in the hope of reminding the then-members of its existence and presenting it to the new membership. It is an excellent piece of work that deserves a better fate than merely sitting on a shelf.]

Ever since modern science made its first appearance in the seventeenth century, its relationship with religion has been uneasy and filled with tensions, to say the least. About one hundred years ago, in the generation immediately after Darwin, some went so far as to claim that there is a permanent and unavoidable state of warfare between the two, primarily because science's confidence in the progress of rational inquiry directly conflicts with religion's self-defensive denial of the freedom of thought. Today, only a few still argue for this strongly pessimistic point of view. Nevertheless, it can hardly be denied that significant tensions between science and religion continue to persist, even though today they may seem a bit less severe.

Why is this the case? Why do we find this continuing state of uneasiness and distrust? Is it because understandable bad feelings still linger among scientists after the dreadful way that Galileo was treated at the beginning of modern science? Is it due to generational rivalries, as it were, with the older custodians of religion, who were in the ascendancy during the medieval era, still feeling angered and upset over being displaced in power by the younger scientists and technologists who now dominate contemporary culture? Or is there perhaps something about the fundamental characteristics of science and religion themselves which tends to block communication and to create misunderstandings between them? It is this latter theme which we which to explore here, although there are clearly many causes operating at many levels which have prolonged the tensions between science and religion.

Scientific Beliefs and Religious Beliefs

The issue before us requires that we undertake an analysis of the characteristics of scientific claims and religious beliefs. As a first uncontroversial step we can point out that most of the facts and laws of science have no impact whatsoever on the meaning and truth value of religious beliefs. Planck's constant is 6.625×10^{-34} erg.sec; chlorophyll is required for photosynthesis in green plants; the positron is the anti-particle of the electron: these scientific claims pose to threat at all to religious beliefs. On the other hand, most religious beliefs cannot even in principle be brought under scientific investigation; for example, the claims that God is immaterial, that there are three Persons in one God, that God forgives our sins and offers us salvation, that there is a life after death in which personal human identity is preserved. There is no way that such religious beliefs can be empirically either verified or falsified. So far we have no problems.

. . . religious literalists have maintained, and still do, that the Genesis account shows that the theory of evolution must be false since it contradicts the word of God. On the other hand, most neo-Darwinian evolutionists, along with many others, have concluded that the first book of the Bible is only an old cultural tale which is not to be taken as literally true.

Tensions arise between science and religion only because there is also a third area of overlap between the two, which, although rather small, seems to be a scene particularly prone to incendiary reactions. Does the sun revolve around the earth, as the Bible explicitly says, or is it the other way around? Does the modern theory of evolution contradict the word of God in *Genesis*, which seems to say that present animal and plant species were created by God at the beginning of time in their adult forms? Galileo and Darwin each started a firestorm with their scientific answers to these questions.

This third area of overlap, where science and religion intersect, has been the subject of innumerable studies. The usual approach has been to identify a specific point of conflict, and then to argue that either science or religion is simply wrong on this point, or to mediate the conflict by showing that it is all based on some sort of a misunderstanding of the true meaning of either the scientific or the religious claim. For example, religious literalists have maintained, and still do, that the *Genesis* account shows that the theory of evolution must be false since it contradicts the word of God. On the other hand, most neo-Darwinian evolutionists, along with many others, have concluded that the first book of the Bible is only an old cultural tale which is not to be taken as literally true. Still others have attempted to mediate the dispute with careful and at times laborious qualifications about the meaning of evolution and/or the concept of creation to show that they are both true from their own specific perspective.

This latter approach appears, of course, to be the most promising. Yet even when it succeeds, it resolves only one issue at a time, leaving many others for dispute. And even then it almost always takes a great deal of time and effort to reach rather meager results. Despite a century or more of such attempts to resolve the dispute over evolution, often at very sophisticated levels of discussion, the issue has still not been put to rest in our day. And it took over three hundred and fifty years before the Catholic Church formally acknowledged in 1992 that it was in error in the Galileo case.[1] Why are these issues so difficult to resolve?

Perhaps we can come to see why this happens if we change our focus away from points of dispute between science and religion, which carry such a great deal of emotional baggage, and look instead at points of agreement or near agreement within the area where they overlap. For when discussion of the relations between science and religion focus on their conflicts, this tends to limit the discourse to the level of their comparative world views. But if we focus on points of agreement or near agreement, then other and more basic levels of comparison come into view. So let us follow this method for the reason indicated, and see what emerges.

