



From high above the ground in my ivory tower I wish you a glorious Easter Season.

The invitations for the October Workshop (*Evolution AND Creation*) were mailed about a week and a half ago. Like all good things, it was slightly flawed. I must have been in a feminine mode when I wrote it. There is at least one very telling error: on the invitation I referred to Father Macior as OSF rather than OFM. I offer my deepest apologies to Father Macior.

In another vein, there is one theme that relates to both the *Patenting of Biological Entities* and *Evolution AND Creation*. That theme is the body. In our celebration these days we read with amazement how Christ operated in His Risen Body and we know with the certitude of faith that our bodies will be "copies of His glorious body." It is not the work of an overactive imagination that leads us to wonder about our living with such a wonderful body.

What size and shape will I be? I don't know and I certainly don't worry about it. I merely presume that my body will be very much like the one I have now. This is how I, Robert, am expressed in physical form. The dogmatic faith of the church has relatively little to say about these things: I will rise physically, recognizably myself. I believe that my body will be recognizable to me as well as to others. In other words, there will be a continuity with what exists now — with a great deal superadded.

I can't prove any of this. Despite the hours of thought I have poured into it, the mystery remains almost as impenetrable as it was in the beginning. But I do believe I will rise. I hope that I will in the Lord be joyous in my new-found embodiment. It will be spirit-embodiment rather than soul-embodiment. Beyond that I cannot penetrate. Anyway, this is the day the Lord has made. Let us rejoice and be glad in it.

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ANNOUNCEMENTS

1. By now you have received an invitation to the October 17-19, 1997 workshop, *Creation AND Evolution*. There is quite an interest in this topic, so if you are thinking of attending, please register early. A \$25.00 registration fee will assure you a place at Fordyce Conference and Education Center in St. Louis, Missouri. If you have a colleague who would like to attend, send us the address and we will mail the invitation.
2. Just a reminder to circle you calendar for the big ITEST celebration in 1999. The Sub-Committee is working now to settle a date, most likely the first or second week of August at a location somewhere in Chicago (preferably either an air-conditioned Retreat House or Conference Center near the Lake) if possible. If anyone knows of such and "Eden" please contact us so that we can explore the possibilities. Naturally, we are looking to keep the cost manageable for the attendees. You could consider bringing your spouse, friend or "the whole family" for a vacation-/celebration experience.
3. We have been contacted by the Program of Dialogue Between Science and Religion of the AAAS asking us to: a) agree to be listed on their Web Site and, 2) to display ITEST materials at the "ecumenical booth" at the AAAS meeting in February, 1998. We have of course agreed to both suggestions. The former will give us even better exposure on the Internet; the latter requires a participation fee which we gladly paid for the opportunity to display ITEST information and materials to such a large group of scientists attending that meeting every year. As we noted last issue, we are getting "hits" almost daily on our Web Site. Some come from high school and college students most likely looking for information for class research projects, but others are really interested in becoming members of ITEST. We are happy to oblige with packets of informational materials.
4. Last time we told you about one of our members who was translating some ITEST material, mostly articles from our bulletins, into French for his discussion groups. Now another member has requested certain articles for translation into Tamil. Our message certainly seems to be "reaching to the ends of the earth." Again, we invite other members in countries outside the United States who would like to do similar work to contact us for permission.
5. The edited book of proceedings from the October, 1997 workshop on *The Patenting of Biological Entities*, is now at the printers. All dues-paid members should look for this copy of the book anytime in late May or early June.
6. We have not forgotten the need to develop faith/science material for students and faculty at all grade levels. At the March, 1996 workshop it was noted that education (yes, even in the early grades) is needed. This can be said for education in the Christian Faith as well as in science. Many, even highly educated people, seem to operate "with a less than eighth grade knowledge" of what Christianity is and teaches. Any suggestions that you can give the Board and Staff (and each other) is needed and deeply appreciated.
7. Again, a notice that we can be reached not only by FAX (314)-977-7264, but by E-mail as well. See front page for our addresses. Take a look at our ITEST Web Site. Any suggestions?
8. Some members have asked to charge their yearly membership dues to Visa or Mastercard. We have been looking into this but we don't as yet have the necessary information to proceed. In the meantime we ask members outside the United States to pay with an international money order or personal check drawn on a company with an office in the United States. Otherwise, it will cost us as much (or more) to cash the check than it is worth. We remind these members that they can pay their dues for two or three years. That would at least minimize the inconvenience.
9. Just a reminder that we still have some funds available for student memberships. If you know and can recommend a serious student for a one year gift membership, simply contact us with the necessary information. Thus far, we have a fair number of students who have been added to the membership list as a result of this special grant.
10. We are looking for articles for the Bulletin. If you have anything ready on faith or science, send it in to us. It will be given every consideration. If you send your submission via e-mail, as an appended document, please send it in any form of WordPerfect (up to 6.1) or, to be even safer, in ASCII. We are having difficulty downloading material sent in other formats.

THE FAITH OF A NEUROLOGIST

Dr. Danielle Darriet
Berck-sur-Mer, France.

[Dr. Darriet received her MD from the University of Bordeaux in 1974. After neurological studies in Bordeaux, she received her doctoral d'état des Sciences from Bordeaux, 1982. Her specialties have been in biochemistry and neurology; her post-doctoral research, in biochemistry and memory. In 1984 and 1985, she was commissioned by the French government to Saint Louis for research in the Division of Radiation Sciences at the Washington University School of Medicine. After seven years work at the Laboratoire de Psychophysiologie in Talence, she resigned her position to become the primary care physician for severe head-injured patients at a small hospital near the northern coast of France. Dr. Darriet is a long-term member of ITEST. The following is the text of a lecture, delivered at The Newman Center, Washington University, St. Louis, Missouri.]

I am French, and a single woman. I work in a rehabilitation unit of a private hospital in a small town of 14,000 inhabitants, in the North of France. It is a center for severe head-injured patients. Most of them had accidents (car accidents), some had vascular diseases, or encephalitis, or tumor, or had attempted suicide, but all of them had been comatose for at least several days and have brain damage. They usually arrive in the center immediately after discharge from intensive care unit. All of them are in bad condition and if you never saw this kind of person I must tell you something about them.

Just imagine that one day you wake up in a place you do not know, with all kinds of probes at different parts of your body, surrounded by people you do not know, in a really strange place with light, noise and white, every body clothed in white, or green when you are in intensive care. And you understand nothing and your body is so strange and you cannot move and you cannot speak.

It is a humbling work because no drug or technique is going to allow a brain to grow and reconstruct the parts which have been destroyed.

Where am I? Why am I here? What happened? Who are they? No answers to these questions, no possibilities to ask them, even no real awareness of these questions. And then begins the struggle to come back to a self governing life. Some of them will never do it and die. Some of them will stop here and remain in a persistent vegetative state. Some of them will improve with more or fewer handicaps.

