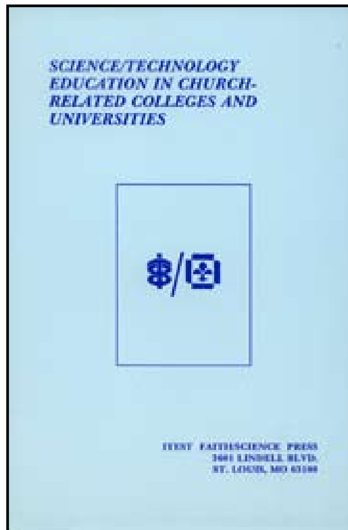

Science/Technology Education in Church-Related Colleges and Universities

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Science and Technology in Jesuit Education

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Introduction

There are, as we have heard during this Colloquium, almost as many aspects of Jesuit education as there are people and institutions involved in it. If we are to talk reasonably about the place of science and technology in Jesuit education, we should offer a rationale for its being there at all. It is possible that there may be some repetition between my approach and what has already been said earlier in these proceedings. I would be truly consoled if there were some repetitions, since that would indicate that I am not standing here alone in all my idiosyncratic glory!

I wish to confine myself more or less to Catholic aspects of Jesuit education -- its Church relationships -- while, of course, not denying in any way its civil obligations and its strictly intellectual (and, therefore, human) obligations. This is done for purposes of simplification and personal preference, not for purposes of ideology.

The Need

Christianity is a faith that is necessarily and solidly based on the belief that the Son of God became man in the womb of the Virgin Mary. He became, as St. Paul tells us, one like us in all things except sin. He became so much a part of the nature and the history of the world that St. Luke can date the beginning of his ministry among us with a listing of those in power in Palestine at the time: "In the 15th year of Tiberius Caesar's reign, when Pontius Pilate was governor of Judaea..." More, we firmly believe that after his death and resurrection he ascended bodily into heaven, retaining his full humanity in glory. Thereby, he instituted a new state of bodily life, one to which we are called and destined.

As Catholics we live in a world which we believe to be sacramental, a world in which "material" things are seen to be of "spiritual" value, to have an everlasting destiny in God. We live in a world where, we believe, bread and wine become the Body and Blood of Christ, where water is a substance that washes us clean of the sin into which we are born and is the material agent (indispensably material) of our introduction into the life and love of the Blessed Trinity. In short, God in Christ has so deeply and permanently penetrated the created world in his body that part of the universe has become a part of him. Thus in him and in us, through him and through us, the physical world itself is somehow redeemed. We are all familiar with St. Paul's triumphant cry of joy that: "creation still retains the hope of being freed, like us, from its slavery to decadence, to enjoy the same freedom and glory as the Children of God."

This statement of St. Paul is echoed in Vatican II's statement in *Gaudium et Spes*, no. 34:

> Throughout the course of the centuries, people have labored to better the circumstances of their lives through a monumental amount of individual and collective effort. To believers this point is settled: considered in itself, such human activity accords with God's will. For mankind, created to God's image, received a mandate to subject to itself the earth and all that it contains, and to govern the world with justice and holiness, a mandate to relate itself and the totality of things to Him who was to be acknowledged as the Lord and Creator of all. Thus, by the subjection of all things to human beings, the name of God would be wonderful in all the earth. . . .

> Thus, far from thinking that works produced by human talent and energy are in opposition to God's power, and that the rational creature exists as a kind of rival to the Creator, Christians are convinced that the triumphs of the human race are a sign of God's greatness and the flowering of His own mysterious design. For the greater human power becomes, the farther our individual and community responsibility extends. Hence it is clear that human beings are not deterred by the Christian message from building up the world, or impelled to neglect the welfare of their fellows. They are, rather, more stringently bound to do these very things.

So the world, this beautiful blue and white planet in what still appears to us to be an otherwise sterile universe, is the arena for our service and our worship. The Council, in that passage, tells us many things about the place of science and technology in Catholic consciousness. Therefore, it should say something about their place in Jesuit education. Science (as a method of intellectual search whose conclusions are mathematically consistent, measurable, and verifiable through experiment) is a still increasingly effective way of human laboring to better the circumstances of our lives. Science and technology have become twins in our effort at understanding the structures of creation and at turning our planetary environment into a world apt for human betterment.