For example, consider the relation between the religious doctrine of creation and the presently widely accepted Big Bang account of the origin of our universe. Many theologians and philosophers of religion have interpreted the Big Bang as the moment of creation. Stephen Hawking reports[2] that even Pope John-Paul II suggested this at a scientific meeting at the Vatican in 1981. This could be taken to be a scientific verification or at least some sort of support for the religious belief in creation.

On the other side, several prominent cosmologists have interpreted the Big Bang account of the universe as implying a revival from within science of what looks very much like the older design argument for the existence of God. They speak of what has come to be known as the Anthropic Principle, which says in brief that the excessively fine tuning of the initial conditions and physical constants immediately after the Big Bang, which would be required for intelligent life to have evolved later in the history of the universe, points to a design in the cosmos. Or to put it in another way, since today as a matter of fact there are intelligent observers of the universe, namely ourselves, this universe in its initial state must have been designed to include the exceedingly rare possibility that cosmic evolution would later produce us as intelligent observers of the cosmos.

The Peircean concern as to whether either of these reactions to contemporary Big Bang theory in astrophysics will or will not be fully justified in the long run is not the question before us. Rather for our purposes what we apparently have here is a case of a reasonably good agreement, and not conflict, between science and religion. The question then is what does this tell us about the characteristics of scientific and religious beliefs?

First we can say that today both science and religion seem to agree that the physical universe which we see around us originally came into existence at some one moment in the past when time itself also began. This general statement immediately acquires, however, a fuller meaning when located within the context of either science or religion. Although these fuller meanings are different, they are not necessarily inconsistent.

For science our presently expanding universe is to be imagined to have been more and more compressed, when traced backwards through time, to a moment about fifteen billion years ago when it would be all reduced to a point. This state prior to the Big Bang is a singularity which cannot be discussed by science since at that point no known physical laws were as yet operative. Science begins its discussion only with the first and successive moments in which the enormous explosion of the Big Bang began to form the physical universe of space, time and energy.

For religion, God has eternally existed as an immaterial being before the physical universe began, and served as the cause of its coming into being from nothingness, but at a first moment of time usually taken to be much closer to the present. The notion of creation also envisions God as continuing his creative act by sustaining all material beings in existence at each moment of time. These and other differences between the full notions of the Big Bang and divine creation are not necessarily in conflict.

Second, very different degrees of permanence are associated with the two teachings on the origins of the universe. The traditional religious doctrine of a creation out of nothingness has been in place since the beginning of Christianity, and has long been classified as an article of the Christian faith, as evidenced by its prominent position at the very beginning of the various Christian credal formulas over the centuries. It is quite unlikely to be changed in the future of religion. On the other hand, the Big Bang theory originated only in the 1950's. It may have a long history ahead of it. Yet it may also well be modified, or significantly changed, or even fully replaced in the foreseeable future — perhaps by something like an alternating expanding and contracting model of the universe in which neither phase ever reaches a singularity. In short everyone now clearly recognizes the fallible character of all scientific claims, which is very much in contrast to the permanent or near permanent character claimed for many religious dogmas.

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Third, the grounds for truth claims are very different in science and religion. In the former case all claims must be reduced ultimately to empirical evidence and to the rational interpretation of that evidence. No one scientist, of course, could ever personally encounter all this evidence and examine all the interpretations. But he believes that other scientists have done so, and that their work is dependable. Also the interpretations involved often result in extremely abstract and abstruse mathematical modeling, as for example is clear in Big Bang theorizing. But the scientist again believes that these procedures do not lose touch with the original empirical base, for example, Hubble's observations of the expansion of the universe. For science to be legitimate the touchstone for what is true and real must always be empirical evidence and its interpretation.

On the other hand, for religion the grounds for truth claims is the revelation given by the word of God. In most religions this revelation is understood to be embodied in a fixed set of sacred writings composed by the original recipients of the revelation. This does not exclude directly experienced personal revelations to religious believers over the later course of time, but that is usually thought to be the rare exception, not the rule. As a result, the average believer must start with the word spoken or written by another, which can then be traced back through time to the original revelation. In this case believing something precisely because it has been said or written by another, who is taken to be authoritative, is essential to ground religious truth.

At first sight this might seem like a flimsy or an insecure ground for truth. But only a moment's reflection is required to realize that most of the knowledge that each of us possesses is of this type, and that it is basically reliable. We all live in a very narrow slice of space-time, and essentially depend on the spoken or written word of others for much of our truthful knowledge. So, such authoritative truth is quite common. The main difference claimed for truth in religion, of course, is that it is much more reliable and secure because God himself is said to be the original authority behind such truth.

