

THEOLOGY AND THE CONTEMPORARY CHALLENGE OF THE NATURAL SCIENCES

INTRODUCTION

What are the principal challenges the natural sciences present theology today? Each of us must try to answer this question for ourselves from our own experience and perspectives. For the impact of the sciences is a dominant influence in our culture. And the challenge they issue to theology is a challenge to each of us.

In responding to this question, many immediately focus on the specific theological issue of creation, and speak of how astrophysical cosmology threatens to remove a need for God in accounting for ultimate origins, or how evolutionary theory explains the emergence of life and consciousness without any appeal to divine action or intervention. Science has closed all the gaps. But when scientific models and conclusions are carefully examined—particularly with respect to their presuppositions and limitations—and when the role of the theological and philosophical inquiries are properly understood, this threat vanishes.

Some raise slightly more sophisticated questions, whose answers promise to link—or sever any links between—the sciences and theology. For example from cosmology we have the question: Can the Big Bang be identified with “the moment of creation?” From evolutionary theory we can ask: Do the processes of evolution governed by natural selection betray any teleological directedness towards higher, more perfect forms of life—towards conscious life, human life?

Can the Big Bang be identified with “the moment of creation”? Or does confirmation of the Big Bang theory confirm the proposition that the universe had a temporal origin? Many well known cosmologists, philosophers and theologians have suggested that it does. And Pope Pius XII, in a now famous and somewhat controversial allocution to the Pontifical Academy of Sciences in 1951, unequivocally makes this identification.¹ Many other specialists in science and in theology, however, including Georges Lemaitre, the eminent priest-cosmologist, have strongly resisted doing so. And I believe that a careful analysis of cosmological theory and its limitations compels us to forego any such theological interpretation of the manifold of events we call the Big Bang.² In fact, Pope John Paul II has

¹Pope Pius XII, “Modern Science and the Existence of God,” *The Catholic Mind* (March 1952) 182-92; the main sections of this allocution are also found in *The Bulletin of the Atomic Scientists* 8 (1952) 143-46, 165.

²William R. Stoeger, S.J., “What Does Science Say About Creation?” *The Month* 246 (1988) 805-11, and “What Contemporary Cosmology and Theology Have to Say to One Another,” *CTNS Bulletin* 9/2 (Spring 1989) 1-15; Ernan McMullin, “How Should Cosmology Relate to Theology?” in Arthur Peacocke, ed., *The Sciences and Theology in the Twentieth Century* (Notre Dame IN: University of Notre Dame Press, 1981) 39ff.

recently warned against making such "uncritical and overhasty use" of scientific theories like the Big Bang in supporting theological conclusions.³ How, then, are the findings of contemporary cosmology, physics, chemistry and biology to be used by philosophy and theology? What is wrong with making an identification between the Big Bang and "the moment of creation," using science directly to support theology? These are the types of question both scientists and theologians must be ready to analyze and answer. But they do not, as we shall see, by any means constitute the principal challenges the sciences issue to theology.

Does a detailed analysis of evolution and the processes of natural selection which drive it reveal either a short-range or a long-range teleology which directs or controls it? A number of scientists, philosophers and theologians insist on maintaining that the processes of evolution as revealed to us indicate such a goal or purpose embodied in the processes themselves. However, it can be shown very conclusively, it seems to me, that the data on natural selection and evolutionary developments in no way indicate such teleological directedness. In fact they indicate just the opposite. For instance, there are millions and millions of species which developed and then became extinct—evolutionary avenues which were essentially blind alleys, leading nowhere. There is a vast scientific and philosophical literature dealing very carefully with this issue—and recent developments have essentially reinforced the conclusion that evolutionary biology itself cannot be understood as needing a teleological directedness as it is usually understood. Those who hold for the operation of such a "teleological force" can point to no evidence within biology or paleontology themselves. Furthermore, they almost always either badly misunderstand the processes involved in natural selection or confuse the different meanings of finality. And they often bring with them a priori metaphysical commitments. This does not mean, of course, that there is no purpose at work in the universe—or in these evolutionary processes. It does mean that at the level of biology, there is no need for one and no evidence for one. There is no need for "a God of the gaps." God's work within the universe is much more subtle and hidden than that. We avoid invoking teleology in biology and in science in general for the same reasons we eschew vitalism.⁴

Here again we have a very important issue scientists and theologians must be able to discuss and analyze intelligently and carefully. And most are unable to do so. But neither is this one of the primary challenges of contemporary science to theology—though the perspectives from which the scientist approaches such issues and the concepts he or she employs in formulating and analyzing them help to carry what is a principal challenge to philosophical and theological discourse.

It is obvious that we live in a scientifically and technologically sophisticated culture, and that the impact of the natural sciences, their conclusions and applications, has been profoundly felt at almost every level of thinking and activity.

³Pope John Paul II, Letter to Rev. George V. Coyne, S.J., Director of the Vatican Observatory, in Robert J. Russell, William R. Stoeger, S.J., and George V. Coyne, S.J., *Physics, Philosophy and Theology: A Common Quest for Understanding* (Vatican Observatory, 1988) M11-M12.

⁴On these issues see the various essays of Ernst Mayr in his recent book, *Towards a New Philosophy of Biology* (Cambridge MA: Harvard University Press, 1988).

The same could be said of the psychological, sociological and anthropological sciences. Certainly the use we make of, and the dependence we have on, the products of the natural sciences—rapid and almost instantaneous communications, computer technology, medical and pharmaceutical therapies and interventions, agricultural and medical use of genetic and nutritional manipulation—have a profound effect on not only the way we live but also on the way we think about ourselves, our world and the relationship we have with it. Beyond this, the knowledge about ourselves, our world, and the universe—our makeup, our evolutionary history, even our origins—emanating from the natural sciences, has significantly, and perhaps even radically, altered the way we imagine the world, the universe, and ourselves as part of them. It has also radically changed the way in which we conceive of what lies beyond, or at the very root of, reality—of the “spiritual,” of who God may or may not be, of God’s action in the universe, in our lives, of the meaning, even, of Jesus and his life, death and resurrection for us and for the world.

Here I want to focus on several key challenges of the contemporary natural sciences to theology. It is not easy or trivial to locate these. They are not necessarily the ones which in the popular account seem to push the theological endeavor to the fringe of intellectual acceptability. According to one simplistic but still influential version, God is no longer needed to provide ultimate or intermediate explanations for reality, or its origins. From another point of view, even though the natural sciences are not adequate for dealing with ultimate questions or with the full range of human experience and intentionality, the attempts of philosophy and theology to complement them are severely vitiated by the endemic uncertainties and lack of professional consensus concerning their methods, and the criteria for truth and evidence they employ. There is also in them a perceived lack of clarity, rigor and precision. This is a more subtle and sophisticated objection to metaphysical and theological endeavors, and one which has some validity to it. But, as it stands, it is based upon certain misconceptions about the character of both philosophy and theology and about their respective methods—misconceptions which are often nourished by philosophers and theologians themselves.

Often enough, however, the apparent challenges the natural sciences—or for that matter the human and behavioral sciences—present to theology are based on other misconceptions—pervasive misconceptions concerning the character and limits of the sciences themselves, as well as concerning the object and methods of philosophy and theology. Along with these is a failure to appreciate the distinction between theology and philosophy as very separate disciplines.