The Council tells us that science and technology (among other things) are a sign of God's greatness and a sign of the flowering of His own mysterious design. As such they should be seen as a part of the human worship of the Creator, especially so for us Christians, rooted as we are in the world by the body and blood of the Lord. If the pursuit of knowledge of the world and the attempts to alter it to make it a place more apt to human living are parts of our Christian worship, then they must be part of our intellectual and spiritual patrimony. What better place and what better mode is there for this understanding and changing than Christian institutions of higher learning, including Jesuit institutions. As Christians, we must live in the world penetrated and transformed by the life and death of Christ. We must love that world for its own sake as well as because of God's further will for it. The understanding of it as well as love for it must be a conscious part of Christian education.

Within the span of years since the beginning of Jesuit education to the present we have gone:

1. from the telescopic discovery of the moons of Jupiter to close-up (relatively speaking) photographs of those same moons;
2. from the beginnings of understanding of the vascular system to bypass surgery, arterial replacement, and heart transplants;
3. from gunpowder to thermonuclear bombs;
4. from the abacus to computers;
5. from primitive understanding of the reproductive system, through the discovery of the ovum, to *in vitro* fertilization;
6. from zero to recombinant DNA;
7. from alchemy to the multitudinous products of chemistry without which our society would no longer function;
8. etc., etc., etc.

There is really no way to compare the times when Jesuit education began with the present times. Much of that difference is directly the result of science and the technology that has grown from it. This is true of the products of our everyday lives (cars, refrigerators, TV's, etc.) as well as the more exotic products like space probes, bacteria producing human insulin, "test-tube babies," etc. Educated people ought to be aware of how such things have come about and how they are to be put together. This is certainly a part of all education, Jesuit higher education included.

Also, in a society where science and technology are so central, people must be educated to quantitative appreciation, to a sense of scale. If I may impose on you, I'd like to quote from a friend of mine at Penn State -- Rustum Roy. He was commenting on the failure even of educated people to develop a sense of quantity:

> "I was involved with Three Mile Island. And the rubbish you had to put up with was so extreme. Take my students. . . 30 seniors at Penn State. I got back to Penn State from Harrisburg.
>
> They said: "We're afraid."
>
> "What are you afraid of?"
>
> "We're afraid we'll die of radiation."
>
> "How much radiation are you going to die of? How much radiation was there at Harrisburg?"
>
> "We don't know, but it sounds pretty big."
>
> "How's it going to get up here?" They weren't sure. I asked how radiation travels. Nobody had the foggiest idea. Little creepy-crawlies? They had no idea. How much radiation? Someone recalled reading a big number -- 1120. I asked what the unit was. It was 1120 picocuries. Sure sounds like a big number! So, I said to them: "We were talking about a nuclear war the other day. We were talking about megacuries. Which is bigger, megacuries or picocuries?"
>
> Remember these are seniors at Penn State. We had a vote on this since that's the way to get the truth in our democracy. Some of them allowed as how megacuries were smaller than picocuries. Twenty three of the 30 students didn't understand 18 orders of magnitude. . . . How many of you know what 18 orders of magnitude is? Well, I could compare the diameter of a human hair to the distance to the sun. Then you get a little feel of how bad a mistake we can make. People simply have no feel, no scale, no sense of quantification."

In a society where quantification means so much, it is discouraging to hear that a sense of scale is that badly lacking. How would such a question be answered in any Jesuit college or university? Would our students do any better? Yet, many of the issues facing society and Church -- issues like nuclear power, nuclear war, acid rain, etc., etc., depend on a sense of scale. Statistics -- as the recent election campaign showed -- are now the grist for public discourse. How many of our students (or ourselves) have an adequate feel for statistics?

Yet, as fantastic as the products of science and technology have become, as powerful as the techniques of science are, as great is the need for a quantitative sense -- these are not primary reasons why the study of science and technology should be central to Jesuit higher education. As greatly as science and technology have altered the landscape of our lives, so greatly has it raised new questions or changed the status of all of the old questions raised over the centuries. Unless philosophy and theology come to cope with these new questions and with the revised questions of the past, they will become simply vacuous.