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As a result the Big Bang theory (based on interpreted empirical evidence) and the creation account (based on the revealed word of God) are very different precisely as to the character of the truth claims made, no matter how much they may agree and even support each other in regard to the scenario of the physical universe which they present. As we shall see, this ineradicable difference in the respective grounds for truth claims in science and religion is centrally important to understanding the persistence of the tension between the two domains.

Rule-Choices and Self-Commitment

A more fine-grained inspection of the methods and procedures used to arrive at the two types of truth claims distinguished above reveals an often overlooked dimension of how science and religion relate to each other. In both cases what we find, in short, is a contribution made by the human will. Neither science nor religion is purely rational in character; each contains a volitional component, albeit in quite different ways. Since this claim is central to our argument, it needs to be justified in some specific detail.

The easier case to grasp is what happens in science, largely because for the past half century or so philosophers of science have subjected scientific method to a detailed, and now rather widely accepted, analysis. The main factors in this traditional account which are germane to our considerations are the following. First empirical laws are formulated in science by the process of inductive generalization, which has been recognized since the time of Plato and Aristotle as being logically invalid. If something is true of part of a class, it does not follow that it is also true of the whole class. Despite innumerable efforts throughout the history of science to solve this problem of induction, no one to date has succeeded.

Second, general laws and theories, once formulated, are then put to empirical test in the process called verification. This also is invalid, basically for the same reasons that induction is invalid. If the consequences of an hypothesis are true, it does not follow that the hypothesis itself is true. The result could have been due to some other hypothesis. Nevertheless science uses induction and verification procedures regularly in the hope that they will give correct results more often than not. Karl Popper was so concerned about this that he tried to develop a model of science, called falsificationism, in which induction and verification are never employed. But he ultimately had to conclude that the genesis of scientific hypotheses is a non-rational process, and that we can only prove that these hypotheses are false, never that they are true. Once again the rules by which science operates are not fully rational, yet the scientist chooses to proceed.

Third, after the seminal work of Thomas Kuhn in the 1960's, it is now widely granted that the normal life of science occurs within an unexamined set of background assumptions about the world and our knowledge of it. These paradigms, as Kuhn called them, are uncritically accepted by normal science, and come under direct attention only when a science is in a state of revolutionary crisis caused by internal anomalies. Even then two rival paradigms cannot be directly compared and mutually evaluated without committing category mistakes. In short they are incommensurable to some degree, and the choice of one paradigm over another injects again a non-rational factor into science. This is the main message from Kuhn's now famous and widely accepted account of how science changes.

Lastly in recent generations science has drifted more and more in the direction of constructing abstract mathematical models of some part of the world, and then subjecting these models to detailed analysis and extension through computer simulations and calculations. A clear example of this is found in chaos theory. Such procedures involve placing a great deal of faith in the claim that a coordination of the abstract model with the actual physical world is maintained throughout the procedure. But such a rule is rarely justified on its own merits.

The net result of all this is that we find built into science a series of choices to adopt certain rules of procedure, for example, induction, verification, paradigm preference and model coordinations, which themselves are not fully justified on rational grounds. These rule choices contain an element of volition; that is, a contribution made by the human will, as mentioned above.

On the other hand religion also contains such a voluntary component, although it functions quite differently. This is

not a new idea. It has had a long history in traditional theology as found in the explication of the personal act of religious faith. In short, an act of faith has traditionally been understood primarily as an act of reason or of knowledge; hence in an act of faith one has knowledge that something is true. But the distinctive characteristic of an act of faith is that the motive for assenting to something as true is not direct factual evidence or logical proof; rather, it is the knower's willingness to accept the authority of a witness. In the old classical terminology faith is an act of the intellect whose assent is determined by an act of the will.

This may sound somewhat mysterious, but is really quite straightforward. Most of our natural, common sense, *non-religious* beliefs are like this. For example, if I tell you that I have two sons, you now know something that you may not have known before from direct acquaintance with my family. You have acquired a new piece of knowledge. Why do you assent to that as true? Simply because you believe me, you trust me, you are willing to accept my word on this as reliable. Of course, I may intend to mislead you, or in my old age I may have forgotten how many sons I have, or you may have misunderstood my remarks. There is no guarantee of infallible truth here; but the fact is that a very large part of the true natural knowledge in each of us is acquired in this way. The important point for our concerns is that such routine natural belief is based in part on an act of the will, that is, on a choice to accept the word of a witness as reliable.