My work is to accompany this process of recovery

from the state of awakening to independent life. This work is done with a staff of nurses and a lot of different therapists and everyone has a unique and necessary role in this process of recovery. It is also done with the family, the only link with the patient's previous life; they will have to welcome back someone different from what he used to be.

It is a humble work because, at the time of the injury, no one is able to predict what the outcome is going to be like several years in the future. It is a humble work because no drug or technique is going to allow a brain to grow and reconstruct the parts which have been destroyed. It is a humble work because we have to teach everything again to people who forgot a lot and do not know anymore how to use what is left.

But it is also a wonderful work of close and intense relationship with very poor people who have lost their most precious wealth, their health and who even, at times, do not know that they have lost everything. It is a wonderful work when you see within one year someone who was completely dependent for every act of the most basic daily life going out walking and talking again. It is wonderful to be a witness of this extraordinary strength of a human being. It is a wonderful work when you see all the sacrifices that a family or a friend is able to do for his sick relative. Even the most apparently rude professional can be moved to tears when he sees small progress in someone he washed for days and months.

I like this kind of true and even crude relationship. At this level, there is little room left for masks or lies, there is almost no more ability of control. You can see all the range of human behavior. It can also be very difficult when nothing happens or when the behavior is out of control or when there is a complication... but isn't it the same everywhere?

Thus, I like my work at this stage of my life. However, I have been doing it for 16 months. And the question is: "How did I arrive here?" This may be my journey of faith.

I was born in a small village in the southwest of France. My infancy was very happy. But this innocence did not last long and I soon became aware that I wanted to be loved and that I had to work to achieve something in my life. Yes, as everyone else, I wanted to be loved and I soon began to behave according to people's expectations. I went very far in this way. It even led me to St. Louis 13 years ago. However, I did not want to be loved by just anyone and I used to exercise some kind of discernment in my choice of the people whom I wanted to please. They had to have some importance in my eyes (but, this judgment of importance highly changed with the passing of years). When I was a child, it was necessarily my school teacher and I was a good pupil; and it led me to become aware that I had a brain, a mind. And I learnt very early that we do not all have the same capacities.

For, at the same time, I also became aware of my physical limits. I was born with a heart abnormality and I had surgery when I was 14. It was almost my first encounter with the medical world and it shaped my choice of my professional life. I admired all the physicians and nurses who were giving their lives to help others. Yes, I was a little dreaming, unrealistic, but, then, I did not know that the world could be a kind of hell. The pain, the suffering that I was experiencing was normal. I mean that I never had any questions about that. I had the grace to just accept and even welcome it. Is it the way that children face suffering? I do not know. I guess it can be. The kind of question, "Why does it happen to me?" never crossed my mind. But the questions were to come later...

I wanted to become a nurse, but someone told me that it would be better to be a physician. I went to medical school in Bordeaux. I became a physician. Then, one day, a professor of neurology whom I greatly admired offered me a place in his department and asked me to begin some research work. Of course I did and I began to work in biochemistry. For some years, I was almost living a dream. First, I was a physician really working in a hospital, and this position had been given to me. Second, I was beginning to do research and through this research I would someday contribute to discover something to save people. Third, I had a real career ahead of me, as I was

combining medical practice and research. I was acquiring this so appreciated double training in science and medicine. I was not conscious that there was a huge difference between the two first points and the third one. To be a physician, to do research, could be an answer to my desire to help, to serve, to save people. To get a position was an answer to my pride and remember, at that time, everything was offered to me. Even the president of the university supported me. Of course, among all these external demands, many questions were already emerging about my true self, but I tried to wipe them away. I lived four very intense years of work, almost without leisure, I had no time. Four very intense years during which I believed that I was going to become someone. Four very intense years in answer to the previous question, "Who am I?". Even more, I then met someone who had a very high position in the French CNRS (the National Center of Scientific Research) and I became a researcher paid by the government: a position for my entire life which gave a complete financial security, a security of employment, a way to earn my living without any anxiety for tomorrow.

I guess you realize that there is a mystery in how so many people I met at key points in my life influenced my journey. Who sent them into my life? This question did not even cross my mind. I was in a materialistic world and I believed in the saving power of science. I had a real faith in science.

I lived four very intense years of work, almost without leisure, I had no time. Four very intense years during which I believed that I was going to become someone. Four very intense years in answer to the previous question, "Who am I?"

But, these four very intense years turned out to be, instead of the expected answers, the ground of much deeper questions, disturbing questions, existential questions. These questions came as soon as I began to work almost full time in a lab. I had only four hours left to see patients in general neurology. I experienced a great distress and I was not able to name it. I continued to work because it was just impossible for me to abandon something which was not finished. I did not have my PhD yet. And I still believed that the best was to come after some time of adjustment. But it was never the case and I remained for years with the questions about the meaning of life? My place?

What I was made for? What is the meaning of freedom? Of love? All the abstract words were completely mysterious to me. And it was impossible for me to accept my not being able to understand. These questions continued to haunt me. All my readings failed to bring me any answer. All my discussions did not help. Some even said that I was depressed. Maybe... Hopefully I remained with my painful questions and did not look for help in psychiatry or pills. Very simply, my acts and my desires were not in agreement, but I did not know it then.

In the midst of this turmoil, I once visited a church. And I met a priest. He is presently a missionary in Africa. And, I was led to remember that I was raised in the catholic faith. Until I was around 15, religion, practice, was easy and even pleasant for me. But soon, it became a burden and, as many other people, I made the mistake of equating religion and morality. A morality consisting only of interdictions. In short, religion became a way that prevented me from living what I now call a *Hitler-like* image of God: "If you do not do what I tell you to do I am going to kill you". I could not psychologically function this way. I stopped going to church. But I was still attracted by spiritual matters, building my own ethic, my own spirituality...

I was looking for knowledge when I first opened a Bible but I found Someone. God, whom I first saw as a creator was becoming a Father.

At the same time, the diving into pleasure or materialism did not bring me any happiness and still no answer to my unending questions. And when I first met this priest, my first request was to learn something about my religion. I already had some academic degrees and yet I knew nothing about my religion. It was a question of honesty. This man, by God's grace, was a very clever priest who did not send me to some school of theology but who just asked me to read the Bible and he lent me some books. I used to see him every month and we talked about my readings in the Bible. And one day, I asked for the sacrament of reconciliation. It was at the beginning of 1982. And the search began... "Quit your country..." said God to Abram (Gen 12: 1).