Perhaps the perennially central religious quest is the search for unity. It assumes several different forms: the unity within God, God's unity with his creation, the unities that occur within the creation. These form the basis of many of the great philosophical and theological questions of the ages. Science of itself cannot help us much with the search for an understanding of the unity within God. Only indirectly can it help us understand God's unity with his creation. But it is of major importance in our recognition of unities among creatures. Where has the knowledge about such unities come from over the last several centuries? We have learned an enormous amount about the unities within creation *from the sciences*.

In 1687 Isaac Newton published the *Principia* in which he showed that the motion of celestial *and* terrestrial bodies was describable by the same equations. This was the final demise of Aristotelian spheres. Perhaps from our superior perch on the tree of knowledge we may yawn a bit when we hear it. But in its own day it represented a profoundly deeper understanding of a basic unity in the cosmos.

Approximately a hundred and twenty five years ago, Darwin, in his *Origin of Species*, maintained the unity of living systems at the level of the species, an idea overshadowed by the creation-evolution debate. Now, within the last decade scientists have discovered a much more profound unity in creation. Writing in *Science* in 1980 ("Recombinant DNA Revisited," Vol. 209, No. 4463, 19 Sept., 1980, p. 1317) Maxine Singer stated:

> We have learned that genes are fungible; animal genes function perfectly well within bacteria and bacterial genes within animal cells, confirming the unity of nature.

Thus, in our own day, in the aftermath of Watson and Crick's identification of the double helix, and as a result of the extraordinarily rapid and significant development in recombinant DNA research, we are becoming aware of the *unity of all living systems* at the level of amino acids. This development represents one of the greatest possible advances in the understanding of the unities with which God has constituted his universe. I personally find it difficult even to imagine a deeper physical unity. The discoveries of such unities within creation can be the springboard for a much more mature theology, a more profound philosophy, a more appropriate legal system, etc., if only we would seriously reflect on what science has *already* taught us.

Father Walter Ong has stated that the central intellectual and emotional problem in the Church's realization of her mission in the world today (and Jesuit education as a part of that mission) is that we have no cosmology. In a private letter to me he wrote, "We have had none (a cosmology) since the Aristotelian spheres and all that went with them were shown not to be there. The lack of a cosmology affects Christology, ecclesiology, and just about everything else in evangelization, including especially any real planning for the real future. For metaphysics, you obviously need a physics." The same is true of an anthropology; we can't have an authentic anthropology without a biology. Science has been a tremendously successful development; we can learn many things from it that are invaluable for progress in theology, philosophy, law, etc. These are among things that Jesuit institutions of higher education are in existence to promote. If there is to be anything like a research and development operation in the Church, it must come from Catholic (including Jesuit) universities and colleges. It is something that must motivate our efforts.

Biological science is now the center of interest in science, in development, in heavy funding -- both governmental and industrial. I shall go further and say that it is at the forefront of human intellectual progress. It may well eventuate that the greatest intellectual watershed of the 20th century was the identification of the structure of deoxyribonucleic acid, DNA. This crucial scientific, technological, and industrial revolution is seen in such things as "test-tube" babies, recombinant DNA, neuroscientific advances, as well as other biological developments which have already had a significant impact on the society and the Church. The spectrum of scientific and technological advance (the biological, chemical, physical, cybernetic, etc.) will have an even greater effect, especially in the areas of personal dignity, personal freedom and the "integrity" of the human body. Twice before in human history our scientific and technological genius has so radically redirected the course of human life as to merit from historians of culture the title of Revolution, namely, the Agricultural and Industrial Revolutions. A third scientific-technological revolution is already well begun. Its capacity to redirect the histories of peoples is *vastly* greater than that of either of its predecessors. Biological industrialization has begun -- on a very significant scale.

We have a great need for a much more positive approach to and appreciation of scientific advance. We in the university community need to be aware of where we are and of what is happening. In about 30 years the life sciences, under a very significant impulse from physics, have moved from an observational posture, through an intense and extraordinarily rapid analytic phase, to a synthetic capability. The life sciences have now become experimental sciences linked to technological and industrial capability. The late Charles Frankel has summed up the power and revolutionary character of these new techniques: "Biomedicine has eliminated the insouciance with

which most people have embraced technological progress. It forces consideration not simply of techniques and instrumentalities but of ends and purposes."