The same is true of a religious belief, for example, that there is a life after death. If one believes this, one claims to know something, and not just to hope something, about the future. But the motive for assent is certainly not direct, factual experience. It is rather the acceptance of the authority or the word of others in the religious tradition, which in turn traces back ultimately to the original revelation reported in the Scriptures. In the classical view, God, of course, is the original authority behind religious belief. How that affects the truth value of religious claims is a very complex question, but fortunately is not our concern here. Our point rather is that religious belief involves an act of choice at its very core, that is, as the motive for truth. For science, on the other hand, the motive for truth is empirical fact and logical proof, which nevertheless also involve rule choices, as we have seen.

It is not just truth, but moral goodness, which is the goal. It is not abstract knowledge, but concrete action in the real world, which is the focus of religion. Religion does not just appeal to reason; it also makes demands upon the will.

In summary, if this analysis is correct, both science and religion involve not only rational understanding but also complex volitional commitments, albeit in different ways. As we shall soon see, these voluntary aspects of science and religion become especially prominent when the two come into conflict.

The human will is involved in religion in another and quite different way which is also germane to our main theme. As we have seen, religious faith consists of a set of knowledge claims which are taken on authority by the believer to be true about God, the world, and the human person. However, the acquisition and contemplation of this fund of knowledge is not what religion is all about, nor is this even the primary purpose of religion. The main point rather is for the religious believer to make a personal commitment to live his or her life according to the norms and guidelines of the religious message, and to carry out that commitment. It is not just truth, but moral goodness, which is the goal. It is not abstract knowledge, but concrete action in the real world, which is the focus of religion. Religion does not just appeal to reason; it also makes demands upon the will.

Now in order to make the move from contemplated understanding to committed action in the world, the religious believer must make a volitional choice to act out the religious life style described in the faith. In short, the religious person commits himself or herself to a life guided by faith. Such a self-commitment is a very heavy investment on the part of the believer. As a result, much more than merely an abstract debate is at issue if, at some later time, that self-commitment is threatened because it seems that it was based on one or more false beliefs.

In science this type of self-commitment does not seem to operate, or at least it seems not to be present in the same sense as in religion. There are, of course, many very highly committed scientists. But this usually, if not always, refers to their firm allegiance to the value of doing science, and to the value of the truths it establishes, perhaps even for some to the point of a sort of fanaticism akin to religious fanaticism. But such a self commitment to science is not, at least in any usual sense, a commitment to a specific day-to-day life style or value system *dictated by the content of the discipline itself*, as is the case in religion. But we need not tarry on this point. If the reader is persuaded that the same type of personal self-commitment found in religion is also often found in science, then that would make our analysis to follow even more decisive.

The Consequences for Science and Religion

If the preceding analysis of the characteristics of scientific and religious beliefs is basically correct, then quite a number of important results follow concerning the relationship between science and religion.

First, that relationship is not static. It has always changed and evolved over time as each discipline changes. Further science changes much faster than religion, for the reasons indicated earlier. Also science is much more fallibilistic in its claims than is religion. These two factors tend to put religion in a reactive, defensive and disadvantageous position in relation to science. In our day, most of the influence is from science into religion, rather than the reverse, which was also evident in the Galileo case.

Second, the interaction between science and religion occurs at two levels: (1) the intellectual level, dealing with how the world is conceptualized and whether such views are true; and (2) the volitional level, dealing with what personal choices and commitments are made by the scientist and the religious believer, and how these choices are to be evaluated. Agreement or consistency between science and religion at one of these levels does not automatically imply agreement on the other level. This fact tends to be concealed when science and religion are on good terms, but becomes apparent when they clash. Since this is central to our analysis, it needs to be developed in some detail.

Let us begin with the case where science and religion are in agreement, or very nearly in agreement, in regard to how they describe the world. The example used earlier for this case was the Big Bang theory in cosmology as compared to the religious doctrine of creation. For purposes of the present discussion let us assume for the moment that there is a full congruence between these two views. This would not mean, of course, that the relevant scientific ideas have become part of religion, or vice versa. Rather the assumption means that the two teachings complement each other without any stresses or strains and are able to fill in for each other at points where either science or religion has reached its limits.

