



The Vineyard: Scientists in the Church

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Chapter I: Scientific Considerations

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Chapter I: Scientific Considerations

Introduction

While many groups have sprung up in the last twenty years to talk about the relationship between theology and science or faith and science, we do not believe that such dialogue is the most critical religious issue involved.(1) While dialogue is important, Christ did not send us to dialogue with the whole world but to preach the Good News. More, Christianity is an earthly religion because God is incarnate in that world. The better we understand that world and the more deeply we bring our knowledge of that world into contact with the Revelation we have received, the more profoundly we can bring it into Christ and Christ into it. This *en-Christing* of the world is the topic of this treatment.

The Role Of The Scientist

What is a scientist? Is science a myth or a very down-to-earth profession? There is no simple answer to this question. *Professionally*, the scientist is considered a person versed in “exact observation, organized experiment, and correct thinking.”(2) Science refers here to natural science, linked to the methodology of discovering and verifying the laws of nature by means of objective experimentation and mathematical description with the aim of discovering reproducible information about physical systems. *As a myth*, the scientist is often seen as a *magician* of a new and better world, pushing ahead the frontiers of knowledge, often pictured as de-throning Christian Doctrine and promising unlimited progress. This latter image has been tarnished of late because of the scientific contribution to weaponry, because of the environmental crisis and even because of scandals like plagiarism, altering data and what on occasion seems to be an unseemly rush for patenting discoveries. Also, the world which has been and still is being *created* by Progress does not seem to satisfy us as we once thought it would. To put it more colloquially, we have found that there are snakes in this paradise as well as all the ones before it.

The Historical Perspective

Any experience of human nature reveals that very little is done *for itself*. It is neither negative nor pessimistic to note that most human activity is a means to some further goal. Rarely is human activity considered to be an end in itself. Certainly some scientists have pursued their scientific work simply to discover what was there. I think we can all admit that this is rather less frequent than it used to be. It is also true that some scientists pursued their studies for fame and fortune. There is nothing at all wrong with this, but it does call into question the validity of the carefully cultivated myth that science is simply a pure and objective search for truth. Most of us, it seems, have pleasantly mixed motives when we do our scientific work; very few of us are single-minded enough to have pure motives about anything. Questions of ultimate goals, even penultimate goals, are as complex as the people about whom they are asked.

Thus, the word science is used both to describe an investigative method and its results (content) as well as to designate a worldview. Science and *the scientific outlook* are not the same things. Science as a methodology and the ideas driving it are two quite different things. In fact, while there is fairly general agreement on the method of science, its philosophical heart has undergone considerable change over the centuries.

Contrary to a common prejudice (3) which sees science and religion as totally hostile to each other, we owe the rise of science (the scientific revolution beginning in the 17th century) to the Greek-Christian heritage of the West.(4),(5),(6)The systematic quest for discovering the unknown was nurtured by the conviction of the intelligibility (and ontological goodness) of nature and found its justification and orientation in the Christian vocation to be, as son and heir of God, the steward of creation. At that time, there was a general religious basis to the ideal of *pure science*, i.e., the disinterested (objective) pursuit of knowledge aimed at placing its fruits at the service of all.

As Herbert Butterfield mentions in his great classic, *The Origin of Modern Science*:

Many of the scientists of the 17th century had been pious Protestants and Catholics, and in this very period both Robert Boyle and Isaac Newton showed considerable fervor concerning their Christianity - even Descartes had thought that his work would serve the cause of religion. It had almost been a mystical urge and a religious preoccupation which had impelled a man like Kepler to reduce the universe to mechanical law in order to show that God was consistent and reasonable - that he had not left things at the mercy even of his own caprice.(7)

Kaiser also points this out:

The eighteenth century or Enlightenment period is often viewed as a radical new departure in Western thought. It can be portrayed, for instance, as a cultural transition from faith to reason, or from the hegemony of theology to the dominance of natural science....

Theological beliefs continued to play an important role in the development of the natural sciences throughout the eighteenth and well into the nineteenth century. The main difference from earlier periods was that there was less orthodoxy and more variety -- ranging from orthodox trinitarianism to monistic materialism -- in the theological stances assumed. The fact that unanimity in theology seemed more remote, or even impossible, undoubtedly contributed to the later (nineteenth and twentieth century) tendency to suppress personal convictions in science -- scientists no longer needed theological legitimation for their work anyway -- but this trend was only dimly evident in the eighteenth century itself.(8)

This reference to God that Butterfield finds in many of the scientists of the seventeenth century is clearly found in Newton's *Principia*:

This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being. And if the fixed stars are the centers of like systems, these, being formed by the like wise counsel, must all be subject to the dominion of the One; especially since the light of the fixed stars is of the same nature with the light of the sun, and from every system light passes into all the other systems: and lest the systems of the fixed stars should, by their gravity, fall on each other, he hath placed those systems at immense distances from one another.