Once these misconceptions are cleared away, there is still an insistent series of critiques and challenges the sciences issue to theology. But now their foci have been displaced from where the misconceptions had refracted them. It is these challenges I wish to discuss here—those purged of the popular misconceptions. It must be said, however that purging the popular and academic climate of these misconceptions is itself an important and difficult challenge for specialists in all the disciplines involved, as well as for those who communicate and popularize their methods and results.

Furthermore, the real challenges of the natural sciences to theology and religion are not easy to locate because they occur on several different levels. Only in a superficial, secondary way are there really direct challenges to the core of what

religion and theology investigate and proclaim. The dominant ones are really semi-direct and indirect—at the level of language, cultural context, symbol, metaphor, story, and implicit philosophy—or at the level of clarifying the methods, evidence, limits of competency, and criteria of truth in the different disciplines. The natural sciences and other disciplines help establish constraints on what really counts as a theological or philosophical issue, how that issue or question can be meaningfully articulated or asked, and how we should pursue a resolution to it. How we can meaningfully speak of the supernatural, the relation of spirit to matter, the action of God in different contexts, the creation of human beings, the creation of the world, God as omniscient, omnipotent and immutable yet sensitive to His/Her creation, free and freedom-endowing, etc., depends a very great deal on a detailed knowledge of ourselves and the concrete reality of which we are a part. And the natural sciences have contributed in no small way to this complex perception. The way in which people once spoke meaningfully of all these issues in centuries past has changed because of the way our knowledge and perception of the world, the universe, its history, extent and probable future, its possibilities, have substantially changed. And that change continues.

After this extended introduction, I should tell you what I want to do in this paper. First, I want to stress that there are indirect, semi-direct and direct challenges—or avenues of interaction—between the natural sciences and philosophy and theology. In some ways, these are much more difficult and important to recognize and address. At the same time, they are more subtle and pervasive. I shall give some suggestions on how these indirect and semi-direct challenges may begin to be met. Secondly, I shall broach the subject of the methodological differences among the sciences, philosophy, and theology in terms of focus, evidential grounds and methods, and discuss to what extent they can learn from one another in becoming more aware of these in exploiting their strengths and in developing a certain “methodological seriousness” and a “critical zeal.” This is the foundation for ongoing in-depth dialogue among them—and for properly perceiving and taking into account the philosophical and theological issues arising from the sciences. Thirdly, I shall give examples of some of the main questions and opportunities emerging from the sciences which are either directly philosophical or theological, or have significant philosophical or theological import, and comment on how I believe philosophy and theology should deal with these. Fourthly, I shall briefly point out the conceptual richness the natural sciences can bring to philosophy and theology and how perhaps that richness can be exploited more fruitfully and critically. Fifthly, I shall focus on some of the philosophical and theological questions emanating from the scientific community itself. And finally, I shall speak about what I perceive as a certain isolation of American Catholic theologians—or more broadly of informed American Catholic theological thinking in general—from the scientific community, which does, like it or not, constitute a major and very influential element of the American intellectual community.

I. INDIRECT AND SEMI-DIRECT CHALLENGES FROM THE SCIENCES

The fruits of scientific research are mediated to us by the products we use, and perhaps more importantly by education, the press, popularization in books and magazines, and the mass-media. Along with the knowledge about our world and

our universe communicated by these channels, there are also detailed accounts of science as an endeavor—of the teamwork, the methods, the controlling visions and ideas, and the fascinating and challenging, though painstaking, work which are important features of theoretical and experimental scientific research. Go to any university bookstore and see the wide range of popular and semi-popular books and magazines dealing with different contemporary quests and aspects of the natural sciences. There are now many widely seen PBS programs like *Nova*, *Cosmos*, *The Astronomers*, etc. There is great demand for, and interest in, this literature and programming, and the issues and ideas presented in them is more widely discussed than you might imagine. Most newspapers and newsmagazines regularly report the most recent advances in all the major fields, and describe in considerable detail the major pursuits now underway or being planned—the Hubble space telescope and its planned projects, and their significance for astronomy and cosmology, the different accelerators now working or planned, such as the Superconducting Super-Collider, the pilot projects involving gene therapy, the human genome program, and others.

There is an amazing amount of ideas, concepts, words, symbols, expectations flowing into our culture all the time from the natural sciences—as well as from the human and social sciences. And, at the same time, our horizons are being expanded, our categories and even our attitudes and values are being modified—for better or for worse. Concepts and images like gene, black hole, universe, Big Bang, computer, hardware and software, archetype, the unconscious, quantum leap, indeterminacy, chance and probability, order out of chaos, find their way into our daily use and understanding very, very rapidly. And some of them become symbols for us of who we are, where we come from, where we are going, as well as carriers of values and explanations, helping to establish and modify the categories, the frames of reference, and the implicit philosophies and language we use in our thinking and reflection—in the way we see things, in our construction of reality. By and large, this process is unreflective—it happens whether we like it or not. We have no, or very little, control over it. It is a cultural process—the building of new mythologies and the telling of new stories of our origins which strongly influence our view of what is important and valuable for us and for our society. And it is worth noting that the weight carried by some of these symbols—the power they exert—is often much greater than the weight they bear within their strictly scientific contexts. This is the realm of the indirect influence upon, and challenge to, theology.

For theology makes use of language, an implicit philosophical framework, concept, symbols, myths in order to articulate the personal and communal experience of faith for people of a given time and culture. To the extent that the language, concepts and symbols theology uses are foreign or devoid of meaning for a society or culture, it will be unable to speak to, or meaningfully express, the crucial experiences and challenges of the people—unable to communicate and articulate what is essential to the Word and our experience of it. It seems to me that it is a real and extremely difficult challenge to theology to perform its essential function given this reality. It needs to maintain its connection with the past—its historical roots—but it also needs to articulate and explore that past together with the present and the prospects for the future in terms which are understandable, intelligently critical, provocative and challenging for people today. Of course, this

indirect and pervasive impact of the natural sciences and their many applications on religion and theology is true of other key aspects of experience and culture. Art and music, the influence of other cultures, political and economic structures (democratic institutions instead of monarchical ones, multinationals, etc.), the experiences of the disparity between rich and poor, of exploitation, oppression, violence, destitution and hunger, often on scales that defy understanding (e.g., the Holocaust)—whether actual or vicarious—in a world that is supposed to be technologically advanced and humane, all have tremendous impact as well on how we see ourselves—on our language, concepts, attitudes, symbols and myths.

Such influences are beyond my background or abilities to study or discuss—I am not a cultural anthropologist. But I see more and more clearly that they must be noticed and dealt with. Here, I merely point them out, and strongly encourage those who are in anthropology, philosophy, or foundational theology to make the efforts needed to help us understand and answer the challenges posed by these indirect and semi-direct channels of influence. An example of someone who has done this is Albert Borgmann. Borgmann's focus is not on the natural sciences themselves, but rather on technology. Among other things he demonstrates how technology will alter values, practices and attitudes of a culture or society as it is appropriated and used. This can deeply impact its underlying philosophy, orientation and direction. Examples of this in his book are his exposition of the pervasive influence of what he calls the "device" and the "commodity paradigms," the devaluation of "the deictic," and related personal, social and ethical concerns.⁵

It is somewhat obvious that the natural sciences do strongly influence the implicit philosophy we bring to any theological reflection. They affect the concepts and categories we use and rely upon, and perhaps more importantly, the horizons within which we work. Examples abound. An evolutionary or developmental framework is now taken for granted—is assumed. Fifty or a hundred years ago it would not have been. We see ourselves as products of physical, chemical and biological processes, in solidarity with inanimate and unconscious creation. As a result of the sciences we have a rather different set of epistemological assumptions than we would have had even a few decades ago: in light of the sciences, naive or even a critical realism of the "traditional" sort is very hard to justify. We have become much more aware of our intrinsic limitations as knowers. And similarly with respect to cultural influences—we have seen the development of the whole area of hermeneutics. There are no completely culturally or socially unconditioned disciplines—not even theoretical physics.