For example, because physical laws were not yet operative, science cannot talk about the state of affairs in the singularity before the Big Bang. But religion can talk about some of the characteristics and properties of God who for religious believers existed still earlier and presumably caused the Big Bang to start. If one asks what God was doing before He created heaven and earth, we hopefully are not limited to St. Augustine's answer that He was preparing hell for people who ask questions like that. And, vice versa, science might present its notion of the Anthropic Principle to provide a more specific account of how God's teleology operated from the very beginning in a universe focused on the genesis of humans in time.

If we assume such a complete congruence, it would seem that the science-religion relationship would be totally unproblematic, and the two should never come into conflict. And by definition of our assumption, that would be true at the intellectual level, at the level of comparing ideas, at the level of the unified picture of the physical world which would result. But if our prior claim is true that both science and religion also involve distinctly different volitional elements, then this presumed full congruence will tend to mask over ineliminable points of difference. This in turn may lead to serious later complications, and even divorce, for this happy marriage between science and religion, as the originally given relationship begins to change and evolve with the passage of time.

To put this in another way, agreement between science and religion about what reality is like can create a false sense of security for both, in which the volitional commitments of the one imperceptibly begin to encroach upon, and to clash, with those of the other as time passes. In our reading of the history of the relations between science and religion, this has happened repeatedly, and it has had very unfortunate consequences.

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Let us look at one particularly clear example of this. There was a quite congenial relationship between science and religion during the approximately two hundred years between Newton and Darwin. Nevertheless this erupted immediately after Darwin into a bitter conflict which was largely due to the way in which the previous peaceful era had been structured.

When Newton published his *Principia* in 1686, an era of enormous optimism began in which many thought that the new physics had provided a method of how to reconstruct all human knowledge across the board into a final and complete form. To be sure some charged Newton with atheism, since the new physics had no need to appeal to a transcendent God to account for things observed in the physical world. But most reacted positively, and especially the British divines and theologians. Newton's science was seen by them as limited to the mechanical aspects of the world; it had nothing to say about the teleology and design which also seem to be so evident in the world.

This latter aspect of the world was then to be accounted for by religion, which was thus seen as fully congruent with, and complementary to, the new science. Throughout both the eighteenth and nineteenth centuries innumerable treatises appeared, written by scientists and theologians alike, who claimed to prove both the existence of God and

the justification of religion. These arguments were all based on close attention to the marvelous complexity and purposeful design in the natural world as showing the mind and hand of God at work in creation. One of the favorite exercises was to reflect with amazement on the anatomy and physiology of the human eye. The authors of these developments, which came to be called "physico-theology," were the ones who made the design arguments for God and religion so prominent immediately prior to Darwin. They explicitly intended their theology to be a consistent supplement to Newtonian mechanical science in an area where the latter remained silent.

This peaceful interlude lasted so long that the volitional commitments on each side gradually became over-extended during the era of confidence which we now call the Enlightenment. Fallible rule-choices made in science came to be seen as unqualifiedly reliable logical methods which gave reason extensive powers of explanation in all domains, including religion. On the other hand the new "natural theology" tried to reduce so much of traditional religion to rational proof and explanation that the personal self-commitment of religious belief came to be based more and more on what was seen to be "reasonable."

With the inexpensive wisdom of hindsight, it is easy now to see how a disaster was brewing. As long as both science and religion could maintain their separate and autonomous domains, domains which complemented each other by filling the gaps in the other discipline, peace could continue. But if the resources of science could enable it to account for the design in the world which previously had been the purview of religion, then the peace would be shattered. And, of course, that is precisely what happened. In Darwin's theory of evolution design in living things is accounted for as due to chance mutations and natural selection. No transcendent appeal to God was needed. In effect evolutionary theory, when accepted, had naturalized the very grounds which for almost two hundred years had been widely used to justify the existence of God and the credibility of religion. The "God of the gaps," as that approach has recently been named, became irrelevant, granted that evolutionary theory is true.

At the first trial, which was held at the Holy Office in February of 1616, the issue was whether or not the heliocentric astronomy of Copernicus was true. It was an intellectual issue. Galileo was not personally on trial; rather an idea was. Both sides agreed that the astronomers of that day were not able to provide a scientific proof of the heliocentric theory.

