RELIGION AND SCIENCE IN AN ADVANCED SCIENTIFIC CULTURE

by Langdon Gilkey

Abstract. These are reflections on the Arkansas creationist trial by a witness for the American Civil Liberties Union. The following points are stressed: First, religion took the lead in defending science at the trial. Second, the appearance of creation science is a function not only of Protestant fundamentalism but also of the establishment of science in our wider culture. It represents a "deviant science" in such a culture. Third, our century has manifested many such bizarre unions of ideological religion and modern science. This shows that science is dependent upon its humanistic, moral, and religious matrix for its social and historical health. Fourth, *part* of the cause of the rise of creation science has been the power, status, and self-assurance of science that it represents "the only form of truth." Fifth, religion in turn tends both to increase and to become fanatical in advanced and precarious cultures; religion, therefore, needs rational and moral criticism if *it* would help in the creation of social health.

Keywords: creation science; dependence of science on the humanities; establishment of science; logical limits of science; "popular science"; proximate versus ultimate origins.

The subject of this essay is the creationist controversy as it came, so to speak, to a momentary boil in Arkansas in 1981 and as it also appeared in Louisiana. In both states a law had been passed requiring that creation science, to all intents and purposes a literal interpretation of the Genesis account, be taught in science classes alongside what they called evolutionary science. Although this is a player's account of the controversy, I am more concerned with articulating what I found to be

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its meaning than with narrating its story. To me it provided a window into the complexity and therefore the opacity of at least one advanced scientific culture, and especially into the relations of religion and science in such a culture. There were shapes to be seen and sounds to be heard there that I had not perceived before—and that certainly neither the media, the scientific community, nor the public at large sense in it. These latter viewed it as simply the latest battle in the continuing warfare between the benighted legions of religion against the enlightened forces of science, as a struggle between blind and ignorant belief on the one hand and objective truth on the other. I shall seek to show that this is a false understanding of the controversy. This mistaken understanding is a part of the optical illusion that the regnant mythology of an advanced scientific culture helps to create whenever that culture seeks to understand itself.

First, here are some facts about the controversy itself which serve to question, as they did for me, that conventional reading. The plaintiffs in the case—those who objected to the law forcing a teaching of creationism as science—were largely (eighteen out of twenty-one) churches, clergy, and ministerial associations: Protestant, Catholic, and Jewish; only one represented a scientific organization, the National Association of Biology Teachers. Half the witnesses on our side (the American Civil Liberties Union side) represented religion and religious studies; all but one of the witnesses on the other side represented one scientific discipline or another.

Correspondingly, the leaders of the movement of creation science, those who write the books and pamphlets, are scientists—in the descriptive, if not the normative, sense that most of them have advanced degrees in science (not engineering) from reputable universities and hold tenured positions in natural science. I have debated against four creationists; each time my opponent held a doctorate in natural science (Massachusetts Institute of Technology, Ohio State, University of Pittsburgh, University of California at Berkeley) and consciously spoke, as they assured our audiences, "as a scientist" (there are four tenured professors at Purdue, five at Iowa State—all in the sciences). This is enough to show that the situation is mixed, strangely confused, and therefore obscure; surprisingly, there is a good deal of *religion* in the forces arrayed against creationism and a good deal of *science* in the forces for it. Both sides in fact represent a different, unexpected sort of union of science and religion. It is this interesting complexity and obscurity, these unexpected sorts of union of science and religion, characteristic of an advanced scientific culture, that I wish in part to elucidate. My essay, therefore, is constituted by a bit of sociology and history of religion, and a larger dose of theology of culture.

An Advanced Scientific Culture

We live in an advanced scientific culture. The first implication of this is that science is now thoroughly established (a category borrowed from church history but useful here). By *established* I mean, first, that science is now utterly necessary for almost every aspect of our life—for the production of goods, agriculture, medicine, communication, travel, self-defense, and so on—and thus does the society unquestionably support it, pay its bills, and revere it. In theoretical circles this means, second, that science is "queen," the paradigmatic form of knowing in the academy, and thus dominant over academic curricula and budgets alike. In short, for our culture science represents that central form of knowledge that brings forth both truth and well-being. As a consequence, it has a sacral character in our common life, and it sheds a sacral aura on those who possess, embody, and further it.

We theologians ought to understand this very well: we once enjoyed this same role. It is well for dominant groups such as these two to understand and recognize their own dominance and power, although they are tempted to deny it, to hide it from themselves, and to pretend that the dominance is not there. Only if they recognize this dominance, can they use their power wisely. One cause of the creationist controversy has been an irresponsible use of this power, that is, of the authority of science in the teaching of science. By this I mean that a vast number of scientists and teachers of science—though clearly not all—have identified their scientific knowledge with *total* knowledge and thus have dismissed religious understanding as primitive, prescientific, and so false. As we shall see, it is this assumption characteristic of a scientific culture, that scientific inquiry represents the only relevant path to truth, that has solicited, incited, produced, and reproduced the creationist reaction.

A second consequence of an advanced scientific culture is that science permeates down to and shapes all the levels of modern society. In turn it is, therefore, taken over and shaped by all levels. In the previous two or three centuries of its life, empirical science was practiced and understood only by portions of the educated elite; it was located, therefore, only at the top and perhaps slightly outside a society actually determined by other established forces, especially the established forces of class and of religion. It is this situation that has radically changed. This permeation throughout society has long been true of technology: every class, every form of entertainment (even the most "country") and likewise every variety of religion (even the most literalistic, bizarre, and in fact "unscientific") participates in and is at home with the most contemporary instruments of modern technology—as

Sunday mornings on television illustrate. Similarly, fundamentalist groups operate faultlessly amid sophisticated commercial and financial matters and even direct large portions of our economic system. They are also in the process of founding universities. It is no surprise, therefore, that members of fundamentalist groups enter the laboratories and the graduate schools of our larger universities in pursuit of doctorates in science and that such doctorates now abound among these groups—although, note, few similar university doctorates in theology or in biblical studies are found among them.