I first saw God as a creator and all the discoveries of science were telling me of the wonders of creation in a wide sense. I then thought that my feeling of

distress came from the fact that I was doing basic research too far removed from medicine and that I missed neurology. Another opportunity came through a man who offered me (again) to work with the PET (Positron Emission Tomography - the most sophisticated technical device to study the metabolism of a living human brain). This PET was to be built in Lyon (another city in France). I went to Lyon. It seemed very interesting to me. I thought I could do clinical work and research at the same time on the brain. More training was needed. I went to Paris where there was already a PET and I learnt some basics about it. Then I arrived in St. Louis, at Washington University, at Barnes hospital, for two years.

With these different moves to Lyon, Paris, I already left a lot of things familiar to me, friends... French people are not used to moving as easily as you Americans do. I was free but I experienced loneliness and I still did not know what the word freedom could mean. I went to church. I continued to read the Gospels. I began to see some differences between my way of life and what was said in the sermon on the mount. But I was not yet able to apply them in my life. God was taking a larger place, but my spiritual life was on one side and my professional life on the other side. I was in search of unity, in search of myself, I wanted to be known.

I arrived in St. Louis in January 1984 and the snow lasted until March. On Palm Sunday, I talked to a priest. I met him almost every week during the time I spent here. He sent me to make a one week solitary retreat in a Cenacle retreat house. It is the greatest experience I ever had. I am still living with it, on it. I made many other retreats since that time, but all were very different from that initial encounter. This priest was a real gift for me. He is the first that I really saw as a gift from God. I then began to realize that all other encounters had also been God's gifts.

In Barnes hospital, I was doing only research. I found very kind people, but I quickly realized that the work with PET was not the answer to my quest for unity between medicine and science. I realized that I could not spend my life working with machines. And, after all, even if I knew everything about the brain, would I be a better human? Moreover, what I was doing was exactly the reverse of what I wanted to do. The patients were used to serve the PET and not the PET to serve the patients. The patients served to increase knowledge which in turn was supposed — maybe one day? — to improve patients. But it appears to me that all discoveries are found in what is not expected.

I was looking for knowledge when I first opened a Bible but I found Someone. God, whom I first saw as a creator was becoming a Father. A Father who knows me better than I will ever know myself. A Father who loves me, although He knows all the good and the evil parts of myself. An all-forgiving Father who always receives His children and gives them the best. I felt a real shock when I read that the father of the prodigal son kissed him — before — he could apologize.

And this Father had a son, Jesus, who did not succeed, who could not be admired at a human level. Why did He seem so attractive to me? His acts and deeds are in total agreement, He never changes according to fashion...

But nothing is ever easy and I had another question. Did I want a father who puts his son on a cross? But God said that "everything He made was very good" (Gen 1:3 1). Then, even a cross is good? Too hard for me! And I could point out plenty of other difficulties. But, if I accept them as God's words, it is the truth and I have to conform my beliefs to it and not the reverse. My views are truly not God's views. I have to adjust. And Jesus? How did He accept the will of His Father?... And Job had heard of God. He was an upright man. He wanted to understand evil. But when he saw God he accepted and rejoiced in suffering. From knowledge to life, it is a long way. A way we all travel by one self. And, yet, we are not alone on this journey. He is always with us whether we acknowledge Him or not.

By the way, there is another image of God, often given by the present society, that I do not like. In my words it is a *Gandhi-like* image of God. As if God was saying to us, "Do what I tell you to do or I will kill myself". No. Jesus for me is very simply telling us, "Do you want to live? Then, follow me; do what I say."

And I guess to say yes or no to this invitation is real freedom. And I guess to help someone in his own choice, even if we do not share the same view, with absolutely nothing in return, is real love. St. Augustine says, "Love and do what you want".

But I was still in St. Louis, working with PET, aware of God's protection and I wondered, "If God brought me here it is what I have to do." And my mind became my cross. I had to use it to serve my God. But by that time, I had already lost my faith in science. Some time later, I was to understand clearly that the world was already saved, that there was only

one savior, that it was not the product of a human mind, not even the product of the minds of all humanity, but that it was a man, my God, Jesus.

And I went back to France. The PET was not yet built in Lyon. So, I did not have to make a choice to work there. I went back to Bordeaux, to my previous lab. I no longer wanted to do basic biochemistry. I still thought I could manage to do some kind of medical research and I went into neuro-psychology and I began to work on memory. As a physician, I could meet patients and I saw amnesiac patients to study memory. What is it? How is it organized? Which parts of the brain are involved in learning, memory, recall and so on. But I did not want to use a human being as a rat. So, my research was bad. If I had an experiment to do with someone and if I then felt that this patient was not ready to do it because he was tired or for any other reason, I did not do the experiment. Moreover, I could not use the people for the sake of science since I did not believe in science anymore and I rapidly tried to find ways to improve my patients' broken memory. It is the way I began to work in rehabilitation. To my eyes, it was no longer research. I was not finding anything exciting and I was unmotivated to write what I was doing. But, then I was in great conflict. On a personal level I was feeling bad because I was not doing what I was being paid for. At that time I was helped by the CNRS who asked me to choose between medicine and research. A difficult choice. But "no man can serve two masters" (Mat 6:24). I had a position in research. I had nothing in medicine. In France, it is almost impossible to go from one field to the other. But I liked the work I was doing with the patients. The patients seemed to be happy with it. Then, I chose medicine. I was ready to go into private practice as a neurologist to work with cognitive impaired persons, when a friend of mine told me that a job was available in a rehabilitation center. One month later I was working there. It is in Berck, where I live now.

But by that time, I had already lost my faith in science. Some time later, I was to understand clearly that the world was already saved, that there was only one savior, that it was not the product of a human mind, not even the product of the minds of all humanity, but that it was a man, my God, Jesus.

During these ten years in Bordeaux, I looked for a spiritual director without success but I continued to

read: St. Augustine (a giant for me), St. François de Sales (a doctor of love), Ste Therese de Lisieux (the smile of Jesus), the Bible. I attended some activities in the church. I tried to join some groups to share my faith without great success. I never studied theology. I met with some groups of students at the college and at the university.

I moved to Berck. I left everything. My life of prayer is extremely poor. I spend about 10 hours every day, except Saturdays and Sundays in the hospital. I have a lot of work. Once again I am alone but I do not experience loneliness anymore. Since I made the choice of medicine, I do not miss research. The existential questions left me. Does it mean that I am in the right place? Once again, I do believe that God led me there.

And I am in charge of thirty brain-patients. I have always been fascinated by the brain. It is amazing to see how a brain lesion can alter the behavior of a person. But, as a handicapped woman said, "This body is the envelope, do not stop with looking at the outside; read the letter inside."

Five of the patients are in a vegetative state and we can find no way to open the envelope and yet, there is someone here. Five of them are in a low awareness state. For these ten patients, the great suffering is for the family. How can we deal with their affliction? And I wonder "What is the meaning of this kind of life?" Some of the patients are still dependent but try to communicate whether with language or signs and their first attempts to communicate are often very clumsy. Finally the others begin to regain independence and their cognitive impairments are really striking. It is terribly difficult to deal with the disturbing and painful symptoms of people who have brain damage. But are they not symptoms of the limitations we all share? So, the patients show me who I am.