It is important to emphasize here that the religious crisis caused by Darwinism was not simply, nor even primarily, a dispute over whether the book of Genesis should be read literally or metaphorically. If that were all that was involved, the crisis should have been more easily resolved. Nor was that crisis due simply, or even primarily, to the need to judge whether the factual evidence for evolution was strong enough to enable one to conclude that that view of the history of life is correct. Rather, because of the way that science and religion had become related after Newton, the religious crisis of Darwinism consisted of a direct challenge to the volitional foundation of religious belief in the word of God and of the personal decision to commit one's self to live the life prescribed by that religious message. Why choose to accept this any more? Why choose to believe that the religious revelation is true in any sense, and why choose to live one's life accordingly? This is a much more basic and more important issue.

The persistence of the dispute between evolution and religion is now easier to understand. For it is much less threatening to change one's mind than to change one's will. It was not simply a matter of judging ideas; it was a question of making choices. Rather than abandon one's religious commitments, which were understood to be based on the highly reliable word of God, why not instead simply reject the conclusions of evolution which, after all, are based on the clearly fallible rule-choices of science? When put this way, this is more a clash of wills than a conflict of ideas.

If we now turn our attention to the other extreme case, i.e., to a bitter conflict between science and religion rather than full congruence, then the distinction of the two levels at which science and religion interact will become even more evident. The classic case for this, of course, is Galileo's clash with the Catholic Church. And, as it turns out, even a rather superficial review of the Galileo case reveals that the clash occurred at both the intellectual and volitional levels.

The key point to note is that the Galileo case consisted of two different trials, which occurred seventeen years apart. At the first trial, which was held at the Holy Office in February of 1616, the issue was whether or not the heliocentric astronomy of Copernicus was true. It was an intellectual issue. Galileo was not personally on trial; rather an idea was. Both sides agreed that the astronomers of that day were not able to provide a scientific proof of the heliocentric theory. Galileo actively but unsuccessfully sought such a proof to the end of his life. Cardinal Bellarmine, on the other hand, explicitly said that he had never seen such a proof, but if and when this proof would be forthcoming, then, but not before then, the Church should say that the Bible needs re-interpretation, or at least that we do not understand the relevant passages of the Scriptures. Meanwhile preference should be given to the straightforward literal meaning of the Bible which speaks in many places of the sun revolving around the earth.

With this in mind the Vatican's Congregation of the Index issued a Decree on March 5, 1616, which pronounced the judgment reached in the first trial. The heliocentric theory was declared to be "false and completely contrary to the divine Scriptures." Thus ended the first trial.

The details of this trial of heliocentrism are, of course, considerably more complex than this, both in regard to the scientific issues involved and in regard to the principles of biblical exegesis involved. Galileo and Bellarmine were each thoroughly acquainted with all these issues. Nevertheless a judgment of condemnation of an idea was issued. Whatever the wisdom or lack of wisdom behind this, it is overwhelmingly evident that the explicit focus of this first clash between Galileo and the Church was on the intellectual level.

One is tempted to ask why the Church did not simply suspend judgment on this case, in consideration of the possibility that the required scientific proof might eventually be produced? Scholars have disputed this question endlessly, but without resolution. Could it be that this happened because of a zealous over-reaction at the volitional level on the part of the custodians of religion, who where attempting to protect the safety of the Church as they saw it? They did not act out of ignorance; they simply made a bad decision.

The question at hand is not the truth or falsity of heliocentrism. That had been settled seventeen years earlier, and the trial documents show no inclination to re-consider that decision. The question rather was Galileo's loyalty to that decision; and more specifically, had he disobeyed an injunction issued to him in 1616 forbidding him to publish anything further on heliocentrism.

When we look at the second trial in the Galileo case, which took place in the spring of 1633, we find a completely different atmosphere. Now Galileo's personal behavior is up for judgment, and not merely an idea. The question at hand is not the truth or falsity of heliocentrism. That had been settled seventeen years earlier, and the trial documents show no inclination to re-consider that decision. The question rather was Galileo's loyalty to that decision; and more specifically, had he disobeyed an injunction issued to him in 1616 forbidding him to publish anything further on heliocentrism. The legal status and the precise sense of that injunction has been debated ever since Galileo himself raised such challenges at his trial before the Holy Office. But that is not our concern at present. Rather what is abundantly clear for us is that Galileo's famous trial in 1633, the paradigm case of the clash between science and religion, did not revolve around the truth of heliocentrism but rather around issues of loyalty, obedience, and authority — all matters located at the level of volition and not reason.