And, if we turn to the ways in which this has found its way into philosophy and theology, we find a wealth of important and interesting examples. Certainly, physics, astronomy and biology have reinforced the direction scripture studies have taken with respect to Genesis and the creation accounts. And scientific conclusions and concepts have at least indirectly influenced recent discussions of creation, human nature, sin and grace, time and eternity, the meaning of the

⁵Albert Borgmann, *Technology and the Character of Contemporary Life* (Chicago: University of Chicago Press, 1984) 302. I am indebted to John Coleman, S.J., for pointing this work out to me.

resurrection, eschatology. In philosophy, people as diverse as Lonergan, Whitehead and his followers in philosophy and theology, M. Hesse and M. Arbib,⁶ and T. Winnograd and F. Flores⁷ have been deeply influenced by the sciences in their approaches. And this is thoroughly understandable—for philosophy, and theology in a way, are radically interdisciplinary disciplines. They must use as grist for their mills the full range of human experience—however it is mediated.

To meet this primary challenge, what is needed, it seems to me, is a continual working dialogue between theology and the other sciences, natural and human. Those who do theology must be more critically aware of the conclusions and the methods of the sciences, what is fairly well substantiated "fact" as distinct from speculation or simply enthusiastic dreaming, what the justifiable impact of a specific conclusion is upon philosophy and what exceeds its scientific warrant, etc. Thus, they must have some conceptual understanding of the key aspects, ideas and perspectives of contemporary science which may have bearing on theological reflection. At the same time, scientists must become more aware of philosophy and theology as legitimate forms of knowledge and investigation—very different in foundation and method from their own. They must also become more conscious of the limitations of their own disciplines, and of the care that must be taken in expanding scientific conclusions beyond the regions where they have been experimentally or observationally confirmed. Scientists must, as well, be responsible in discussing their ideas and their results with the mass media—distinguishing carefully between firm conclusions, conclusions which are preliminary and in need of confirmation, well-founded speculations, and flights of the speculative imagination.

The expectations people have of knowledge deriving from the sciences puts philosophy and theology in a difficult light. The natural sciences, like it or not, have become paradigms of what rigorously tested knowledge is. They are, at their core, at least, extremely well substantiated cumulative bodies of knowledge, qualitatively and quantitatively substantiated in a very careful, systematic and repeatable way according to very rigorous standards upon which the vast majority of practitioners agree. And the fruits of such knowledge is impressively obvious in its applications. Usually, those expectations are transferred uncritically to other disciplines, like philosophy and theology—or to psychology, economics and sociology—and the judgment rendered that, because they are not true sciences, they are very deficient forms of knowledge and investigation. Expectations of reliable knowledge, carefully arrived at and tested, are dashed. Philosophy and theology have to counter these expectations, not by aping the sciences, but by being themselves, remaining in dialogue with the other disciplines and stressing their own special character—important and crucial, but very different from the natural sciences.

In some many ways, of course, these expectations have been beneficial. The strongly empirical and testable bases of the contemporary sciences—and their

⁶M. A. Arbib and M. B. Hesse, *The Construction of Reality* (Cambridge: Cambridge University Press, 1987).

⁷T. Winnograd and F. Flores, *Understanding Computers and Cognition* (Reading MA: Addison-Wesley Publishing Co., 1986).

provisional character has led us to emphasize the analogous characteristics of the theological disciplines, and of philosophy, too. There is, obviously, a renewed and profound rooting of both in experience, critically examined—in individual and community experience, in the mystical, in impoverishment and powerlessness, etc., and a rediscovery of the terribly limited character of the understanding we do gradually achieve. Of course, in this regard, theological reflection always has—and always will have—a negative component, the denial of what it just struggled to affirm, simply because of the limits of our intellect and of our language to understand and to describe adequately what has been revealed to us, what we have found in our experience. And so, just as the scope and intricate interconnectedness of the world and the universe revealed by the sciences expand our possibilities and horizons for positive affirmation, they at the same time broaden and deepen what it means to deny that we have any adequate knowledge of God and of God's action towards us in our world.

It is true that the primary experiences—the data—to which faith appeals and upon which theology reflects is radically different from that to which the sciences appeal. My main point in what I have said so far is, that, although this is the case, the ways in which theology reflects upon and articulates those experiences—the critique it offers of them, the language, symbols, and categories it employs in describing them, the presuppositions it begins with, the methods it subjects them to—all depend completely on the knowledge and description of the world and of ourselves we have at present, and the horizons of that knowledge. This is determined, among other things, by what the sciences reveal our physical, biological, psychological make-up and context to be. If professional theologians, or philosophers, are not in adequate dialogue with key aspects of their culture, they will be unable to communicate with it and will further be insensitive, or uncritically sensitive, to important experiences of insight, faith, commitment and value which are being found there. This is why I maintain that the single most important impact of the sciences on theology is this context of knowledge, implicit philosophy, evolving symbols and language, and epistemological expectations which they help set up in our culture and within which theology is done.⁸ To the extent that it is not done with reference to that context, to that extent it will be irrelevant, unintelligible, or both.

II. THE METHODOLOGICAL DIFFERENCES BETWEEN THE NATURAL SCIENCES, PHILOSOPHY, AND THEOLOGY

This could be the subject of a separate paper. Here I just want to point out a couple differences which are crucial for correctly understanding some of the challenges the natural sciences present to theology, and how theology should respond to those challenges.

The focus and evidential grounds of the three disciplines are very different, though their material objects overlap. For the natural sciences the focus is on qual-

⁸William R. Stoeger, S.J., "Contemporary Cosmology and Its Implications for the Science-Religion Dialogue," in Robert J. Russell, William R. Stoeger, S.J., and George V. Coyne, S.J., eds., *Physics, Philosophy, and Theology: A Common Quest for Understanding* [hereafter abbreviated PPT] (Vatican Observatory, 1988) 419-47.

itatively and quantitatively modelling the detailed processes and causative (in the sense of efficient causality) factors which are involved in the transformations of entities into one another—the emergence of novel entities, structures, processes and “laws,” or the evolution of an entity from one stage to another. The evidential grounds are the results of carefully designed and controlled, repeatable experiments or observations, which are both conceived and interpreted in terms of detailed descriptive/explanatory theories, which in turn are subject to continual modification and improvement undertaken to harmonize the models or theories more and more closely to the experimental and observational results. The sciences are thus organically cumulative.