We can never eliminate the Cross.

But, as a profoundly brain damaged patient recently wrote, "The critical mission of a healer is to ease our crosses a little when they burden our shoulders too much" (Jean-Dominique Bauby, *le Scaphandre et le Papillon*, 1997). To be translated soon: *The Bubble (diving suit) and the Butterfly*

A COMMUNICATION FROM FR. WILLIAM A. WALLACE, O.P.

It was good to see that you republished my 1983 article "Religion and Science: Must There be Conflict?" in the Autumn 1996 issue of the BULLETIN (Vol. 27, No. 4). As you mentioned in the note introducing it, several points I had made in it should be reconsidered in the present day. One item, however, I would wish to revise in the light of the 1992 report of the Galileo Commission and Pope John Paul II's address when presenting its results to the Pontifical Academy of Sciences. The item occurs in the next to the last paragraph of the article.

There I raised the question whether the norm Cardinal Bellarmine had used at the beginning of the Galileo case was still being invoked, namely, that every finding proposed by a scientist had to be conclusively *demonstrated* before the Church would take it into account. I then added, "To my knowledge it is still in effect. . ." That part of my statement surely requires revision in view of the Pope's address, for without doubt he relaxed that requirement. He did so when discussing science's complexity, when he admitted that this makes it almost impossible in the present

day to certify any scientific discovery as absolutely true. But, he went on, if a scientific theory cannot be known to be true (the equivalent of *demonstrated* in Bellarmine's day), at least it should be "seriously and solidly grounded." And he explained that it was this type of knowledge-input he expected of the Pontifical Academy of Sciences. He stated that the purpose of the Academy, as advisors to him, is precisely "to discern, and to make known, in the present state of science and within its proper limits, what can be regarded as an acquired truth or at least enjoying such a degree of probability that it would be imprudent or unreasonable to reject it. In this way, unnecessary conflicts can be avoided." So the present situation is definitely not as stark as I portrayed it in 1983. And the Pope's recent statement on evolution seems to me to be a further step in his plan to implement that policy.

Perhaps I should also mention that I found the points made in the same issue by Peter Hodgson and Alfred Kracher very informative. The latter's comment on the language in which Catholic theologians address issues

arising in the science-religion dialogue, which he referred to as "Aristotelian language," as not being very helpful, struck a resonant chord. But it is not only the theologians who are at fault, Catholic philosophers also must share part of the blame. I have long complained of the neglect in which they have allowed natural philosophy to fall, putting all their emphasis on metaphysics. My own efforts over the years has been to build a bridge between the philosophy of nature and the philosophy of science, to show how they mutually complement each other, and, within a Catholic perspective, can contribute to serious dialogue with revealed theology. In this connection I am happy to report that a book on which I have long been working has finally been published. It is *The Modeling of Nature: Philosophy of Science and Philosophy of Nature in Synthesis* (Washington, D.C.: The Catholic University of America Press, 1996). I sincerely recommend it to members of ITEST as laying the groundwork for more enlightened discussions, serving as an intermediary, as it were, between science and theology.

But it is not only the theologians who are at fault, Catholic philosophers also must share part of the blame. I have long complained of the neglect in which they have allowed natural philosophy to fall, putting all their emphasis on metaphysics.

The Modeling of Nature: Philosophy of Science and Philosophy of Nature in Synthesis

by William A. Wallace

As the new millennium approaches, our scientific knowledge of the universe surpasses that of any previous age. Yet, paradoxically, the philosophy of science movement is now in disarray. The collapse of logical empiricism and the rise of historicism and social constructivism have effectively left all of the sciences without an epistemology. The claims of realism have become increasingly difficult to justify, and, for many, the only alternatives are probabilism, pragmatism, and relativism.

But the case is not hopeless. According to William A. Wallace, a return to a realist concept of nature is

plausible and, indeed, much needed. Human beings have a natural ability to understand the world in which they live. While many have suggested this understanding requires advanced logic and mathematics, Wallace believes that nature can more readily be understood with the aid of simple modeling techniques.

Through an ingenious use of iconic and epistemic models, Wallace guides the reader through the fundamentals of natural philosophy, explaining how the universe is populated with entities endowed with different natures - inorganic, plant, animal, and human. Much of this knowledge is intuitive, already in people's minds from experience, education, and exposure to the media. Wallace builds on this foundation, making judicious use of cognitive science to provide a model of the human mind that illuminates not only the philosophy of nature but also the logic, psychology, and epistemology that are prerequisite to it. With this background, Wallace sketches a history of the philosophy of science and how it has functioned traditionally as a type of probable reasoning. His concern is to go beyond probability and lay bare the epistemic dimension of science to show how it can arrive at truth and certitude in the various areas it investigates. He completes his study with eight case studies of certified scientific growth, the controversies to which they gave rise, and the methods by which they ultimately were resolved.

WILLIAM A. WALLACE, the author of sixteen books and more than three hundred scholarly articles, is professor of philosophy at the University of Maryland. He is professor emeritus of The Catholic University of America, where he taught for twenty-five years both philosophy of science and history of science. In addition to doctorates in philosophy and theology, he holds degrees in physics and electrical engineering. He served with distinction as a naval officer during World War II, following which he entered the Dominican Order, being ordained a priest in 1953.

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A RESPONSE TO ALFRED KRACHER

Lucien Morren

[Professor Lucien Morren, emeritus professor of Engineering at the University of Louvain, *has been a longtime member of ESSAT. We welcome his remarks. Lucien has been a member of ITEST since the very early seventies and was present at our meeting in Frascati, Italy in September, 1972.*]

Having participated in all the European Conferences on Science and Theology and, in particular, in the ECST 6, held in Cracow last March, I read of course with great interest the two articles that Dr. Alfred Kracher wrote in the ITEST Bulletins No. 3 and 4, 1996. This is an exchange of information between groups having similar preoccupations which is highly advisable.

I was, however, puzzled by the prevailing tone of the second of these articles centered on the role of Catholic thought on science. This tone is reflected in the following quotation: "As a Catholic, one sometimes feels as if the entire Catholic tradition were thoroughly out of touch with contemporary science. A great deal of Catholic reflection is expended on moral evaluation of technology, but from an epistemological distance as if we were looking at the issues from alpha Centauri." (bottom of 1st column and top of second column on page 6).