This Being governs all things, not as the soul of the world, but as Lord over all; and on account of his dominion he is wont to be called Lord God *pantokrator*, or *Universal Ruler*;....(9)

Whether the *scientists* of the sixteenth and seventeenth century thought of themselves as natural philosophers (or theologians) or as *scientists* (a word that did not come into currency in English until the middle of the nineteenth century), they developed an effective methodology, one little changed since then,(10) with which to pursue a deeper and clearer understanding of the composition and laws of the tangible universe. The success of this endeavor, under the hands particularly of the French, brought about the *emancipation* of this intellectual pursuit from any religious mooring or meaning and made scientific understanding the paradigm of the world views of the 19th century. This development, however, hardly came from the scientists. As Butterfield states:

The results of the scientific revolution were precipitately and hastily translated into a new world view, and this work was carried out not so much by scientists as by men of letters.(11)

What many of our contemporaries accept as *science* is in reality the agenda of literary men, secularizers like Fontenelle, Voltaire, and the French encyclopedists. Butterfield continues:

He (Fontenelle) did not merely popularize the scientific achievement of the seventeenth century. It is important to note that the literary man intervenes at this crucial stage of the story and performs a second function - the translation of the scientific achievement into a new view of life and of the universe. . . .

Fontenelle . . . had held his skeptical views before coming into touch with the scientific movement at all - had learned them from Lucretius and from more modern writers like Machiavelli and Montaigne. A scepticism which really had a literary genealogy combined to give to the results of the seventeenth-century scientific movement a bias which was rarely to be seen in the scientists themselves and which Descartes would have repudiated. And this was encouraged by the obstructive attitude of the Roman Catholic clergy in France, who helped to strengthen the impression that the Church was the enemy of scientific discovery and, indeed, of anything new. In this connection it is important to note that the great movement of the eighteenth century was a literary one -- it was not the new discoveries of science in that epoch but, rather, the French *philosophe* movement that decided the next turn in the story and determined the course Western civilisation was to take. The discoveries of seventeenth century science were transformed into a new outlook and a new world-view, not by the scientists themselves, but by the heirs and successors of Fontenelle.(12)

As Kaiser remarks:

Like d'Alembert, Laplace referred to the 'Author' of nature, but worked to eliminate the remaining grounds for any reference to God in discussions of nature. Whereas Newton and others were motivated to heroic lengths by their desire to demonstrate the activity of God in nature, Laplace was motivated by the desire to eliminate whatever grounds remained for such reference to the divine. In effect, his science was his religion.(13)

Still today, scientific self-understanding is dominated by the anti-authoritarian bias of the progenitors of the French Revolution, and its agnosticism or atheism comes largely from Post-Revolutionary intellectuals like Prudhon and Comte. The philosophical base of contemporary science is an atheistic belief in the dogma of Progress; it is anti-creation and anti-providence. Karl Löwith's assessment of Proudhon's thought shows how sharply religious the issue really is:

Proudhon had the keenest insight into the anti-Christian implications of the modern religion of progress. He is the theologian of progress and, as such, the most radical critic of providence; for he understood that the recognition of and submission to either pagan fate or Christian providence is incompatible with the faith in progress, which is essentially revolutionary and worldly. Christianity ... replaced impersonal fate by personal providence; the task of the modern revolution, according to Proudhon, is the *defatalisation* of the latter by taking into the hands of man and of human justice the direction of all human affairs. Man has to replace God, and the belief in human progress has to supplant the faith in providence... The providence of God is nothing else than the "collective instinct" or "universal reason" of man as a social being. The god of history is but man's own creation, and "atheism (i.e., humanism) the foundation of every theodicy. This "humanitarian atheism" is the last term in man's intellectual and moral liberation, and at the same time it serves "the scientific reconstruction and verification" of all those dogmas which have been demolished by rational analysis....

...The coming revolution, which is economic and social, will mark the end of the religious, aristocratic, and bourgeois age. It will bring about final equality by the "equation of man with humanity." To effect this ultimate advance, man has to take up the eternal fight between man and God and decide it; for God, or the Absolute, is the one great source of all kinds of absolutism -- economic, political, religious.... "We attain to science in spite of him (God), to well-being in spite of him: every progress is a victory in which we crush the deity." By and by man will become the master of creation and thus equal God. Instead of man's being created in the image of a providential God, God is created in the image of man's power of foreseeing and providing.(14)

The scientific movement has been a part of the general secularizing movement of western life and thought over the past three centuries. Two important Christian truths, namely, providence and original sin, have been denied in western gnostic culture. These truths have been replaced in the general culture, and in many elements of the scientific sub-culture, by the gnostic dogmas of human prevision and the perfectibility of human beings.

Progressivist science is a salvation scheme; it is not merely just another system of thought. What is called *unbelief* in the scientific community is either a belief in the immanent gnosticism of contemporary western culture or simply a basic indifference to questions of meaning.