Philosophy, in contrast, studies the pervasive characteristics of reality, its ultimate foundations together with the presuppositions of our knowledge of it, and their correct articulation and possible justifications. Because these characteristics are so fundamental and pervasive—such as causality and its basic features—they are almost always presupposed by the natural sciences, and are thus relatively insensitive to the controlled experimental and observational/theoretical methods used in the natural sciences. One cannot isolate a part of physical reality that has such a characteristic from a part of physical reality which does not. All entities we encounter possess these characteristics. The evidential grounds for philosophy is experience and the careful description and analysis of experience. But not in the way of the sciences. The findings of the sciences are often used to clarify and purify—to give examples which rule out certain philosophical conclusions, for instance, to force philosophy to take all ranges of experience into account (not just “the middle range”), to test intuitions with clear, precisely understood examples, or to restrict philosophy from adjudicating an issue which is outside its sphere of demonstrated competency. Certain well established, counter-intuitive conclusions of the sciences—quantum indeterminacy, quantum non-locality, non-Euclidean geometry are obvious examples—have strongly influenced both metaphysics and epistemology. Different philosophical schools have developed different kinds of philosophical analyses—phenomenological, linguistic, transcendental, etc. It is clear that these methods are different from those in the sciences—they are analytical in the strict sense and they do not directly depend on controlled observation and experiment interacting with highly detailed, often quantitatively sensitive, theory. Philosophy does not concern itself directly with the detailed processes and entities which are intricately marshalled and interrelated to give the marvelously variegated and unified universe we live in. It does concern itself with the universe’s general and pervasive characteristics, and then with its relationship to us as knowers. And, of course, there are levels within philosophy itself which it seems incapable of justifying or properly examining. It has its own presuppositions, some which strongly resist strict justification, or precise delineation of their allowed ranges of application. For example, the principle of sufficient reason seems to evade the possibility of independent demonstrated justification. Philosophy can analyze what it means, look to the experiences which found it, etc., but it cannot demonstrate it from more fundamental principles, or experiences, except to appeal to its reasonableness, and to the lack of any clear counterexamples.

When we come to theology, the focus is on neither of the above, but rather on the revelatory—on what we experience being communicated to us from beyond

the horizons discovered and articulated in philosophy, and beyond the phenomena and patterns which concern other disciplines like the natural sciences. The horizons do not vanish, but they become revelatory of what is beyond them. Running up against those horizons, shouting at them, struggling to make some sense of them, or surrendering ourselves to them, we find ourselves addressed by what is beyond them. In particular, it is the personal and particular with which theology deals—upon which it reflects. It focuses upon what Borgmann calls “the deictic”—that which can be indicated or pointed out, but which cannot be subsumed under general laws.⁹ The particular experience or the particular person which gives special meaning and orientation to our life and activity, in a way which the general laws uncovered by the sciences or the profound analyses of philosophy can never do. The evidential grounds are the experiences themselves—communal and individual—and the various witnesses or certifications of them, along with the fruits flowing from them which we gradually discern, and experience—not just from outside, but more from inside the reality: faith as the dialectic of discernment/commitment. Clearly, the natural sciences do not deal with “the deictic,” it is outside the range of their competency. Certain of the sciences may deal with deictic phenomena, but only insofar as they indicate patterns which may be studied scientifically, i. e. may be subsumed under some generally applicable law or model, not as they exist in all their particularity.

It seems to me vital to recognize these differences. Theology should not become like the sciences. Nor should philosophy. Each must maintain its own distinctiveness. There are legitimate challenges which the sciences pose for theology and philosophy. But there are also unreasonable or badly based ones, unreasonable and unfounded expectations, which are rooted in a failure to appreciate the radically different character of these three disciplines. It is absolutely crucial that philosophers, scientists and theologians sift out the legitimate challenges and expectation each discipline finds itself presented with by the others, from the illegitimate or unfounded ones.

It is worth mentioning briefly in this context two other related issues. The first is that in the popular and even in the educated mind, the distinction between philosophy and theology is not clear or well understood. Oftentimes problems and issues relating to the sciences are presented as being religious and theological, when, as a matter of fact, they are philosophical. Of course, one reason for this confusion is that philosophical conclusions and analyses are often used extensively in theology—so the two are closely related at some level. But it is vitally important to keep them fundamentally separate, and to insist on the distinctions between the two. Further, philosophical backwardness or anachronism often leads theology into real disrepute. Insistence on philosophical categories or concepts which no longer have clear meanings or referents in the educated discourse of contemporary culture, or rather different ones than in the philosophical system in which they originated, does theology and the faith community a severe disservice. This issue is complicated by the fact that there are now several major only weakly interacting universes of intellectual discourse in our culture.

⁹Albert Borgmann, *Technology and the Character of Contemporary Life*; see reference 5.

The second issue is that religion, or theology, must studiously avoid looking to the sciences, or even to philosophy, for its apologetic. This is still a real temptation for many believers today—and for some theologians and people in the ministry. Religion has its own basis in the range of experiences which give meaning, hope, and orientation to our lives—it should without excuse or embarrassment stress the importance of those experiences—the experience of personal relationship, of particular and significant people, of Jesus and his gospel, of prayer, community and the individual, of the dying and rising that continues to go on. The sciences and technology, and to some extent, philosophy, devalue “the deictic,” because they cannot deal with it—it is outside their abilities to handle properly. But “the deictic” is still crucially important. And many people, including a large number of scientists, are rediscovering its importance and its irreducibility, as they grow in a sophisticated awareness of the limits of their own disciplines, and of other disciplines.

This trend is reinforced by the recognition that our universe is not deterministic, and cannot be described or explained in its detailed behavior by a reductionistic program. Quantum mechanics and quantum field theory first put physical determinism to flight. But more recently, work in the macroscopic areas of physics—chaotic structures in dynamical systems (their ubiquity throughout the physical, chemical and biological world), the ways in which higher order issues from such chaotic structures, and the related thermodynamic processes characteristic of systems which are far from equilibrium, the hypersensitivity of many, many different types of systems to initial conditions, the new area of the physics of complexity and the role of top-down causality, and the pervasive phenomenon of spontaneous symmetry breaking (in both quantum and classical contexts) along with the indeterminates associated with it—have purged serious scientific thought of the last vestiges of determinism. Only the most simplified and thoroughly isolated and idealized systems exhibit strict determinism. And very little of concrete reality as we now know it can be adequately modelled by such systems.

III. THE THEOLOGICAL ISSUES DIRECTLY RAISED BY THE NATURAL SCIENCES

How direct or indirect a challenge an issue emerging from the sciences is for theology depends very much on “the theology.” To be more specific, we should not talk about “theology,” but rather about this or that theological conclusion or statement. It is grounded in a critique and an interpretation of specific data which are taken as evidence and is justified by reasoning which uses a method based on more fundamental insights and well-justified principles, and moves from that interpreted evidence to the conclusion itself. Theologians may disagree substantially among themselves concerning the correctness of this or that conclusion—concerning the validity of the analysis and interpretation of the evidence on which it is based and of the reasoning which led to it. On the basis of a particular type of theological reasoning, one may arrive at any number of statements which eventually are abandoned or significantly modified because of radical reinterpretations of the evidence, for example, a scriptural text, a tradition, an important experi-

ence of the community at prayer or in action over a long period of time.¹⁰ (Analogous changes and modifications occur for scientific conclusions, or course, but there are essential differences: Correspondence principles usually operate linking one paradigm to another—a general theory becomes a special, limiting case of a more general theory; and there is usually not a change in the discipline under whose competency the issue falls.) What once was considered a valid theological conclusion may no longer be so, due to all sorts of circumstances, as well as to the context within which the issue was originally presented. Often the question itself was either meaningless or mistaken—and so the answer given was meaningless or mistaken. Or the issue was considered to have a theological import it no longer is considered to have, for various reasons. Not least of which may have been the cosmological context out of which it was asked!