Such considerations may be valid in some cases (every denomination has outdated traditionalists) but, surely, this is not to the point for "the entire Catholic tradition." In particular, the statement does not apply to Catholic contributions at the Conference in Cracow to which this second article is devoted. In his first article, Dr. Kracher enumerates the five plenary lectures (the Templeton lectures) we heard in Cracow. Is it not

interesting to note that four of them were delivered by Catholic scholars? And in their titles, one finds such expressions as "an evolving universe." (Bishop Joseph Zycinski), "Evolutionary Contingency and Cosmic Purpose" (Ernan McMullin), "New Insights in Physics" (Xavier Sallantin), not to speak of "The role of philosophy in the Science-Theology dialogue" (Jean Ladrière); all these expressions are far from being "thoroughly out of touch with contemporary science" and of being looked at from alpha Centauri! More generally, my own experience based on quite a number of organizations or groups of reflection as well as publications (mostly in French speaking Europe) regarding science-theology dialogues is far from being as pessimistic as Dr. Kracher seems to be.

I should add that, if there are still some theologians who keep an obsolete vision of science, there are — alas! — quite a number of scientists whose theological views belong still to the old-fashioned "scientism" (May I refer to my response to the inquiry on recruiting young members for ITEST, issued in the Bulletin No. 1, 1996).

There is thus still work to be done by institutions like ESSAT, ITEST (and others) in order to improve the situation on both sides!

Lucien Morren

YOUR ROLE IN THE "GREENHOUSE EFFECT"

Jerry Hannan

[Jerry Hannan is retired from the Naval Research Laboratories in Washington, D.C. He spends roughly 30 hours a week at the Environmental Protection Agency. In response to the ITEST volume on Christianity and the Environmental Ethos he was prompted to "dust off" something he had written as a result of several speaking tours for the American Chemical Society dealing with the ignorance of the public regarding scientific matters.]

It is time to place one aspect of the global warming

problem (often interpreted as the Greenhouse Effect)

into understandable terms. Occasionally mention is made of the millions of tons of carbon dioxide that are released into the air each year but the numbers are incomprehensible. More relevant would be a consideration of the contribution each of us makes to the carbon dioxide content of the air.

Fresh air contains less than 0.04% carbon dioxide. A human's breath contains almost 5% carbon dioxide. Therefore, we are contributing to the problem with each breath we take. Every person's output varies according to the amount of exercise taken, the food consumed, etc., but for the purpose at hand a reasonable figure is that each person exhales 445 liters of carbon dioxide per day (the average of 1000 samples measured by the USDA). In the course of a year this production by one average person represents 704 pounds of carbon dioxide.

Suppose you drive a car. Let us assume that the American Petroleum Institute is correct with its calculation (for 1995) that the average car in the U.S. uses 551 gallons of gasoline per year. Gasoline is a mixture of many hydrocarbons but, as a reasonable estimate, let us consider it to be octane. Let us also assume that, upon burning, it produces only carbon dioxide and water. With these assumptions we arrive at a figure of 19 pounds of carbon dioxide produced from each gallon of gasoline. If we burn 551 gallons per year, we are producing more than 10,000 pounds of carbon dioxide (> 5 tons). Adding our own metabolic production to that brings the production to roughly 5.5 tons of carbon dioxide per year, for one person driving a car and using the average amount of gasoline.

Therefore, we are contributing to the problem with each breath we take. Every person's output varies according to the amount of exercise taken, the food consumed, etc., but for the purpose at hand a reasonable figure is that each person exhales 445 liters of carbon dioxide per day . . .

A Consideration of the Balance in Nature:

Take this one step further. Carbon dioxide is absorbed by grasses, plants, shrubs, trees and phytoplankton by the process of photosynthesis. If we assume that the average person has a lawn which serves as an absorber for the carbon dioxide that he and his car produce (certainly an unwarranted assumption), how large

must that lawn be? Again, we must rely on an estimate. By using productivity data for "temperate grasses," and assuming that each CO₂ produces CH₂O (the shorthand notation for cellulose), the area of lawn required to absorb the CO₂ by one person and one car is more than 70,000 square feet, approximately 1.5 acres. Obviously most urban residents have considerably less lawn than would be required to absorb the carbon dioxide they produce. This is an interesting figure but perhaps irrelevant. I called a laboratory of the USDA in Beltsville, MD, which is involved with matters of this type and spoke with Jim Bunce who pointed out that I was asking the wrong question. Grass absorbs CO₂ but only on a short term basis. Grass clippings decompose or are eaten, but in a relatively short time much of the carbon is released back into the atmosphere as CO₂. A more pertinent question would be to ask about the CO₂ absorption rate of trees because they are the more permanent absorbers. Trees that have been converted into furniture provide a very long term storage of carbon.

For an estimate of the number of trees required to absorb the one person/one car CO₂ production I contacted Gregg Marland, Senior Staff Scientist of the Environmental Sciences Division at Oak Ridge, Tennessee. Before making a judgment on this problem he provided a different statistic: in burning every form of fossil fuel in this country, *the carbon produced on a per capita basis is 5.1 tons per year*. Expressed as carbon dioxide, this is 18.7 tons per person per year.

Therefore, we have two measures for consideration: 1) A car and driver produce about 5.5 tons of CO₂ per year and, 2) When all fossil fuel is considered, every man, woman, and child can be said to be responsible for 18.7 tons of CO₂ per year.

An Estimate of the Forest Size Required for Sequestering the CO₂ Released by Man and Fossil Fuels in the U.S.

Marland's estimate of the average absorption of a U.S. commercial forest is 0.8 tons of carbon/hectare/year. By converting this number into the units mentioned above, this equals 2.93 tons of CO₂/hectare/year, or 1.19 tons of CO₂/acre/year. With this figure as a starting point we have two numbers to ponder:

- 1) To absorb the CO₂ produced by a car and driver, a forest of 4.6 acres is required,
- 2) To absorb the nation's CO₂ production (just from

fossil fuel), a forest of 15.7 acres per person is required.

If we were to substitute a fast-growing forest of pine trees for the commercial forest cited above, these areas would be reduced by a factor of about six, which would still be a huge number (i.e. even if we were to have nothing but fast-growing pine trees, there would be a need for 2.6 acres of these trees to absorb the CO₂ produced by every person in the U.S). Remember that this calculation regarding the nation's output of CO₂ concerns only fossil fuel. Add to that the CO₂ exhaled by humans, cattle, pets, horses, birds and soil fungi and the number of acres of forest required becomes much higher.

We must be mindful in making such estimates that there are many unknowns. Forests are not the only absorbers of CO₂. Lakes, ponds, rivers, and oceans contain phytoplankton which photosynthesize and produce oxygen which can be shared with our air. Remember, however, that the fish, insects, mussels, and other components of these aqueous habitats require oxygen which then limits the amount available for equilibration with the atmosphere. I asked Marland if he might comment on the accuracy of the figures concerning CO₂ production by fossil fuels and the CO₂ uptake by forests. He felt that the data on fossil fuel consumption were probably accurate within several percent because there have been reasons to track some of those figures. I was less certain of the calculated rates of CO₂ uptake by forests and asked whether they might be off by a factor of two or so. Marland felt strongly that the data (based largely on work done at Harvard) were better than that although not so accurate as those concerning fossil fuels.