Stimulated by the tremendous promises of its use, men of politics and industry as well exerted their influence. As Butterfield continues:

The passion to extend the scientific method to every branch of thought was at least equalled by the passion to make science serve the cause of industry and agriculture and it was accompanied by a sort of technological fervor. Francis Bacon had always laid stress on the immense utilitarian possibilities of science, the advantages beyond all dreams that would come from the control of nature; and it is difficult, even in the early history of the (British) Royal Society to separate the interest shown in the cause of pure scientific truth from the curiosity in respect of useful inventions on the one part, or the inclination to dabble in fables and freakishness on the other.(15)

From the beginning, science has been influenced from outside itself, with agendas quite different from those of the scientists. Since its methodology works by its own momentum and (functional) autonomy,(16) science in itself does not depend on the attitude or creed of the individual scientist. Science and technology are *means to an end*. We might seriously contemplate the driving forces of science. What is it that determines the direction of science, which sciences are *in*, what research is funded and what research is not funded. These are driven by social or political ends, not by the inherent needs of the discipline. AIDS research is a prime example of this. The *ends* of scientific research are not a matter of the science as such. Recently, scientific development has taken place in a kind of religious and moral vacuum. Neither the church(es) nor other religious groups have been willing or able to give any serious meaning and orientation to the accelerating growth of scientific discovery and its technological application. We shall consider this a bit more specifically in Chapters 4 and 5.

The consequences are alarming. Science and technology have opened unheard-of “perspectives for a full humanness” as well as “gigantic projections of human malice.”(17) As C.F. von Weizsäcker states it:

A culture cannot be stable as long as its means are developed one order of magnitude farther than the awareness of its ends.(18)

We have cause for concern, but no cause for panic. Yet, any who would have humanity abandon technical progress and return to a simpler, less technological way of life stand athwart the currents of history.

The future of progress is still doubtful and precarious. Humanity at best appears as a shipwrecked crew which has taken refuge on a narrow ledge of rock beaten by wind and wave; we cannot tell how many, if any at all, will survive when the long night gives place to morning.... (We see) gigantic and novel forces of mechanical invention, upheavals of peoples, social discontents ... vast implements of destruction placed in the hands of a civilization imperfectly self-controlled (in which) material advance has transcended moral progress.

Much is written about material advances transcending moral progress. The above citation, reported by Barbara Tuchman in *The Proud Tower*, is from a book entitled “*The Condition of England*,” written by Charles F. G. Masterman in 1909. The more things change they more they stay the same. Take “gigantic and novel forces of mechanical invention” and add atomic power, the computer, the biotechnologies! Take “upheavals of people, social discontents” and add the Russian Revolution, the Nazi era, the communization of China, the end of colonialism! Then wonder about civilizations “imperfectly self-controlled” in the context of World War I and World War II, Cambodia and so on! But we’re still here -- and we’re still worried.

We can derive much hope and consolation both from the facts that the experiment has not ended and that people are still concerned about “material advances transcending moral progress” and “means developed ... farther than the awareness of its ends.” If the experiment that is humanity had ended, through human ignorance or malice

or through the divine plan, worry would not be possible. If human moral progress had caught up with human curiosity and its penchant for creating problems, this race would have lost its creativity, its inherent dignity and its freedom. Life without issues, challenges and problems would be, from a Christian point of view, a useless experience. The Christian challenge is not to live a life of moral ease. It is rather to attempt to cope with the issues we human beings ourselves raise. In this we do not *play God*, we simply follow the dynamism of humanness and the power of the freedom with which God has blessed us.

Starting with the atomic bomb, escalating with the new challenges of today's technologies, a seeming *ethical neutrality* of the scientific endeavor is questioned by the community of scientists and society as a whole.

The Present Challenge

It is hardly an exaggeration to say that *pure science* is a thing of the past. Since the early part of the 20th century, and especially since the beginning of World War II, the age of science has given way to the age of technology. Better, science has become closely wedded to technology. The lead time between scientific discovery and technological application has become significantly shorter, especially in the life sciences. Advances in computer technology have themselves given birth to new kinds of scientific efforts, all the implications of which we cannot yet see.(19) Though scientists are themselves the makers of what we call the technological age and though they are still the professionals doing "genuinely demanding and exciting labor at the frontier"(20) of understanding, there is significant evidence to support the statement that scientists are undergoing a change in or a crisis of identity.

Some scientists are increasingly uneasy about the unforeseeable and uncontrollable possible consequences of scientific effort. They also seem to be uneasy about their role in society and perhaps even about the meaning of the scientific endeavor as a whole. There are questions about the certainty and applicability of scientific knowledge, about the limits of the scientific method itself, about the moral integrity of scientists in the pursuit of highly competitive research and about the spiraling cost of this quest for the unknown, especially in the case of "Big Science" projects like the Superconducting Super Collider and the Human Genome Project.