In fact, it has often been the conclusions of the natural sciences and human sciences which compelled such modifications or re-interpretations of the evidence flowing from scripture and tradition, or of the philosophical assumptions and concepts used in the formulation of the conclusion—its articulation. What was originally considered a theological truth turned out not be something which really could not be adjudicated by theology, or by “the truths of faith,” but rather only by the sciences. Many of the issues surrounding the rise of Copernican astronomy and Galilean physics, and those emanating from the advent of evolution in biology, are cases in point—there are many others. Or the way in which a particular theological truth or conclusion was initially understood turned out to be significantly inadequate or inconsistent with what was known on the basis of other disciplines. Or, finally, a new concept, image, or paradigm originating in the sciences or some other field finds fruitful application in theological work, leading to a richer and deeper understanding of the theological issues in question (again, evolution provides examples, as well as developmental psychology and cultural anthropology; certainly contemporary physics, astronomy and cosmology give new meaning to what God’s creative agency involves and how it is or is not channelled). These changes and modifications have occurred in the past. They are occurring now, and will occur in the future, whether we like it or not. The question is really: “Will they occur responsibly and reflectively as the result of dialogue and interchange among the disciplines, or only unreflectively and haphazardly primarily through conflict and alienation?”

At any rate it is clear that concrete statements or conclusions emerging from theology can be, *de facto*, in contradiction with the conclusions of the natural sciences. The Earth is not the center of the universe. Creation was not effected during six days 4004 years before Christ. Such statements seems ridiculously obvious to us now, as presenting no theological problem. But there was a time when they presented great problems! Are there “theological” conclusions we hold stubbornly today which will undergo a similar fate at the hands of advancing knowledge and a gradual purification of our religious perspectives and our theological idols? Candidates: all human beings descended from a single couple. God directly

¹⁰As suggested by Avery Dulles, S.J., “The Meaning of Faith Considered in Relationship to Justice,” in *The Faith that Does Justice*, ed. John C. Haughey, Woodstock Studies 2 (New York: Paulist Press, 1977) 10-46.

infuses the human soul into its body at conception. God is immutable. Human beings are uniquely made in the image and likeness of God (there may be other free and self-reflective creatures in our universe who are also made in His/Her image and likeness).

It seems reasonably clear to me that whenever a well-substantiated and repeatedly confirmed conclusion of the natural sciences is in direct contradiction with a theological or philosophical statement, and the issue is within the competency of the natural sciences, the scientific statement must prevail. The character of the philosophical or theological statement or conclusion must then be more carefully examined to see how these disciplines may have unwittingly strayed outside their realm of competency, or incorrectly interpreted the evidence to which they appeal. This resolution of the contradiction or challenge is based on an analysis of the epistemological character of the disciplines involved. Of course, an apparent conclusion of the natural sciences may also be in contradiction with a philosophical or theological conclusion and have to yield to those disciplines. But, in all such cases I would maintain that the supposed scientific conclusion is not well-substantiated or well-founded, or more than likely is the result of an unwarranted and unjustified expansion of scientific results into speculations about an area on the fringe, or outside, its present area of competency. An example would be the more extreme claims of genetic determinism from sociobiology.

The lack of symmetry in this relationship between scientific and theological (also philosophical) conclusions is traceable to a lack of symmetry in the clarity and unambiguity of the criteria of acceptability and of truth in the two sets of disciplines. In the natural sciences these are relatively well established and universally agreed upon, and rigorously enforced in a reasonably uniform way, though the philosophical interpretations of the conclusions of the sciences are not (e.g., the philosophical interpretations of the principal conclusions of quantum mechanics and quantum field theory—many of them counter-intuitive—fundamental indeterminacy (within strict limits!) at the quantum level, quantum nonlocality, etc.). In philosophy and theology, the uniformity, rigor and even professionally agreed-on fundamental understanding of the analogous criteria is significantly lacking. I am not recommending that philosophy and theology “get their houses in order.” I believe that these relative deficiencies are inherent in the two disciplines, taken by themselves—not in interaction with other disciplines. I am only pointing out that this is the reason for the lack of symmetry in the way in which the “truths” of the natural sciences and those of philosophy and theology optimally impact one another.

Some of the key theological issues in which there is a direct challenge (and opportunity!) from the natural sciences—leaving aside those of ethics and moral theology—are: the theology of creation—immediate origins and intermediate origins; the relationship of human beings to the rest of creation—unity, ecology, use, stewardship; the character of the supernatural, the character of “spirit” and its relationship to “matter”—the natural sciences strongly push us in an anti-dualist direction (there is the radical dualism of God and not-God, but any other dualism is, on the basis of the general picture emerging from the physical, biological and psychological sciences, it seems to me, deeply flawed); theological questions relating to our understanding of time and temporality—of which there are many—

including the relationship between time and eternity, the meaning of eternity, the omniscience, omnipotence and immutability of God, divine freedom and human freedom, etc.; the embodiment of purpose in the unconscious levels of creation; the possibility of intelligent, freely acting created beings elsewhere in the universe and the effect that possibility has on our understanding of and appreciation for the dimensions of redemption, of christology, of church, etc.; concrete eschatology—the future and destiny of the universe and of ourselves as a part of it; the meaning of God's direct action in the world, particularly at the level of the impersonal, and the relation between "primary" and "secondary" causality—an interventionist interpretation of divine agency, particularly outside the context of the personal, seems to be insupportable, but on the personal level it seems very possible; the dimensions of the Incarnation; what is a human being?

There is no time to discuss even a few of these. But I think some careful reflection on each of these topics will help us see that the findings of the natural sciences in each of these areas will be important in helping theology articulate its questions and propose answers and perspectives which are meaningful to people today—and sensitive to the knowledge we have of the world around us and to what that may tell us of the transcendent. In no way do I intend to imply that the natural sciences can replace theology in dealing with these issues. What I am saying is that theology—and philosophy—must take into account the conclusions and perspectives of the sciences with respect to the phenomena, structures, processes, origins, and evolution of the physical, biological and psychological realities involved—always, of course, in a critical and well-informed way. It is in this sense, that theology—and philosophy, upon which theology relies—are radically interdisciplinary disciplines—not in their methods but in the ranges of experience and findings to which they both must be actively and critically open. That, I believe, is the crux of the problem in meeting the challenges and taking advantage of the opportunities presented by the sciences.

And certainly, besides challenges, there are a wealth of opportunities! The whole area of the interface between chaotic structure in dynamical systems, non-equilibrium thermodynamics, and the study of phase transitions, spontaneous symmetry breaking effected by them (both in the quantum and in the macroscopic realms) and the indeterminates they leave open, is an obvious example. As I have already stressed, ontological reductionism and determinism are dead in the natural sciences—though their ghosts still haunt and disorient the minds and hearts of even the most careful and the most creative. The crucial importance of these processes in the emergence and ordering of physical, chemical and biological entities and contexts is testimony to that—along with the indeterminacies which prevail at the quantum level. These thematic patterns are at the basis of the infant science of the physics of complex systems, and make top-down causality and personal agency understandable, and even necessary, leading to a more profound and subtle understanding of the interconnections between physics, chemistry, biology, and the neurological-psychological-human sciences. There was no place for these in the reductionist and deterministic universe of yesterday. Today there is little place for that simplistic, inflexible paradigm. Epistemological or methodological reductionism, of course, will always be important in the sciences, by their very nature. That should not be confused with the ontological reductionism of which I have just been speaking.