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A Need for Humility

Undoubtedly there are yearly changes in any of these large numbers, therefore the caution flag must go up lest they be interpreted too strictly. The recent crisis in the Biosphere 2 project attests to the difficulty of

attempting to make one's own little world. Undoubtedly much thought went into that project but the oxygen content of the habitat dropped to less than 14% after about 1 1/2 years. A supposed factor was that the oxygen consumption of the soil microorganisms was greater than anticipated. On the other hand the CO₂ concentration did not rise as much as expected because much of it was absorbed by the concrete in the habitat. Another surprise was that the N₂O content of the air went up to 79 parts per million. Also the ant population exploded in a manner that had not been predicted. I mention these items, not as criticisms of the planners, but merely as examples of factors whose importance could not have been predicted.

How About Our Oxygen Supply?

If oxygen is required to burn all of the fossil fuel, why don't we run out of oxygen? The reason is that for every volume of CO₂ absorbed in the photosynthesis process, there is slightly more than one volume of oxygen produced.

Based on the facts available it appears that the CO₂ produced in the continental United States, by human respiration and the burning of fossil fuels, is greater than the CO₂ absorption capacity of our forests.

With algae, for example, the ratio of O₂ produced/CO₂ absorbed can range from about 1.06 to 1.18 depending on the nitrogen source being used by the algae (the lower figure is with urea, and the higher with nitrate as the nitrogen source). Furthermore, a slight increase in CO₂ concentration in the air can result in a faster rate of photosynthesis although there are limits to this phenomenon.

Summary

Based on the facts available it appears that the CO₂ produced in the continental United States, by human respiration and the burning of fossil fuels, is greater than the CO₂ absorption capacity of our forests. These estimates do not include the substantial CO₂ production by animals or by microorganisms in the soil. Despite the tremendous burning rate of fossil fuel, the oxygen content of the atmosphere has remained stable, probably because of the slightly better than 1:1 ratio of O₂ production to CO₂ absorption.

A WORLD OF MEANING IN A DROP OF ICE

Professor A. Jesuraja

[Professor Jesuraja is Professor of English at St. John's College, Palayamkottai 627 002 India. Professor Jesuraja has kindly sent a chapter of his book, *Glimpses of the Divine*. He is now in the process of finding a publisher in the U.S. for this work.]

The discoveries of modern science have brought to light many of the facts that have long remained *obscure* in the physical and biological world. To mention but a few, the nature of electromagnetic energy including light, with its particle - wave duality and the intimate relationship between space and time as a four dimensional continuum have been explored by Quantum Physics and by the theory of Relativity, respectively. As a result, the interaction of matter and energy has been revealed more than ever in the past. The combined efforts of Particle Physics and Astrophysics have enabled us to have a glimpse at the origin of the universe with reasonable certainty. Moreover, by delving deep into the elusive, subatomic world, nuclear science has succeeded in releasing the immense energy locked up in the atom. Genetics has cast a novel light on the physical basis of life. Biotechnology, in particular, by laying bare the structure of the human genome, has even suggested the possibility of gene transfer to eradicate certain congenital diseases at the genetic level, and thereby improve human heredity! As a result, what was once formidable has become *less formidable* (for instance, with the aetiology of diseases more accurately known than in the past, dreadful diseases have been brought under effective control). What was merely dreamt of as something beyond the human reach, like man's reaching to the Moon or to the other planets, has become a possibility now. To crown it all, the invention of the computer has revolutionized human productivity.

Thus, for instance, (medical) science has thrown much light on the causative factors of death. But about the "beyond" of death, science has little or nothing to offer. Philosophy and Religion alone can enlighten what cannot be enlightened by science.

Thus the steady progress in science, both in the microscopic world and in the macroscopic universe, continues to shed *light* on many physical phenomena. But, strange as it might seem, science has also discovered that 90 percent of the universe is filled with dark matter and that visible matter occupies only a small por-

tion in the total mass of the universe. That is to say, nearly 90 percent of the density of the universe is thought to be "non-baryonic, in the form of weakly interacting dark matter."¹ This discovery by the astrophysicists is perhaps a pointer to the fact that whatever may be the volume of progress in our era of science, some of the deepest problems which affect man's ultimate destiny, like Life and Death, will always remain a bit obscure and mysterious. For science, it seems, has not unlocked the door to every treasure-chest of human knowledge. Many a magic casement still remains at least half-hidden from the scientist's eye. Thus, for instance, (medical) science has thrown much light on the causative factors of death. But about the "beyond" of death, science has little or nothing to offer. Philosophy and Religion alone can enlighten what cannot be enlightened by science.

The fact of death may indeed haunt some minds like a ghost. Death is shrouded with a mystery, no doubt. But it can have no terrors for a Christian. For death is not a cessation of life but a beginning of life, though on a different level. As always, an analogy from science can assist us in the understanding of this religious mystery. For instance, a particle of water crystallizes into ice under very low temperature. That is, the same water exists as ice when the temperature is below the freezing point. When the room temperature goes up, the warmer air melts the ice into water once again. A similar phenomenon is observed when water is heated to the boiling point. The steam that is emitted is still water but it has been *changed* from the liquid to the gaseous state. Human existence is the crystallization of God's plan in a "still point of time." Death, which only *changes* our mode of existence without really taking it away, as the liturgy of the Roman Catholic Church sings in the preface for the "Mass for the Dead," ("Vita mutatur et non tollitur"), leads us to the threshold of a new existence, which is a truer and a fuller form of life in God who is the ground of our being.

The concept that life is *not destroyed* but *only changed* by death, may become less baffling if we draw an analogy from nuclear physics. When an electron

(negatively charged) and a positron (positively charged) join together, they get converted into electromagnetic radiation by a process called annihilation. In the process, the material of each particle is not destroyed but only changed into energy. In fact, it is a universal phenomenon observed by physical science that the release of energy follows the "destruction" of matter. But the word "destruction" in this context, only means that matter has been "transformed and has not been literally destroyed."² That is, the energy associated with matter is "transformed" into radiation, according to Einstein's principle of mass-energy equivalence, $E=mc^2$. This process of "transformation" of matter that results in the production of energy, is a result of "degeneration," i.e., "a breaking down from the complex to the simple," observes Harry Rimmer.³

The life of a Christian, St. Paul would tell us, is hidden with Christ in God (*Col. 3:3*), a sort of "dying life." Only when death occurs does our true life emerge, leading to our fuller union with God in spirit. As long as we lead our corporal lives, our spirit is held captive in the prison of the body. With death, however, it attains a liberation, to taste the fulness of life divine. The "radiation" of life from the "destruction" of the body or the deliverance from death to life, has to come from Christ, by belief in Him (*John 5:24*). He who keeps His word, i.e., observes His commandments, will never see death (*John 8:21*), though his body perishes. According to the teaching of St. Paul, though death is brought about by the ebbing away of physical life, death in the real sense is caused only by sin: "The wages of sin is death" (*Rom. 6:23*). And hence, "whoever believes in him, though he die, yet shall live," affirmed Christ (*John 11: 25*).