Our central conclusion from all this is that history clearly shows not only that science's interactions with religion fluctuate widely between near agreement and strong conflict, but also that throughout this spectrum these interactions occur at two very different levels, the intellectual and the volitional. You may recall that the title question of this paper was "*Science vs. Religion: A Conflict of Ideas or a Clash of Wills?*" The answer we hope to have established is that the science-religion interaction occurs at both levels. If this be true, then much of the literature on the relations between science and religion is an exercise in over-intellectualization. Disputes over the relative truth and falsity of world views is, of course, a very big part of the picture. But volitional ingredients should not be overlooked, and when they are taken into account, our understanding of the interactions between science and religion takes an a significantly different and more realistic character.

Science and Secularism Today

If our discussion up to this point is granted, then we are in a helpful position to reflect on the present state of affairs in the changing relations between science and religion. What characterizes that relationship today, how did it come about and what can be done to improve the situation?

The hostile relationship between science and religion, which was ushered in in the late nineteenth century as a result of the disputes over Darwinism, has slowly evolved during the course of the twentieth century into a quite new situation in which religion has become increasingly more excluded as a participant in the debates over developments in science. This turn toward the secular, as we might call it, has resulted from the view of many scientists (but certainly not all of them) that the scientific mind-set not only does not appeal to the transcendent but more strongly that it can and should deny the transcendent altogether. By secularism here we mean the view that only the natural world is real and also that that world is adequately understood by natural reason alone, especially in its scientific mode.

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The causes of this scientific turn toward the secular in recent times are, of course, extremely complex and cannot be delineated here. However, it is beyond doubt that today we live in a stage of human culture which is overwhelm-

ingly dominated by a secularized science and technology. Physics became the centrally dominating science during the first half of this century and was followed by the ascendancy of microbiology, beginning with the discovery of the chemical structure of DNA in 1953. Technology has followed the same course, so that today its leading edge is defined by such things as recombinant DNA techniques, genetic manipulation in many plant and animal species and, most recently, the application of cloning techniques to human embryos. The secular turn of science shows up most dramatically in these latter areas, of course, because here we are not dealing simply with understanding living things but with the startling prospect of re-creating them, and that in a context where transcendent values have little impact.

The fading influence of religious values in the world of science has been replaced oddly enough by a distinctively contemporary sense that the pursuit of science is itself a morally uplifting enterprise, and this for two reasons. First knowledge in itself is seen as a good, and, second and more importantly, the practical fruits of scientific knowledge must and will contribute significantly to human betterment. Although this moral innocence was shattered by the atomic bomb almost half a century ago, it seems to have experienced a re-incarnation because of the personal and health benefits promised by contemporary biological and medical technologies. Even secularism needs an ethics, and some have found it in the benefits claimed for the human race from the pursuit of science in itself at the purely secular level. Of course, such an ethics finds room only for a fully secularized human person.

Technology has followed the same course (as science), so that today its leading edge is defined by such things as recombinant DNA techniques, genetic manipulation in many plant and animal species and, most recently, the application of cloning techniques to human embryos.

The main conclusion of this paper should by now be evident. In addition to their respective world views at the conceptual level, both science and religion also contain their own distinctive set of volitional commitments. We have delineated these commitments in detail earlier to justify the conclusion that, although clashes can and do occur at this level, that is not inevitable. A religious scientist or a scientific religious believer is not a contradiction in terms, as some might want to argue today. However, and this is the main point, there is also nothing to prevent an alliance between an acceptance of the volitional commitments required by science and a concomitant counter-choice to reject the values of religion.

The result is a peculiar form of anti-religious science which many scientists seem to advocate today. Its peculiarity arises from its denial, not so much of the conceptual claims, but of the volitional commitments central to religion. It thereby goes beyond mere disagreement with religion to the stronger claim that the latter is not even a relevant participant in the dialogue about developments in science. The long and changing history of the relations between science and religion thus has reached a distinctively new stage in our day. Its most visible intrusion into our consciousness is the widely expressed discomfort with many of the growing applications of genetic technologies to the human person conceived in such purely secular terms.

If our analysis is basically correct, what advice should be given on how to deal with this situation? The pessimistic response (which need not thereby be false) is that nothing can be done. Conflicts of ideas alone are difficult enough to resolve, but in such cases at least we have the tools of evidence and argumentation to help us. But resolutions of clashes of wills are beyond such appeals.

Another alternative would be coercion. That at least confronts the will. But this clearly will not do, given the sorry history of coercion. Coercion at best might produce short-term verbal agreement, but is certain to produce long-term animosity. As the Galileo case shows, religious inquisition against science resulted in disaster. A "scientific inquisition" against religion, if somehow that is what the future holds, will have the same consequences for science.