IV. THE CONCEPTUAL RICHNESS PROVIDED BY THE SCIENCES

Although I have not directly focused on it, the conceptual richness which is contributed by the sciences, including even mathematics, to our culture is a potential resource for theology and philosophy. This has already been implied to some extent by what I have already said in speaking of the direct and the indirect channels of challenge and interaction between the sciences and theology. Both philosophy and theology—as well as some of the less fundamental natural and human sciences, to some extent—are usually dealing with abstract and transcendent realities and experiences, ultimates, particulars, upon which we can only struggle to describe and reflect. In order to do so we need more concrete images, metaphors, examples, and concepts. The other disciplines, the sciences, the arts and literature, human experiences and endeavors can supply them. No one formulation or articulation of transcendent experiences—horizons, ultimacies, etc.—ever will be adequate or final, obviously. And so new images, symbols, concepts and paradigms are constantly being imported and “tried on for size,” sometimes replacing or modifying—sometimes complementing—those which remain fruitful, provocative, and catalytic of synthesis. Again, this process will happen, whether or not we like it or want it. Our openness to it, critical awareness of it, in dialogue with the other disciplines, will help us use this resource wisely and critically.

The use of ideas, metaphors, images, conclusions and concepts from the sciences, or from elsewhere for that matter, is a mixed blessing. They can be misused! Or misunderstood and misappropriated—or absolutized in a way which can paralyze and blind, leading to an abdication of or neglect of theology's true strengths and competencies, and reinforcing its reputation of being a pseudo-discipline with nothing to offer beyond an ill-founded and illusory panacea for the uncertainties, anxieties, fears and hopelessness of people today. Using the conclusions of the sciences as foundational for the truths of faith—as an apologetic for theology—or binding it too closely to them by an uncritical appropriation of their methods, conclusions, etc. is always a very real danger.¹¹ Careful dialogue, research, and interaction are desperately needed to take advantage of the opportunities and to avoid the serious pitfalls of doing so superficially or uncritically.

V. THE PHILOSOPHICAL AND THEOLOGICAL QUESTIONS EMANATING FROM THE SCIENTIFIC COMMUNITY

If we look at the challenges and opportunities presented by the sciences from a rather different angle, we are very much aware of the philosophical and theological questions which are being posed again and again by scientists themselves, and by many others who are imbued with a fascination and a curiosity with science's unfolding perspective on the universe, its make-up, origins, constituents. Some of these questions are clearly philosophical or theological, some are not directly so, but have significant philosophical and theological dimensions. Some

¹¹Good examples of this are found in Paul Davies, *God and the New Physics* (J. M. Dent and Sons, Ltd., 1983) 255. In his recent writings Davies has developed an improved sensitivity to the distinctions between philosophical and theological issues.

others, too, are misguided or betray misconceptions.¹² But even these indicate that a search beyond where we are, and where science can go, has begun and is continuing in earnest.

Some of the issues raised by the scientific community certainly are very valid ones—but they may not be in the form or in the categories familiar or acceptable to philosophers or theologians. (I can assure you that there is a great deal of very challenging and thoughtful discussion on these levels within the scientific community, when they gather not so much as scientists but as co-workers and friends—as they often do. Scientists working in the same field on the same problems—or in the same discipline generally—are socially very close knit. They share and interact a great deal together on many different levels—more so, my impression is, than in the nonscientific disciplines.) Many of the questions are old ones in philosophy or theology, but posed in a different way, situated in a different context, background knowledge and paradigmatic perspective, with new insistence. Some are either new questions, or old questions which have such a different angle or set of nuances to them that they are effectively new.

Examples of such questions would be the following. If intelligent, freely acting beings exist elsewhere in the universe, how should we view their place in creation, in salvation history, with respect to incarnation and redemption in Jesus Christ? (Obviously, a knowledge of their religion and culture, and their evolution and history would be important for answering this question, after we came in contact with them. But there are certain things that could be said beforehand, it seems to me.) What is soul, or spirit? And what is its relation to matter, as we now know it? Can one really avoid vitalism, while maintaining a matter-spirit dualism? What is a person? And what is the relationship of "person" to something that possesses intelligence and self-reflective consciousness? What are the dimensions of "religious experience?" Is all experience of God "religious?"¹³ Is all "religious experience" experience of God? How can one determine that a certain experience is "of God" and not of some other origin, particularly when it all is in some way mediated? Does unmediated experience of God make any sense in the light of what we know about psychology, anthropology, etc.? What are the limits of genetic determinism and genetic conditioning? And what are the origins of those human characteristics which are genetically conditioned but not determined? Within a non-dualist perspective, how does one conceive adequately of "the supernatural," life after death, eternity, free will? How is the continuing creative action of God to be described in light of the emergence of novelty during the thermal history and evolution of the universe, and in light of evolutionary scenarios for the origin of life, of consciousness, of human life? Can the Big Bang, or any unique physical, chemical, biological, psychological event, or set of events, ever be attributed to "the direct, unmediated, action of God," or of a completely non-physical cause, on the basis of scientific evidence, or lack of evidence? Can it ever be ruled out?

¹²Michael J. Buckley, S.J., *At the Origins of Modern Atheism* (New Haven CT: Yale University Press, 1988); "The Newtonian Settlement and the Origins of Atheism," in PPT, 81-102.

¹³Nicholas Lash has studied these last two questions in detail in his recent book *Easter in Ordinary* (Notre Dame IN: University of Notre Dame Press, 1990).

Do we ever really know things in themselves? How would one begin to describe or model the action of God in the world as we now know it—at the level of the impersonal, and at the level of the personal? Would the indeterminism due to quantum mechanics, chaotic and nonequilibrium structures, and complex systems make any difference to the adequacy of those models or descriptions? Should they? If not, why not? If so, why?¹⁴ Does our more subtle understanding of time at both the level of physics and psychology provide ways in which we can integrate time and change into divine life and action in a more acceptable way than in the past, without resorting to immutability and omniscience? How does the deep unity we as human beings share with the rest of creation, as well as the new appreciation for the fragility of living systems, alter our concepts of ourselves as images of God, as privileged? How does it change our concepts of the Incarnation, of our relationships with other levels of creation? How should it do so? Does the inevitable demise of our sun, of our planet, of the life bearing potential of the universe as we know it (there just might be intelligent and super-technological ways of countering this later in certain cosmologies) square with a theological certainty of the “end times,” and a theological assurance of eternal life? How does it purify or alter the object of our hope? Is a natural theology, in the traditional sense, possible? Can the so called “anthropic principle” (which originated in contemporary cosmology) be used as the basis for new arguments for the existence of God from design? Can one really conclude anything from it? Are its assumptions justified?¹⁵ Is scientific evidence ever, of itself, an adequate reason for belief? (For example, if the shroud of Turin had been shown to be from the time of Christ and that of a crucified person, and its impression unexplainable by any presently understandable process, would that be an acceptable reason for a person to begin to believe?)

How should theologians and philosophers deal with such questions? Should they be taken seriously by philosophers and theologians? Are they genuine philosophical and theological issues? Are philosophers and theologians dealing with them? These, to my mind, are very important issues. And the answers to some of them are not simple to formulate.

First of all, I think it goes without saying that some of these questions are genuine philosophical or theological questions. Some of them issue from a deeper sense of awareness of the assumptions and the limits of the sciences, which they themselves are not capable of addressing. And some of them flow from the new, sometimes counter-intuitive, perspectives or horizons, new images or conceptual sophistications, established by the sciences in their confrontation with certain “traditional,” taken-for-granted answers to questions about creation, the supernatural, body and soul, etc. What I have said above concerning the relativity of what is considered a theological question, or a philosophical question, must be factored into these comments.

¹⁴Frank J. Tipler, “The Omega Point Theory: A Model of an Evolving God,” in PPT, 313-31, and reference therein.

¹⁵William R. Stoeger, S.J., “Contemporary Cosmology and Its Implications for the Science-Religion Dialogue,” in PPT, 219-47.