For the believer in Christ, therefore, death is really a transformation of one form of life into another, from a perishable, bodily existence, to a glorious and eternal life. As the release of energy does not involve a literal destruction of matter in the physical and scientific sense, death in the Christian thought does not spell out the total destruction of the physical body. The disintegration of the body does really occur. Yet, the Bible repeatedly affirms the reunion of the body with the spirit on the last day: "For the hour is coming when all who are in the tombs will hear his voice and come forth ... to the resurrection of life" (*John 5: 28, 29*). Both the body (which was the instrument of sin) and the soul (the real agent of sin) will be reunited on the last day, to face the judgement of the Lord, either to receive the reward of eternal life or suffer the consequences of sin. "God created man as a unified whole, observes Don Fleming, "and

therefore he deals with man in the totality of his being. God does not divide man into physical and spiritual 'parts'. Man's final destiny, whether for salvation or damnation, is connected not with death but with the resurrection of the body after which the person faces final judgement."⁴ The reunion of the perished body with the spirit on the day of the Resurrection, is a mind-boggling mystery. Yet, the concept of the "half-life" of radioactive elements may throw some light, however feeble, on the mystery; similarly, the existence of radioactive carbon atoms in animals or plants "for thousands of years after death has taken place."⁵

For the believer in Christ, therefore, death is really a transformation of one form of life into another, from a perishable, bodily existence, to a glorious and eternal life.

The belief in the resurrection of the body has always been one of the cardinal tenets of Christianity and it was also typical of later Jewish thought. It was echoed in Martha's words to Christ at the death of her brother (*John 11: 24*). The belief in our own, individual resurrection is based on the glorious Resurrection of Christ, which may be described as the corner stone of Christian faith. It has also been overtly asserted in all the pastoral elegies since the Renaissance, beginning with John Milton.⁶ In particular, in Walt Whitman's celebrated elegy on the death of Abraham Lincoln, death is described as shorn of all its terrors. For, rather than being a depriver of life, death is imaged as a "strong deliveress," leading us to the gateway of life and hence, to be welcomed with a carol of joy. In "a panorama of visions" the poet sees the departed hero, rising again as the glorious morning star. The doctrine of individual Resurrection is given great prominence by St. Paul who combines it with the Resurrection of Christ Himself, "the first-born." "If the dead do not rise, neither has Christ risen" (*I Cor. 15:16*). Without the hope of Resurrection, Christian life would lose its meaning and would be "the most to be pitied." For, the humiliation of the Cross and the glory of Resurrection are inseparable and intrinsically linked in the Divine scheme of things. As to the mode of Resurrection, it is a mystery. Yet St. Paul tries to enlighten the mystery by alluding to different degrees of materiality and of glory in created things (Cf. *I Cor. 15: 39-41*). The risen Christ will have the glory of the spiritual body, or they will be "as angels in heaven" (*Mk. 12:25*), even as Adam, before his fall, was a "living soul."

Christ's insistence on the continuance of life in the case of a believer even after death, involves a paradox, but not a contradiction, for it refers to a different state of life after death. The doctrine of the Resurrection of the body defies our rational understanding, because it entails the non-destruction of the human body. But the religious mystery becomes less incredible when viewed in the light of the scientific concept of radiant energy.

"Trailing clouds of glory do we come," wrote Poet Wordsworth in his "Immortality Ode," trying to glorify the divine origin of the child. Whether we subscribe to the belief in the pre-natal existence or not, all those who die in Christ, to sin, will appear again with Him in glory (*Col. 3:4*) even as He, the first born, triumphed over death by taking away its "sting." A virtuous life, lived in accordance with the plan of God and in keeping with His commandments, makes us "enter into the joy of the Lord." In this way, Death may take us to the portals of Life. To an ardent believer, therefore, "to die," means "to be dissolved in Christ." And his hope of the Resurrection is not for the gaining of life to his corpse, "but for the changing of his whole person into the likeness of Christ."⁷

The doctrine of the Resurrection of the body defies our rational understanding, because it entails the non-destruction of the human body.

NOTES AND REFERENCES

1. According to Joseph Silk, the "inflationary cosmology" derived from the Big Bang theory of the origin of the universe, "predicts that ordinary matter or baryons, namely, the matter out of which stars are made, constitutes only about one-tenth of the total density of a closed universe." See "Some Cosmological Perspectives," *The Church and Contemporary Cosmology*

gy, ed. James B. Miller & Kenneth F. McCall (Pittsburgh: Carnegie Mellon UP, 1990) 187. Corey S. Powell states that according to some cosmologists, "the mass of the universe is dominated by fast-moving invisible particles known as hot dark matter" and, according to some others, by "sluggish cold dark matter." This is probably because "the early universe initially contained a population of massive neutrinos, neutral particles that barely interact with normal matter." See "Goldilocks Cosmology," *Scientific American* 269.5 (1993) 10.

2. W. Osborne Greenwood, *Biology and Christian Belief* (London: Student Christian Movement Press, 1938) 30.

3. See Harry Rimmer, *The Harmony of Science and Scripture* (Grand Rapids, Michigan: WM. B. Eerdmans, 13th ed. 1949) 22. Discussing the question whether matter is actually destroyed to produce radiation, Ernest William Barnes states that if it were so, "atoms must vanish when their protons and electrons unite to disappear as radiant energy." And he concludes: "We have no positive knowledge of the existence of such a process as the destruction of matter." Ernest William Barnes, *Scientific Theory and Religion* (Cambridge: Cambridge UP, 1933) 205.

4. Don Fleming, "Resurrection," *Bible Knowledge Dictionary* (Brisbane: Bridgeway Publications; Indian reprint. by Pilot Books Co., 1990) 370.

5. Willard F. Libby, "Radiocarbon Dating," *The Book of Popular Science*, vol. 4 (New York: The Grolier Society Inc., 1955) 1315.

6. "So Lycidas sunk low, but mounted high,
Through the dear might of Him that Walk'd the waves
..."
John Milton, "Lycidas," (174-75).