In the United States there are congressional hearings on the misconduct of scientists, on the breakdown of procedures for everything, from the research protocol itself, through personal profiting from public funds, to the methods of the publication of results. Movements, such as the animal-rights movement, call into question the once generally accepted justification for basic research and especially for publicly funded research. Within the scientific community itself there is something of an awakening to a new sense of social responsibility and a somewhat partly increased skepticism, or even cynicism.(21)

No one, however, can close his or her eyes to the new challenges which the expanded scope of science has brought about. For example, the methodologies of science were developed primarily for research on inanimate objects. There, the manipulation of the research object could be as complete as the experimenter could make it, even to finally destroying it. Now, that same methodology has been brought to bear on animate research objects. During World War II a still relatively unnoticed but very significant event occurred: the publication of Erwin Schrödinger's book, *What Is Life?*. Physicists became interested in biological issues, and biology very rapidly became *the physics of living systems*. Historians in the future may see the implications of this change as greater than those of the development of atomic and thermonuclear weapons. Biology has moved with great speed from its former observational posture through an extraordinarily intense analytical period to, presently, a synthetic stage: synthetic in the sense of building new living systems or parts thereof. The challenges hidden in the shift from observation to synthesis are not yet clearly seen by the majority of scientists, nor indeed by others.

To take up just one crucial issue: There is an increasing amount of research on human tissue, especially in the areas of reproductive biology and embryology. If we continue unthinkingly to apply the canons of a research methodology developed for inanimate systems to research on human beings, there is a dilemma inevitably to be faced. Part of the scientific ethos always has been objectivity, indifference as to result. Whether an inanimate object exhibited this or that property could be viewed with indifference. Whether the dielectric constant of boron,

for example, was large or small could be accepted with equanimity. When, however, scientists experiment on living human beings, say in embryology or genetic research, can they remain indifferent to results? Can they be *objective*? Does an objective experimental approach to the study of human beings imply that they are mere objects to be manipulated at the experimenter's will? More, what is the justification for such experimental work? Inevitably this must raise the question, *What is Man?* Most scientists would back away from that question with great haste. Yet, the question is there and will have to be *resolved* even if the resolution comes down to ignoring the question.

Science has become so important to human living and social development that its results affect every facet of human life, every aspect of planetary living, either through the technological products or through the view of reality that drives science itself as well as technological and industrial production. In this regard the philosophy or theology that drives science is of utmost importance to the society as a whole and the Christianity.

There is a clear need to reappraise the meaning of science and its activities and products. The very preeminence of science in human living today demands this. Like all the rest of creation, science and scientists are not immune to the need for reformation, for redirection. This reformation or redirection, as in the case of all human activity, must be conscious and deliberate. Needless to say, it is not just science that ought to be the object of such reflection. Harry Boardman, former General Secretary-General of the Council for Biology in Human Affairs, the Salk Institute, La Jolla, California, made a very clear point on this issue:

Far too pervasively, these endless biomedical-science-value discussions manifest a deplorable blindness which seems to proceed from an hypnotic fascination with appliances and appliance-makers.... The central concern is not with science or scientists but with the whole of knowledge - its benefits, the price it exacts, and its special province: that of ideas. For ideas far afield from science and technology may be the most lethal. Inspiration for man's action lies not in his appliances - as much as they may encourage or inhibit it - but in the spell of ideas and the conviction of mind and heart which they generate.(22)

Convictions of mind and heart root the human being in certain ideas, values, persons, which in turn give meaning and goals to our lives; they establish the *climate* in which interior human living expands and ultimately flowers. As St. Augustine emphasized: our actions flow from our *deepest loves*. Therefore, it is those deepest loves which demand our prime attention and concern.

If there is any accuracy in the above assessment of our cultural development, men and women in science have an obligation to re-examine not only the assumptions of science, its position and purpose within the broader human scheme, but also and especially *those convictions of mind and heart* that motivate the pursuit of scientific work. We cannot abdicate that role; we cannot "wash our hands" of this obligation by saying that what society does with our results is society's concern. It is very much ours as well.

Is the scientist prepared to engage in this critical reflection?

Generally, so it seems, scientists are unwilling to acknowledge even the need for such re-thinking. The prevailing mood, in spite of the growing uneasiness of individuals and the public, is one of *business as usual*.

What about the ethicists or theologians? What about the Church(es)? The Christic origination (23) of science would make it logical to seek the general frame of a vision for scientists in that cultural tradition from which science received its primary motivation. Does the Christian faith still have anything to offer in the challenge of re-thinking scientific development? Of course it does -- and we Christians in science bear the most serious obligations to work both in the church(es) and in the scientific community to bring the riches of our faith to these fundamental issues and concerns.

In view of the tangled relationship between science and theology (and derivatively, Christian faith) over the past three centuries and the coolness (and even hostility) which still exists today between science and the Christian

faith, this is a daring question. The answer is even more daring. It is an unequivocal Yes. And the Yes must be shown and proclaimed by us Christians in science and technology.

As mentioned above, secularized thinking entered science very early on, apparently without any counterbalance from the Christian vision. Yet we held and currently hold that a life in science is not only compatible with but *in se* fulfills the Christian call to worship God. What went wrong?