Some fundamental questions which often emerge, would be characterized as being on the boundary between the natural sciences and philosophy.¹⁶ Examples would be: how much weight is the anthropic principle really capable of bearing—philosophical? Scientific? And how should we describe these capabilities? What is the ontological status of the different levels of what are usually called “the laws of nature”? In contemporary cosmology, we use a space-time Lorentz manifold with metric as our fundamental model: to what extent does that fundamental construct represent reality, and to what extent must the subtle consequences of our reification of it (in terms of the operation of causal self-connectedness on scales larger than the usual particle horizons of the cosmological model, for example) be purged from scientific conclusions as spurious or at least unjustified assumptions? In these cases the questions are certainly at the interface of the scientific and the philosophical. They probably can be profitably probed by neither discipline without extensive collaboration of the other. They really involve what might be called an intermediate specialized metaphysics.

I do think that some of these questions—outside this last category of the intermediate specialized metaphysical ones, which are the domain of interdisciplinary specialists—should be taken seriously by theologians and philosophers. At the very least they should be studied, critiqued and understood as questions—which then can be discarded as mistaken or meaningless, accepted as genuine and provocative, or modified and made more clear and precise. This is a more important issue than it may at first seem. These questions—often in very insistent and clever form—find their way into widely read popular literature, the mass-media, the classroom. Take, for instance, the questions that have been made popular by Carl Sagan and Stephen Hawking: is there anything for God to do in the universe as we know it? Did God really have any choice in creating the universe? They may be simplistic and ill-formulated questions to us, but they are asked again and again—and discussed—by students, faculty, and well-read people in high schools, universities, homes and work places across the country. And usually there are few other available resources to help these people in their analysis other than Sagan, Hawking, or new age and scientific-creationist accounts.¹⁷ That may be a slight caricature—but not by much!

Many of these questions are beginning to be seriously addressed and studied by philosophers and theologians—but, unfortunately, rarely by Roman Catholic philosophers and theologians. There are one or two notable exceptions. There is considerably more interest and expertise in these areas among Anglican and Protestant theologians and philosophers. That is true both in the United States, Canada, Latin and South America, England, and Continental Europe. Less so, perhaps, in Continental Europe. Roman Catholic theologians and thinkers have pretty much limited their interest and serious work in these areas to either the important moral and ethical dimensions or to issues relating to the emerging creation and ecological spiritualities. Both of these foci of research and discussion are very important

¹⁶Cf., e.g., Michael Heller, “Adventures in the Concepts of Mass and Matter,” in *Philosophy in Science*, vol. 3, ed. M. Heller, W. R. Stoeger, S.J., and J. Zycinski (Tucson AZ: Pachart Publishing House, 1987) 15-35.

¹⁷Stephen W. Hawking, *A Brief History of Time* (New York: Bantam Books, 1988).

and welcome, but they only indirectly engage the principal questions and issues the scientific and scientific-philosophical communities are generating. In sponsoring our ongoing conferences and workshops on science, philosophy and theology at the Vatican Observatory, we have found it almost impossible to find Roman Catholic theologians who have a reasonable expertise in one or other of the sciences or an interest and background in dealing with issues relating theology and the natural sciences. It is not difficult at all to find a large number of well qualified non-Catholic theologians in these areas. This, it seems to me, is a question which must be taken seriously by all who involved in theology, religious studies and theological training. The ongoing dialogue and intelligent, critical interaction of the Roman Catholic community with a dominant intellectual and creative force in our culture is being seriously neglected and compromised. And the large number of Roman Catholics who are deeply involved in scientifically and technologically intensive areas are finding little theological help or support in integrating their interests and viewpoints with their Christian faith and action. Nor is their potential for enriching the reflection, intellectual vigor and theology of the church being tapped. A serious, ongoing discussion must be initiated in this area, and they need to be encouraged and brought into it. Perhaps this would best be prosecuted on all levels in an ecumenical context—particularly since the principal resources and effective structures for doing this lie there.

An apparent problem arises. If such issues are addressed by philosophers and theologians—particularly by theologians—how does one move from scientific hypotheses which raise these issues, but cannot resolve them, to theological considerations? I personally do not think this is a problem. The issues that emerge in the scientific context and which it cannot resolve, are already philosophical or theological—they are not scientific issues which have to be transformed into philosophical or theological ones. They may have to be studied carefully to be properly understood as such, because they are often not formulated in the usual philosophical or theological categories. They may be phrased and contextualized in the scientific imagery and metaphors with which those who ask them feel most comfortable. But they are philosophical or theological questions, for the most part. Philosophical ones, principally, I would say, but with important theological implications.

The more meaningful questions are: how or why did this particular philosophical or theological question arise from these scientific hypotheses or conclusions? And, how do scientific hypotheses or conclusions constrain philosophical, and theological, hypotheses or conclusions—how should theology make use of the data and conclusions of the sciences, or of any other discipline, for that matter? The second is very difficult and involved and would take us too far afield. The first can often be answered fairly simply. Usually, such issues arise, as I have already indicated elsewhere in this talk, when, in probing for a more fundamental level of explanation, researchers formulate a key question which they discover is in principle outside the competencies of the natural sciences; when one has to return to fundamental assumptions of the sciences and begin justifying them, and cannot do so without appealing to philosophical analyses; when a conclusion or repeatedly confirmed hypothesis or set of hypotheses forces one to abandon or modify a previously assumed implicit or explicit epistemology or metaphysics—for example, when quantum mechanics and quantum field theory force us from a

naive or critical ontological realism to a position of empirical realism or weak objectivity (at least with regard to microscopic phenomena), and this in turn poses uncomfortable questions about other "truths" or perspectives we held with some certitude; when such conclusions are in obvious or apparent conflict with other positions we have been holding, or with other experiences to which we cling (religious experience, experiences of being important, being cared for, of finding meaning and orientation in our lives, and in the world around us, for example). Realizing these etiologies of the scientifically derivative philosophical and theological questions may help us understand them, understand how they are formulated, and dialogue with the people who can help us reformulate them more precisely and answer them more effectively.

The second, more difficult question I side-stepped a moment ago: "How should theological method make use of the data and formulation of questions stemming from the sciences? How should philosophy do that?" I would just suggest here that this is a problem for theological method. If the theological method is clear and well-developed, then how that is to be done is obvious. In all cases, philosophy, it seems to me, is an important intermediary—both philosophy as an analysis of language and critique of conceptual formulations and philosophy as epistemology and metaphysics. The data of the sciences can never be used by theology as they are given "at face value." They must be critiqued and weighed, so to speak, on the basis of the internal critical evaluation of them by the scientists themselves, and then by using various philosophical analyses. Of more difficulty, really, is how should philosophy, as an independent discipline, make use of the data and explanatory models of the sciences? In a similar way, I think, but especially by being sensitive to the direct and indirect critique which the sciences, and implicit philosophies of the sciences, make or offer of the philosophy which attempts to make use of them. There is a lot more to be said here. These are just brief comments which indicate very sketchily the approach I would advocate.