7 Don Fleming, "Resurrection," 371.

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MARQUETTE UNIVERSITY
 Excerpts from an Undergraduate Course Description
 THEOLOGY AND THE NATURAL SCIENCES
 Professor Jame Schaefer, PhD

Are science and theology adversaries battling one another for supremacy? Or, are they allies in search of truth, each seeking to help the other? If neither adversaries nor allies, do they have very little in common, one dealing with "how" and the other with "why"? Or, do they share similarities in methods and subject matter which make conversation between them possible as well as desirable?

This course has been designed to enable students to become informed about major ways in which Christian theology and science have been perceived in relation to one another and to formulate their own working models of the roles these two disciplines should play in the world today. Toward this end, students will critically assess the following: (1) literature by Kepler and other early scientists with the aim of recognizing their theological perceptions of their tasks; (2) works by and about Galileo and Darwin to discern why religion and science clashed; (3) various conceptual models for understanding the relationship between theology and science today; (4) current theories of physics, astronomy, evolutionary biology and ecology to perceive their theological implications for Christian anthropology, the doctrines of creation and providence, and the studies of Christology, soteriology and eschatology; and, (5) an essay by Pope John Paul II on the role of the Church in our scientific era. Midway through the semester, students will begin to draft their working models of the theology-science relationship.

Evaluation will be based on the student's contributions to class discussion of assigned readings, a research paper delineating a preferred working model for relating theology and science and applying that model to a chosen scientific topic, and two cumulative examinations.

Required Texts:

John F. Haught, *Science and Religion* (1995)
 James Huchingson, ed., *Religion and the Natural Sciences* (1993)

Course Development and Major Goal

A course in Religion and Science had not been taught at Marquette University since 1989. Because I have a

strong background in ecology and a keen interest in the other sciences which open inevitably to theological reflection, I tackled this course for the first time in the 1996 Spring Semester. The two sections provided me with one of the most exciting, exhilarating and satisfying academic experiences I have ever had. After reviewing the diverse model courses provided by the Templeton Foundation's Science-Religion Course Program, talking with several prior award winners, and reviewing a plethora of illuminating materials, I developed my course with the major aim of enabling my students to delineate their own working models for relating science and religion. I wanted each student to take from this course an initial plausible way of thinking about the two disciplines vis-à-vis one another.

On the first day of classes, I made my students aware of the fact that we would be trying out a new course together, and I invited their critical reflection on the adequacy of the lectures, readings and group exercises. The students were required to keep logs of these materials as a basis for their written evaluations at the end of the course.

I had planned to present the scientific materials by myself, but my experience in attending the 1996 winter workshop sponsored by the Templeton Foundation's Science-Religion Course Program at The Center for Theology and the Natural Sciences in Berkeley made me realize that the course would be much richer if faculty members from the various sciences were invited to give presentations on key topics. Much to my delight, every faculty member I approached responded positively to my request. Their contributions proved to be highlights of the course for many of my students.

Working with these outstanding and generous scientists had an additional benefit of establishing links between our department and theirs. One tangible result is our collaboration in planning a symposium on the origins of the universe to be held in two years.

There were twenty-seven students enrolled in each section; one dwindled to twenty-four while the other remained constant. Both sections were comprised of students from nearly all the departments within Arts and Sciences as well as other colleges at Marquette. According to voluntary statements made by students

on their exams, in their papers and during class discussions, the three theistic religions were represented. The vast majority of students belonged to major denominations from within the Christian tradition.

Objectives

Five objectives were established for the students. Upon completing the course, they were expected to demonstrate their ability to: (1) evaluate some basic models for relating science and religion; (2) identify, think critically about and summarize perspectives expressed in assigned readings by theologians, philosophers and scientists; (3) approach issues regarding science and religion with some understanding of past interactions; (4) demonstrate comprehension of key theological and scientific concepts; and, (5) specify a preferred working model of the science-religion relationship and apply it to a scientific topic of the student's choice.

Objectives 1-4 were tested on two cumulative exams. The fifth objective was tested through the papers the students wrote delineating their working models.

John Haught's latest book, *Science and Religion: From Conflict to Conversation* (1995) was the mainstay for our course. My students and I found it highly informative, thought-provoking, cleverly written and user-friendly. Most listed it as one of their top ten texts.

James E. Huchingson's anthology, *Religion and the Natural Sciences: The Range of Engagement* (1993), provided some exceptional selections from the works of major scientists, philosophers, theologians and story-tellers. We read more than half of these works.

In addition to these texts, I provided excerpts of others in the form of handouts or class reserves at the Library. Most of these works pertained to the historical background I gave predominantly in lecture format during the first four class sessions. All are primary materials from their respective eras. For example, I used the preface to Kepler's *Mysterium Cosmographicum* and a selection from *Four Letters from Sir Isaac Newton to Doctor Bentley* to show how they theologically perceived their scientific enterprises, Galileo's *Letter to the Grand Duchess Christina* which provides one of the best polemical treatments on the relationship between scientific truth and religious truth (another designated by most students as a top ten), part of Darwin's conclusion in *The Origin of Species*, Draper's preface to *History of the Conflict between Religion and Science* (1898) and White's introduction

to *A History of the Warfare of Science with Theology* (1929) which mischaracterize the historical relationship between the two disciplines, and graphics depicting the ancient-biblical, the medieval-Aristotelian and Copernican world views with their diverse understandings of God and God's relationship to the cosmos. I supplemented these graphics with a slide presentation of our micro-to-macro contemporary world view (the final slide showing the billions of galaxies captured recently via the Hubble telescope).

To acquire an understanding of how the Church views science today, we read Pope John Paul II's 1988 message to the Director of the Vatican Observatory which appeared in *Physics, Philosophy and Theology: A Common Quest for Understanding*, edited by Robert John Russell, William R. Stoeger, S.J. and George V. Coyne, S.J. (1988). I encouraged the students to bring in statements by leaders of their own religious denominations, but none were forthcoming. Some of the Catholic students indicated that they were more open to considering the theological implications of scientific data because the Pope advocated dialogue between religion and science!

For each reading assignment, the students were required to provide synopses of the author's thesis, how it is supported, and the contribution the reading makes to the scholarly discussion about the religion-science relationship. More specific requirements for each reading were announced during the prior class session.

Bases for Evaluation

The final grade was based on participation in small group and full class discussions, written synopses of assigned readings, a journal indicating the student's reactions to readings, and an evaluation of all materials (25%), a five-page research paper specifying a preferred working model for relating science and religion, why the model was chosen, and applying that model to a scientific topic of the student's choice with the instructor's approval (25%), the first cumulative exam (25%), and a comprehensive final exam (25%).

[The entire description of the course runs several pages. If you are interested in more details about this course you could write to Dr. Jame Schaefer, Theology Department, Marquette University, Milwaukee, WI 53201-1881. This course received an award from the John Templeton Foundation and was selected as an example to distribute to those interested in the next round of competition.]

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