Kaiser's observation is appropriate here:

The secular ideals of d'Alembert and Laplace are important because they have become the motivating ideal of many physical scientists of the nineteenth and twentieth centuries. We are suggesting that they are the product of a particular history and theology, not a necessary concomitant of progressive science. Those who single-mindedly pursue scientific research will generally be motivated by ideals of some sort. The ideals in question must be the ones that appear to vindicate faith in the comprehensibility, unity and relative autonomy of the world. As long as Christian theology was clearly associated with these beliefs, it was conducive to good scientific work and constructive criticism of science as we have seen. But, in the seventeenth and eighteenth centuries, a long-range tendency to view the active role of God and the innate properties of matter as alternative modes of explanation gained credence to the extent that the ideals needed for the furtherance of science could no longer so readily be sustained by positive Christian commitment.

From an historical viewpoint, this development resulted from the tendency of theological parties to define themselves by the exclusion of others at the expense of the integrity of the creationist tradition as a whole. This is perhaps most clearly seen in the naturalist-conservative split of the twelfth century and the latitudinarian-spiritualist controversy in seventeenth century England. There is no reason to believe that the development was inevitable or that it could not have pursued a different course. Therefore, there is no reason to suppose that the future development of science might not find its motivation once again in the creationist tradition, particularly if its present secular orientation is found to fail.(24)

Considering the fact that what is called the Scientific Revolution took place in the seventeenth century, the more adequate question might be: was the Church of that time prepared to meet the challenge? The newness of the newly self-conscious scientific endeavor, the fascination and power of its methodology, the outlook and spiritual climate it creates, were (and are) experiences that hardly enter the theological heart of the Church. What theologian could grasp the challenge of science not only as a profession but as a culture-forming force? Unfortunately, none did and very few seem aware of it even now. There was no explicit official statement about the laity's mission or the relationship between the Church and the world until Vatican II. Actually, the role of the laity was taken for granted, but the church showed no real appreciation of the deeper reality of this then new formal methodology. Thus, it should not be surprising that the Church's answer is not sufficiently developed.

History and the problems we are facing today both teach us that faith and science must enter into dialogue and that such dialogue should be more than a forced communication from one closed *autonomous*(25) system to another. It seems that a Christian vision of science and, consequently, a Christian *heart* within the scientific endeavor, will come particularly through the dialogue of faith and science *within the person of the scientist himself or herself*. Though a deeper theological development of faith/science issues is the work of the theological professionals, the content of those formulations is *acutely the task of the scientific professionals themselves*. There is an urgent need, then, for Christian men and women in science -- those deeply faithful to the canons of their science and deeply committed, personally and corporately to their Christian faith -- to re-examine, develop and propagate the resources of the Christian Faith.

While the conviction of mind and heart of the *individual* Christian in science is of great importance, it is not sufficient to the full dimension of the issue. The church as the covenantal Bride of Christ must be involved as well. It is here that we individuals are enabled to bring Christ to the world. Moreover, because of the escalation

of the problems and responsibilities that are part and parcel of the professions of science and technology, there is an urgency in developing a *new ethos* for an entire group of people; this involves, in brief, a culture-forming potential. By a *new ethos* we mean an understanding and a way of doing that is imbued with the richness of the true Christian realization of the meaning and destiny of the created world. It must be both an understanding and a way of doing on a *communal* as well as an individual basis. We are never just individuals; we are the bearers of Christ in and through the church. It is our duty and opportunity to be able to bring these concerns to a conscious deliberate level both in the scientific community and in the church(es).

In many ways, the opportunity and challenge of the contemporary development in our scientific-technological-industrial culture, namely the growth of a *global consciousness and integral responsibility*, applies primarily to the scientist. As H. Beck states:

What formerly had been the most intimately private affair, namely how to fill one's life with meaning, manifests itself today as a public matter of worldwide existential significance. With the decision that each one has to make for a religious or a-religious approach he assumes responsibility not only for himself but also for everyone else. This truth has always been valid, but only today, in our technological age, it proliferates with all its inherent radicalism....(26)

Certainly, such communal aspects must be approached with caution. Many of the environmentally conscious thinkers and writers carry the communal aspect beyond any realistic bounds, demanding of people a cosmic responsibility (and a *cosmic piety*) which will lead to tyranny, to a loss of God's greatest gift to humanity, namely, the need for and the urge to a fuller and fuller freedom. The Gaia hypothesis, in our view, is a perfect example of this excessive cosmic *piety*. Equally, the fact that a *conviction of mind and heart* is not only a private but also a communal affair, runs counter to the prevailing cultural obsession with *privacy*. The technological challenges, however, cannot be met otherwise; they cry out for a new ethos and pedagogy; they ask for a new and enriching mobilization of those inner forces (conscience, vision, a love of neighbor and creation itself and especially of Christ and the church) which only faith can engender.