Many may worry that such close involvement with the issues emerging from the natural sciences and such serious and detailed study of the ways in which their findings and conclusions may enrich and purify theology and philosophy would lead us to rely on them as a primary support and justification for religion and religious belief. I do not see how this engagement with the sciences, and with the philosophical and theological questions emerging from them, poses any serious temptation to use them as an apologetic or as underpinnings for religion or for theology—as long as the engagement is serious and continuous, and not just superficial. In fact, ongoing, in-depth dialogue with the natural sciences would be a sure way of avoiding that trap. A theologian's or a philosopher's almost first-hand appreciation of the weaknesses and limitations of the sciences, along with their strengths and rigor, should inoculate him or her against such dangers. The very fact that insistent philosophically and theologically oriented questions with which the sciences themselves cannot deal regularly arise should remind theologians and philosophers that it is sheer folly for anyone to try to turn theology into hyperphysics, or to use cosmology, physics, molecular genetics, neurophysiology and the other sciences to justify and found a philosophy or a theology. A well-developed and well-informed critical sense is absolutely essential. But all this is developed and finely honed precisely within the context of serious ongoing dialogue, mutual collaboration and intellectual interaction.

It is true, of course, that there will always be people who attempt to use scientific hypotheses and conclusions to "prove," justify, or reinforce a religious belief or stance—e.g., to see the Big Bang as "the moment of creation" and as a proof that God did create the universe from nothing at a particular "moment." Highlighting consonances, symbolic relationships, and helpful analogies between the "truths" of natural sciences and those of religious belief and theology is one thing. Employing scientific conclusions as a principal basis for belief or for asserting a theological truth is another. That is why serious interactive engagement is so important: such confusions are, I think, easily avoided if one is in thorough critical contact with the scientific material and those who know it well—and if, at the same time, one has well-grounded and refined philosophical and theological methods, which are sensitive to the linguistic and hermeneutical problems and to the other methodological, historical and developmental issues. Even just an operative awareness of these—and a sense of the limits of the respective disciplines—should be enough to prevent us from making this mistake.

Should the same quality of seriousness and rigor which our culture comes to expect from scientists also characterize the work of the theologian? Is this a realistic expectation? I have already discussed this in another context. Certainly, we must insist on careful scholarship, but also, I believe, on a critical sensitivity and vulnerability to all those aspects of experience and endeavor which may have bearing on the theological issues being investigated (theology is radically interdisciplinary in the sense I described above), and on a continual striving to refine, reinvigorate and modify theological method so that it better and better fulfills its purposes. This is fostered by interaction, not by isolation—by a growing awareness of the strengths and limitations of a given discipline and of the methods it is currently using. I believe it true, also, that, although theology and philosophy should not ape or appropriate the methods of the natural sciences—that is very clear—there are certain methodological insights and structures which theology and philosophy can learn from the sciences and other fields, and employ in modified or analogous ways in their own pursuits. This is already happening. The idea of complementary models, of paradigms, of operator and operation are some examples.

Ongoing dialogue and collaboration with other disciplines and immersion in other situations and cultures, is absolutely essential for the theological community. This may seem like a very tall, and impossible, order. But we are helped and aided, as I indicated briefly above, by the fact that, as theology is radically interdisciplinary, every believer is a potential amateur theologian, whether he or she be a scientist, a lawyer or doctor, or carpenter or farmer, a housewife or salesperson, a husband or wife or single, a beggar or a millionaire. The reflection in faith, and in struggle for integration and wholeness, on our joys and sorrows, our sinfulness and our blessedness, our knowledge and understanding of the world around us, our deepest senses of meaning and self-value, and our insights and our confusions, etc., feeds into the rich pool of reflections, insights, testimonies, prayers, understandings, questions and tentative answers, documented encounters with recalcitrant or receding horizons, and new paradigms and metaphors, which can nourish everyone else. Professional theologians and ministers of the word must constantly drink at this pool—what they find there will already to some extent be worked over in a preliminary way by the amateur theologians in all walks

of life who reflect prayerfully and intelligently and creatively on all aspects of their life, and on the reality they see around them from their own special backgrounds and perspectives.

But, for theology by itself—outside of any dialogue or interaction with other disciplines—to exhibit the seriousness, rigor and universal agreement which characterizes the sciences at their best may very well be an unrealistic and dangerous expectation. It presupposes a clear and well-defined methodology upon which all basically agree—along with universally accepted standards of excellence in applying it. It also presupposes that theology is a discipline which is rigorously and organically cumulative in a way, perhaps, which it is not capable of being, without falling into the trap of aping and uncritically appropriating the methods of the natural sciences. Some of the human and social sciences have fallen into that trap in the past, attempting to achieve such methodological rigor and seriousness, forgetting that they themselves study much more complex and less algorithmically compressible realities. And they have ended up, in some cases at least, losing themselves, and the sense of their real objectives, and severely oversimplifying their objects of study.

VI. THE NATURAL SCIENCES AND NORTH AMERICAN ROMAN CATHOLIC THEOLOGY

Finally, as I have already indicated, American Roman Catholic theologians may very well be much too isolated from the scientific community, to interact effectively and fruitfully with the natural sciences in the ways I have suggested as essential for maintaining the vigor and the crucial interdisciplinary character of their discipline. The scientific community in this country, and in most countries throughout the world, constitutes a major element of the intellectual community. Certainly, as I have already pointed out, Roman Catholic theologians are more isolated, in general, from that community than their Anglican and Protestant counterparts. In my own experience, this has struck me time and again—at the university level, the seminary level, and on the parish and diocesan levels: there is a remarkable lack of serious intellectual interaction of Roman Catholic members of the scientific community with theologians and those in ministry. I am not saying that there is absolutely none—but I am saying that there is a very serious and persistent lack of it.

There is also some definite lack of interest among many on the other side—even among some of those who are deeply interested in theological and philosophical questions. They often seem to have lost any confidence they had in the ability of philosophers and theologians to discuss or shed light on the issues in which they are interested. There is also a lack of opportunity. There are few theologians or theologically interested philosophers at universities where the most significant scientific work is done, and where there is time and interest and motivation for profitable interdisciplinary interaction and collaboration. Very little opportunity exists at Catholic universities—the isolation extends there—and few Catholic universities emphasize significant scientific research. Again there are notable exceptions, and there are the theological consortia near places like Cal Berkeley, Harvard and MIT. But these are certainly exceptions. Finally, there is the per-

vasive fragmentation of the American intellectual community—it seems to be growing slowly back together, at least there are signs of it, under the discovery of new-found common interests—computers and information management, ecology, social and environment problems, the impact of technological innovations, etc. But there is still great diversity, and much reluctance towards interdisciplinary communication. Still, I sense that Roman Catholic professional theological community, in general, is very much on the fringe of all this—including being on the fringe of the infant alliances being formed within the intellectual community. This seems to me to be a real challenge—such isolation could easily get worse, and the long term effects will be devastating.

Ways of concretely breaking out of the pattern of isolation are desperately needed. And it is not easy to see how that is to be done, except perhaps by relying heavily upon the active involvement of both the science-religion structures and resources in the Protestant and Anglican communions, particularly, and the Roman Catholic scientists, engineers and philosophers. That is already being done to some extent. But the commitment to it will have to grow considerably on different levels before it is securely established.

These are the principal challenges I see the natural sciences presenting to the church, and thus to theology and to the theological community. The first step towards meeting them, as I have stressed again and again in this paper, is dialogue—serious intellectual discussion and collaborative research with members of the scientific community and especially with believers, Catholics and non-Catholics alike, who belong to the scientific community. In this dialogue we will discover philosophical and theological issues of common interest and concern, and then begin to probe and research them seriously. This is a very difficult set of challenges, but perhaps they should be looked upon more as opportunities—opportunities for reinvigorating and renewing our common search for understanding of the universe in which we live, of ourselves and of God who offers Him/Herself to us in so many different ways within this awesome, fragile and mysterious context.

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