However, and this is the main point, there is also nothing to prevent an alliance between an acceptance of the volitional commitments required by science and a concomitant counter-choice to reject the values of religion.

That leaves the use of persuasive rhetoric to respond to the present situation in which science and religion find themselves. Abstractly considered, that is probably the best approach, but concretely it has not worked very well. The reason, we think, is that very few of the custodians of religion know science from the inside, as it were, while at the same time too few scientists have a genuine sense for theology and religion. Indeed the way we now educate students in graduate schools in these fields seems almost purposely designed to produce and to perpetuate this state of affairs. Even the best of rhetoric has no effect on deaf ears.

Endnotes

1. We refer here to Pope John Paul II's address to the Pontifical Academy of Sciences on 31 October 1992. For the text of his remarks, *Origins*, Vol. 22, No. 22 (12 November, 1992) 370-73.

2. Stephen Hawking, *A Brief History of Time.* (New York: Bantam Books, 1988) 115-16. Although this paragraph by Hawking has been widely quoted, it is apparently based on a misunderstanding of the Pope's remarks, which were intended to distinguish the scientific question of the physical conditions needed to account for how this universe originated from the metaphysical-theological question of why the universe was created and is conserved in existence by God. See George V. Coyne, S. J., "*Implicazioni filosofiche e theologiche delle nuove cosmologie,*" *La Civilta Cattolica,* 4 (1992) 343-52, especially footnote 7.3. For example, see J. D. Barrow and F. J. Tipler, *The Anthropic Cosmological Principle* (Oxford: Clarendon Press, 1986), and John Leslie, *Universes* (London: Routledge, 1989).

REVIEW OF *GLIMPSES OF THE DIVINE: REFLECTIONS ON REVELATION AND LIBERATION THROUGH SCIENCE*

by A. Jesuraja

Professor Jesuraja, a teacher of English at St. John's College in Palayamkottai, India has provided a hard-to-classify book. It is not strictly speaking a treatise on science/technology and theology. It assumes the compatibility of the trio and works from the standpoint of its product. It is not essentially a book of meditation material — *points* as they were called in the old seminary training — but it could also pass for that. It is neither a systematic treatment of science, technology, philosophy nor theology but it deals with each of them. It is not a treatise on English but it displays wide acquaintance with English (and Eastern) literature. It is neither fish nor fowl, but that is its charm.

Glimpses of the Divine seems to be an extended meditation in the manner of St. Ignatius Loyola's "Contemplation on Love," the last meditation of a 30 day retreat. It can be considered a meditative catalogue of things for which we thank God. As a result we grow more deeply in love with him in the contemplation of their beauty and their usefulness. In that sense it is a most refreshing volume, not too technical but quite satisfying.

It may also be a bold book for many people but I am sure that ITEST readers will find it exceptional. We all know that God has provided more beauty than we shall ever be able to contemplate and has lavished more love on us through creation than we can ever return. In this volume Professor Jesuraja calls them to our attention. This is a volume of praise and worship to God in the manner of the Psalms, a paean to the God of creation and redemption. Although not written in a poetic form, the poetry and the music of the universe is easily discerned. It says a great deal about the author's love of nature described in the sciences and turned back to God. Unlike those who deify creation and its beauty, the author refers all to God.

It is perhaps time (actually, long overdue) to turn to the poetic to again manifest the glory of God, as did the Psalmist 3000 years ago and many since. How much of our contemporary liturgy manifests the glory of the cosmos as a wondrous gift of God? If any, it is certainly not enough. That could be a blessed gift to the Church from those ITEST members who express themselves well through art, poetry or music. Professor Jesuraja has shown us the path.

I have often mentioned that Christians, like good scientists, need to live in the world "as it really is." Christians cannot indulge in the radical pessimism of the gnostics and materialist. We live in freedom in the world as it truly exists in and by the Eucharistic Lord. That is the only way Christ is now present to us — sacramentally. This world in which Professor Jesuraja perceives such beauty is the only world that Christ redeemed. Professor Jesuraja is at home in this metier. But it is the "spiritual" level toward which he is continually turning, offering the beauty and the fascination of that world back to God.

This book is published by the Rev. Ashish Amos of the Indian Society for Promoting Christian Knowledge, Post Box 1585, Kashmere Gate, Delhi, 110006 under the Christian Emphasis Series. It can be ordered through the Indian Society for Promoting Christian Knowledge. The ISBN is 81-7214-450-4. The cost is $9.00 or Rs. 95.00.

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