The remainder of this essay deals with this challenge. What can Christian scientists bring to the workbench to help insure that the scientific/technological future be one which truly benefits human beings and, reductively, the whole of creation?

The Christian Vision

Christian men and women in science, in virtue of their baptism, are obligated and, indeed, privileged to lead the church into this new era, to help the Church formulate both the scientific and the theological aspects of that "New Human" who is about to be born through scientific and technological advance and, finally, and at least equally important, to be evangelists to the scientific/technical community. This is a massive and difficult agenda, and a long term process.

This work does not intend to assess (yet again) the relationship between science and technology. While a critical appraisal of where the church and science are going will be needed from time to time, the purpose of this book is the beginning of a formulation of a faith-approach to science and the life of the scientist. That is to say, the development here treats the meaning and challenge of a life of science (as a vocation in its own right and as an indispensable way of life for those Christians who are attracted to it) in terms of a Christian understanding and practice.

The development is also concerned with a Christian approach to science as a form of true worship. This clearly demands an enlargement and enrichment of our understanding of science and Christian worship. In presenting a vision for those Christians who pursue a life in science, we may and must call upon the biblical and theological tradition and also the great spiritual traditions of the Benedictines, Franciscans and the like. What elements may and must be included, and even come to the fore?

What approach does justice to the situation of the scientist?

Any Christian vision of the scientist's vocation must, indeed, reflect critically on the work he or she does and on that specific spiritual climate that (natural) science creates. How does the Covenant offered to us in Jesus Christ, become experience (*event*) for the scientist? In the work they do scientists encounter creation, i.e., the material universe, in its most untouched state -- whether we think of probing the atmosphere of Mars, of detecting new elementary particles, or of genome mapping and sequencing -- and they very often find it void of God. The language of science (mathematics) is bare of any symbolism by which our imagination would *bridge the gap* between this world and its creator. Scientific methodology adjusts perfectly to nature's own relative autonomy (and the real limiting situation in nature). Quite naturally, some scientists may want to *discover* God in the same way they discover elementary particles, and equally naturally they know that they will not find him.

We experience God's transcendence more often than his immanence. While there are moments in life -- be it birth, death or an encounter of deep personal love -- when we touch mystery in a way that God seems to be *just behind* a thin veil, everyday scientific work in its objectivity lacks those dimensions. Consider two widely reported impressions of astronauts: "I have been out there and have seen no God" or "Never did I stand with such awe before God's creation." These reactions are everyday experiences of scientists and accompany every advance in their work. In this context, there is no way to relate the physical creation to God except by way of the human who is a part of this creation, takes it into service, and lends it a human voice.

In seeking God, scientists cannot turn to their field of work nor resort to its methodology; they must establish a relationship to God from within as *persons and agents* of the scientific effort. This implies the need for an *anthropological, i.e. truly existential approach* to a Christian vision of the scientific vocation. There are two apparently contradictory experiences specific to scientific activity, that support this assertion.

First, science is a deeply human activity in which the human carries out a command of God as well as an innate drive of the person to inquire, to imagine, to play, to know, and to act upon that knowledge and appreciation. To be a good scientist, one must be a scientist with his or her whole being, and only in this way will the vocation be fully realized. The Christian vocation of the scientist, then, is not the matter of a few hours' reflection or attending church on Sunday morning. Rather, it is fulfilled in the scientist by the Christ-based, very *personal* conviction about the necessity and worth of his or her existence and role in the developing salvation of the universe. It should be, ideally, a conviction so deeply rooted in one's total being that in the midst of highly sophisticated intellectual activity it accompanies one as a subconscious security, motivation and ultimately, joy -- another expression of Augustine's *deepest love* -- at being a scientist and doing scientific work.

On the other hand, although science is intensely human activity, *it does not have the total human as its direct and immediate object*. It deals with aspects of humanness -- the body, the history of bodily development and so on. The method of inquiry looks for those phenomena which are common to all of matter, animate or inanimate, and which lend themselves to mathematical description. Science abstracts from the uniqueness of the research object: this is especially evident in research on living systems. Probably more than anything else, this seems to be the root of the *vulnerability* of science toward misuse and of the scientist toward disillusionment, or an improper reductionism.(27) As was mentioned earlier, science has been and continues to be directed by influences outside itself.

While those in other professions -- doctors, nurses, lawyers, clergy -- see the immediate human effects of their work and also experience a direct human recompense, scientists are thrown back on themselves for motivation, thrown back on their own natural resources. Scientists stand in greater need for the recompense involved in meaning and counsel on the direction of their work, for a controlling vision that addresses them in the depth of their humanness. In a truly existential approach they must call upon their own dignity and power to determine *from within* themselves the meaning of their unique historical situation. In other words, conscience must accompany science from within the scientist, if science is to remain a humane endeavor. It must be a concerted and deliberate working toward the common good of humanity and the whole creation.