This should in its own right be a mandate for the place of science and technology in Jesuit higher education. Science and technology -- especially now bioscience and biotechnology -- are significant (and perhaps the most significant) engines for changing the course of human history. To be weak in science is, these days, simply to be divorced from the real world. There may have been a time when this was not true, but that time passed 50 years ago. Without a deep commitment to scientific understanding and appreciation, Jesuit higher education is fatally weakened. Without it that education is of significantly degraded value to society and to the Church in the realm of what we can loosely call "research and development." More, if we do not offer significant instructional opportunities (the-transmission-of-knowledge part of education) to our students, we are not preparing either a religious laity nor citizens competent to contribute to the cultural life of the Church and of the nation.

Still more, unless we dare be prophetic in our approach to education, we fail to fulfill our mandate as Catholics. Transmission of knowledge is necessary to Jesuit education but it is not sufficient to it. Dare we be prophetic? If we don't, we should quit. If we do, we should be realistically aware of the quality of a prophet's life. Do we have the courage?

The History

Does the historical place of science in Jesuit education inspire confidence? I think the place of science and technology in Jesuit education, if visually depicted, would resemble nothing so much as a painter's drop cloth. There is a significant amount of paint on the cloth, but it does not present an easily identifiable pattern. Because I have not been able to discover any real order in our approach to science, I plan to treat that history anecdotally.

After I accepted this assignment some seven or eight months ago, I looked up several Jesuit scientists of my generation and that generation immediately ahead of me. I figured that their experience would be a mirror on the place of science and technology in Jesuit higher education. That was and is my modest assumption here. I wanted, then, to check their reactions on the assumption that those reactions would be a significant commentary on the place of science in Jesuit education, say, for the last half century in the United States.

When I began my graduate studies in physics here at Saint Louis University thirty years ago, the older Jesuits, especially those in the sciences, used to speak of a priest who clearly belonged in anyone's pantheon of legendary eccentrics. The lore was that this man (a physicist) had written either a paper or a series of papers (that point was never very clear) on physics. The paper was never permitted to be published because it was considered to be irreconcilable with the then "official" philosophical doctrines. Theories proposed in that paper, the story continued, won a Nobel Prize for someone else years later. I can't say for sure whether or not this story was true. If all the stories we heard in those days about our athletic ability had been true, then almost all of us had been All-Americans. Nonetheless, what is important to this discussion is that no one felt that this sort of thing could not happen. It would have been no cause for surprise.

Another interesting chapter in the lore concerned Father Teodore Wulf. In 1936 the Nobel Prize went to a student of Father Wulf, Victor Hess, for work on cosmic rays. Father Wulf was a pioneer in such work; he invented the early cosmic ray detectors. But after World War I he was sent to teach the philosophers at Valkenberg, and relinquished the cosmic ray work. To be scrupulously fair I do not know that there were not other factors at work in the decision to send him to Valkenberg. Father Wulf had been a divisional chaplain in the German army during World War I. He *may* have been, as we say now, "burnt out."

Anyway, beginning after World War II, times and personalities conspired to make something new under the sun. A number of Jesuit superiors sent increasingly larger numbers of Jesuits into graduate studies in science. For a while it looked as if the parousia had arrived. There was major commitment of Jesuit manpower to science. But many of those trained at the time have a suspicion that, in terms of Jesuit education, they were never any more than a

highly trained labor pool, obviating the necessity of paying high salaries to non-Jesuit professors. Others felt that it was in response to the availability of federal money in science. Still, let's take the high road and assume that it was done out of the highest educational motives. Even in that case, the love of science for its own sake never really permeated the spirit of Jesuit education. Science, it is my opinion, never really occupied a central place in Jesuit education.

I have given these anecdotes not to suggest that we ought to send large numbers of Jesuits into science again nor to say that all of the blame for the demise of science and technology in our universities and colleges is to be laid at the feet of university administrators. Cultural factors were at work as well. The decline in the granting of graduate degrees in physics matches very closely the decline in religious vocations -- a very curious correlation. Financial factors were clearly involved. Finally, many of us who were brought along in the halcyon days have not stayed in the science in which we were trained. I myself am a perfect example of the syndrome that "old physicists never die, they simply become philosophers (or theologians)."