As Francis Bacon noted long ago, scientific knowledge is such that it fosters control. Therefore, the one who knows and applies it must do so in a context of a deeper knowledge and a more profound appreciation (i.e., love) of as much of creation and especially mankind as we can understand. It has been the lack of this accompanying knowledge and, even more, appreciation and respect that has led to the environmental degradations that we are beginning to notice.

In a classical way, Jesus Christ describes this deeper knowledge, and appreciation in his words “I know mine and mine know me” (Jn 10:14). *Knowing each other* in this context stands for the most profound oneness between himself and his followers, similar to the oneness of Father and Son in the Trinity. It is not a knowing from the outside that probes the other regarding his potential, usefulness, manipulability, but a *being at home* with each other, an identification with and responsibility for the ultimate *raison d’etre* of the other person. It is understanding and care. “I know you,” spoken by Jesus, implies: “I am in you,” and, even, “I am here for you.” Such knowledge does not awaken fear in the other one but a sense of being sheltered. It is the same kind of knowing by which a mother is certain about what serves the life of her child. She needs no study for this; the child once was (and forever is) within her. Her discernment about what is good for the child and what is destructive is ideally an intuitive knowledge coming from disinterested concern. Jesus invokes the image of such concern when he speaks of the Good Shepherd and of his Father’s love for humanity and all of creation.

There is good reason to call for this deeper knowledge and concern to accompany the present development of science and technology. To a large extent, our world has become the scientist’s own creation and responsibility. He “adapts himself to the world but not without adopting it.”(28) As scientists develop and use new technology, as described above, the responsibility for their actions and the products of their work reach into totally new dimensions, human life as such, life conditions beyond our planet and generations to come. Speaking about these new challenges, Hans Jonas uses parental responsibility as a paradigm.(29) The Bible implicitly does the same when it states that the human person dealing with creation should be an image of God the Father. It is typical of parental love to secure and foster the growth of the beloved. Reverence or appreciation should do so in every kind of love, but in parental love the growing self-reliance and freedom of the child is in se the primary concern. Since neither the earth nor future generations can defend themselves against the forming or deforming grip of a scientifically based technology, such *fatherly* and *motherly* concern in directing science seem to be a necessity.

While the concern for what serves life has always been part of the ethos of the health professions, of the clergy and so on, and is developed in the exercise of these professions themselves, it is alien to the *methodology* of science. Again, this implies that scientists, more than other professionals, in animating and evaluating their work, must rely on Christ within them, on a *vital* knowledge of and a *covenantal relationship* with God the Father in and through Christ in the church.

Certainly, in our Christian tradition, scientific work has always received purpose and meaning from seeing nature as a free gift from God to mankind, and the labor of its discovery as a divine mandate to realize a fuller human life as well as an enriched creation. For such a vision to become an inner driving force, the divine mandate has to be a personal appeal and invitation of the One who knows me and whom I know as part of myself in Christ. It presupposes that scientists, as persons and agents, have first experienced, in the core of their being, the life-giving presence of a personal God and Savior. Only such knowledge can open the inner eye to the ever valid Christian vision which enables the scientist to recognize a divine and loving plan and invitation behind the challenges and the daily routine of a life in science. It enables the scientist to feel co-responsible for it. The full Christian dimension of scientific activity is not fulfilled by *making a living in science*; scientific work, done in awareness of the full responsibility (and also grace-given capability) of imaging God’s own activity, is worshipping God.

The Christian vision of science should be rooted in an enriched theology of work, a deep understanding of the commission of the laity, of the sacramental and covenantal dimensions of Christian life in the world. It will have to cope realistically with many seeming polar opposites: work and religion (i.e., contemplation and action), the present state of the world and that of the world to come, autonomy and accountability in the context of the positive

limits of creation and of God's will, scientific objectivity and subjective interiorization. In an analogous way, this should ideally move toward a vision of mission for all working men and women in our increasingly technological age.

Endnotes

1. The Institute for Theological Encounter with Science and Technology (ITEST) is one of these faith science groups with a somewhat different focus from most. The purposes of ITEST are: (1) To act as an "early-warning system" for the Church on work being done in the scientific laboratories; (2) To translate this information into a theological/ecclesial vocabulary; (3) To identify those scientific developments affecting Christian belief and to promote Christian teaching in these matters; (4) To build a community of scientists who are dedicated both to the advancement of scientific understanding as well as to the growth of the Church. We consider this fourth purpose to be the most important for ITEST.

ITEST is an international, interdisciplinary, interfaith community of Christians concerned with one of the most urgent problems facing the Church and the civil society, namely, the revolutionary advance in scientific and technological capability, particularly as it is being directed toward living systems. Religiously, these developments are important relative to human dignity, freedom and integrity. Socially, the technologies and industries developing from advances in the life sciences have the potential of being used to create a society in which the human being is merely an interchangeable part of the social machinery.

ITEST addresses itself primarily to the scientist and technologist. It also invites the integrating participation of economists, lawyers, social and behavioral scientists, physicians, philosophers, theologians, and those concerned with opportunities and challenges of future scientific development. ITEST is concerned with the meaning of scientific and technological advance as that relates to the Christian understanding of the human and of creation.

ITEST was incorporated in 1968 under the Missouri not-for-profit Corporation Act and was granted tax exempt status under section 501 (c)(3) of the Internal Revenue Code. Membership now stands at almost 600 in 30 countries, from all major scientific fields, medicine, law, the humanities, philosophy, and theology.

2. *Collier's Standard Dictionary*.
3. Cf. the books, for example, of Carl Sagan and Steven J. Gould.
4. Enrico Cantore, "The Christic Origination of Science," *ITEST Monograph*, 1986. Reprinted from the *Journal of the American Scientific Affiliation*, Vol. 37, No. 4, Dec., 1985.
5. Among others, Lynn White, Jr., "The Historical Roots of Our Ecological Crisis," *Science*, 10 Mar., 1967, Vol. 155, pp. 1203-1207.
6. Christopher Kaiser, *Creation and the History of Science*, Grand Rapids, MI: Wm. B. Eerdmans Publishing Company, 1991. This book traces the complex interaction between science and Jewish and Christian faith since the 2nd century BC. It is worth reading the entire volume to see the multiple sources of both modern science and religion.
7. Herbert Butterfield, *The Origin of Modern Science*, (revised edition), New York: The Free Press, 1957, p. 177.
8. Kaiser, p. 188.
9. Isaac Newton, "Mathematical Principles of Natural Philosophy," in *Great Books of the Western World*, Robert Maynard Hutchins, Editor in Chief, Chicago: Encyclopaedia Britannica, Inc., Vol. 34, 1952, pp. 369-370.

10. This is evidently about to change with the greater use of “computer-driven science.” Very large and very complex systems (like weather systems or complex biological organisms) are being studied through computer simulation. Although data supported, the primary base for such scientific “experiment” is the set of assumptions built into the system. This is one step further away from the research object. The immediate object of such scientific work, then, is already an interpretation of data. We should be more aware of the differences involved in such science from the way science has been practiced.
11. Butterfield, p. 177.
12. *Ibid.*, p. 178.
13. Kaiser, p. 268.
14. Karl Löwith, *Meaning in History*, Chicago: University of Chicago Press, 1949, pp. 61-65.
15. *Ibid.*, pp. 197-198.
16. Eva-Maria Amrhein, “Aspects of a Theology of Technology,” in E. Lugo, *Etica Profesional para la Ingenieria*, Puerto Rico: Libreria Universal, 1985.
17. Andreas G.M. van Melsen, *Naturwissenschaft und Technik*, Koeln: Bachem Verlag, chapter 12.
18. Carl Friedrich von Weizsäcker, *Der Garten des Menschlichen*, Frankfurt: Fischer Verlag, 1980, p. 76.
19. ITEST plans to treat the issue of computer-generated science at length in a volume on faith/science issues that should be available by the summer of 1993.
20. Alfred Borgmann, “Prospects for the Theology of Technology,” in *Theology and Technology*, ed. C. Mitcham and J. Grote, Lanham: University Press of America, 1984, p. 414.
21. Lugo, Chapter VI.
22. Harry Boardman, “Some Reflections on Science and Society: A Terrain of Mostly Cliches and Nonsense, Relieved only by the Sanity of Whitehead,” a paper delivered at a meeting of the American Association for the Advancement of Science. The authors have never been able to find a reference to publication and have this talk only in manuscript form.
23. See Endnote 4.
24. Kaiser, p. 269. As Kaiser says elsewhere, “the historic creationist tradition is not to be confused with modern-day ‘creation science’ or ‘creationism’.... The fundamental idea in the creationist tradition is that the entire universe is subject to a single code of law which was established along with the universe at the beginning of time. The origin of the universe is beyond human understanding, depending as it does on the wisdom and will of God, but its subsequent operation can be understood due to the fact that human reason is in some way a reflection or image of that same lawfulness or reason that governs the world. (page 6).
25. The word *autonomous* will occur frequently throughout this work. Unless otherwise noted, we shall use this word in its root sense, namely, that which moves by its own laws. The autonomous is independent but not self-sufficient in this terminology. Part of the problem with the environment and with the effect on humans from science and technology derives in part, we think, from the element of self-sufficiency. Also, recent awareness indicates that we should think of *autonomous* systems more in terms of interdependence than of independence.

26. Heinrich Beck, *Kulturphilosophie der Technik*, Trier: Spee Verlag, 1979, p. 65.
27. Among others, see Ian Barbour, *Science and Secularity*, San Francisco: Harper and Row, 1970.
28. Gabriel Vahanian, *God and Utopia*, New York: The Seabury Press, 1977, chapter 4.
29. Hans Jonas, *Das Prinzip Verantwortung*, Frankfurt: Insel Verlag, 1980, p. 184f. This includes an earlier work Jonas published in English, "Technology and Responsibility: Reflections on the New Task of Ethics," *Social Research*, Vol. 40, No.1.

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