Yet, seen subjectively, many of the people with whom I talked, were aware of an intellectual priority in Jesuit higher education: theology and/or philosophy was first, depending on whether you were talking to a theologian or philosopher. Then there were the classics followed by English, maybe next by history, and then finally by the trade school courses like science, engineering, law, et. The sciences seem to have been an aside to the essence of Jesuit education. Ours were liberal arts colleges and universities; seemingly there was little place for science and technology.

Over the years, several Jesuit schools had very highly regarded programs in astronomy and in seismology. Various reasons were given for this: some felt that astronomy was popular when Jesuits started their educational apostolate; some thought that we were not able to re-establish our efforts in physics and chemistry when the Society was restored after its suppression; several pointed out that biology was eschewed because of a deep-seated malaise over questions of human origins. So, too, anthropology was basically ignored as dangerous.

Then, too, the *Ratio Studiorum* at least as it was interpreted to us, was certainly orientated to the `liberal arts' which were so defined as to exclude science from an integral role. I am of the opinion, the validity of which I shall leave to you to decide, that in Jesuit education the theoretical was to be preferred to the practical, to the technological. The impression was given that Greek was better than Latin, pure mathematics better than applied mathematics. ontology more dignified than ethics, etc. There seemed to be a set of preferences, if not formal priorities, which promoted the more theoretical over the more experimental. This also had the advantage of avoiding the raising of disturbing questions which called for a revision of thought or behavior.

My intention is certainly not to denigrate either the people involved nor the system itself. If my informal survey is accurate, then Jesuit education put rather little stress on *modern* science or technology. These were never a *central* concern in U.S. Jesuit education. We must steal a slogan from elsewhere: we were the "people last hired and first fired." So it has seemed to eventuate. The Golden Years (roughly 1945-1970) seem to have been an anomaly.

Summary

There can be no doubt that the fruits of modern science are not really a part of the Church's patrimony. At best the Church's conceptual life is finally Darwinian. It can not be said to be Einsteinian, Heisenbergian or Watson-Crick. The Church's failure here is mainly the failure of Catholic colleges and universities, and, reductively Jesuit institutions.

Theology is by nature involved with vast quantities of knowledge, all of which is radically beyond its control. It is not a research discipline, as that terminology is generally understood. It does not generate its own data as many other disciplines do. It derives its basic information from sources other than itself. Science and technology are absolutely basic to this process. But what is true of individuals is most likely true of institutions as well. The individual who learns a discipline as a tool for another discipline rarely learns it as well as one who approaches it in its own right,

for its own sake -- things like talent being roughly equal. So, too, I think, our institutions must promote science and technology in its own right, because it is an acceptable, appropriate, necessary intellectual enterprise.

If we are to be a serious intellectual force in our communities, in the nation, in the Church, we will need excellent science programs, rather than continuing the retrenchment that has been occurring. Not all science (even research science) is necessarily expensive beyond our reach. We could pick and choose; we don't need bevatrons.

Let me conclude by urging a growth in our commitment to both research and teaching in science and technology. Until we do, how can we call ourselves universities? Until science and technology are a significant component of the intellectual air we breathe on our campuses the Church will not be able to have an intellectual presence in the contemporary world. Moreover the stakes presented by that contemporary world are probably the highest with which the Church has been presented.

I believe that an objective appraisal of the issues facing our society and the Church will reveal the need for Catholic institutions of higher education to be deeply involved in scientific and technological advance as well as in critical evaluation of the meaning of this advance. If the Church as a whole is going to begin to think in categories appropriate to the issues raised by contemporary science and technology, it will have to begin on campuses like this one. If theology is to come alive again, it will have to learn to handle the vast, revolutionary new concepts that have arisen in the last half century. If philosophy (at least in its cosmological aspects) is to speak to the contemporary world, it cannot ignore the advances in physics. If law is going to be appropriate, it must be able to handle technologies like *in vitro* fertilization with its attendant issues like surrogate mothers, frozen embryos, etc.

Our institutional currency depends on our ability to incorporate science and technology into our curricular imagination. If we do not, our educational approach will be simply quaint. Yet we can always look to the imagination of our educational leaders to spur their schools to leadership in at least the less expensive aspects of science and technology.

The society we live in needs it. The Church needs it. If we are true to the spirit of Jesuit educational life, we shall provide it -- because that is our vocation.

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