This participation in our technical and scientific culture has only recently become true of fundamentalism. At the Scopes trial in 1925 the major forces of fundamentalism were anti-urban, anti-university, anti-science, and anti-wealthy capitalist; they represented a rural and small town reaction to the more sophisticated areas of contemporary American life. This is patently no longer true. This change is represented not only by the doctoral and professional authors of these documents and defenders of the creation science credo; even more it is evident in their repudiation of evolutionary science, *not* because it is science but because it is "bad science" or "false science," and in their defense of their own view as "true science."

Thus appears our second useful, though quite unexpected, category borrowed from religious studies (the first was the *establishment* of science), namely the category of "*popular science*." I mean by that the sort of thing we think of when we speak of a level of "popular religion" in a culture where a traditional religion has long been thoroughly established, as when Catholicism was established in Greece, Sicily, or Spain or evangelical Protestantism in American mountain culture. An established religion then takes on, as a part of itself, local, age-old, often deviant or bizarre forms (syncretistic forms) as a result of its mingling with the whole range—from aristocracy to peasantry—of the culture. Unquestionably such forms of popular Christianity are still Christianity, however unpalatable they may be to the Councils of Bishops or the National Council of Churches. Thus what we here refer to are forms of modern science, however they may horrify the American Association for the Advancement of Science (AAAS). An established spiritual force tends to lose its clarity of definition and its purity—even its moral excellence—and to appear on different levels and in widely different forms, in popular and dubious as well as in elite and noble forms.

Unexpected Unions of Science and Religion

In our century we should have been aware of this syncretism in relation to science as well as to religions, but for various interesting reasons we

were not. It has been an important part of twentieth-century experience that different cultures with different ideologies have incorporated modern technology and science into their life, have reshaped them, and as a result have produced variant forms of both. One thing one may be sure of is that every modern culture is deeply intent on incorporating into itself technology, industry, and so science. However, as the examples of China and Japan show, each one seeks to do so on its *own* terms, to reshape it by means of its own most significant cultural and spiritual structures. Thus the forms taken by technology, industry, and especially science shift interestingly as they become embodied in different social matrices, many being in one way or another strikingly deviant forms from the point of view of the science of our own elite Western culture. Nazi Germany was scientific, and it incorporated all the universities and laboratories of modern Germany almost without a whimper into its ideological life and vividly reshaped them; Stalinist Russia did the same; so did Shinto Japan. Believing in the universality and necessity of our own form of science, we took each of these as mere aberrations, and they were. Still, consider that Maoist China would have been another differently shaped example had it lasted, and possibly Khomeini's Iran will prove the most bizarre of all. Surely, we cannot be so naive as to think that the vast number of Sunni and Shi'ite students at our technological and engineering schools will return to their lands, to Iran and Saudi Arabia, to reproduce there MIT and the Charles River Basin (or the Backs of the Cam!) rather than help create an Islamic form of modern culture and so of science!

Each of these represents a different union, to us possibly bizarre and even menacing, of science and the religious. When traditional and powerful cultures import a spiritual force, they reshape it profoundly —as in turn it reshapes them. Our liberal understanding of science and of technology thus reveals itself not as the one necessary or guaranteed form of scientific culture, but as *one* option, one developed by and indebted to the liberal democratic, humanistic, and capitalistic culture of the European Enlightenment. Quite naturally it remains for us "true science," but we may be sure that it is not the only form of science, of technology, or of industrialism that developments in the immediate future will produce.

In any case, let us note that in these cases we see before us examples of particular kinds of union of science with a religious base, of science and religion—and that creationism or creation science represents our home-grown American variety of this species. The warfare in this case, therefore, is not one between science and religion but one between different *sorts* of unity of science and religion: on the one hand we have what one might term an "elite form" made up of elite science (the

AAAS) and religion (the National Council of Churches, the main denominations, the seminaries, and the graduate schools); on the other hand we have a "popular form" constituted by fundamentalist religion and popular science and technology. What this series of "unions" of science and ideology shows is that it has been the liberal humanistic culture of elite science, not its scientific or technological components, that has made it liberal; and, as recent history shows, there is little reason within science itself why the latter cannot associate itself with other nonliberal cultures, ideologies, and religious forms. Correspondingly, a given scientific community in a culture is as vulnerable—as Japan, Germany, Russia, and China indicate—as is any other community in that culture to a powerful religious ideology. As a result, the health of science as a social force depends on the persistence and the health of the wider liberal culture in which it is embedded.

Effects of Establishment on Science Itself

As we noted, the establishment of science means that science represents for our culture the paradigmatic and so sacral form of knowing. It provides our culture with the knowledge we feel we need, that is with the intellectual and theoretical basis for the culture's most important forms of praxis. Scientists are, therefore, for us society's crucial and inexpendable "experts" in medicine, technology, social policy, defense, and so on. Each form of sacred knowledge has for very understandable reasons a sacral aura, symbolized in our case by the white coat and by the super prizes bestowed on scientists. In effect, then, as the forms of religion in such a culture seek to be scientific, so science itself begins to manifest a religious dimension or religious attributes. A quite intelligible expansion or inflation of science takes place from method or heuristic rules or canons to metaphysical, ontological, and theological substantive statements. That is to say, the claim appears that *only* scientific statements are cognitive and that only the factors scientific inquiry uncovers and knows are real and effective causes of things.

The belief that scientific explanations represent in this sense *total* explanations—all that can or all that will be known—dominated both sides of the creationist controversy. The creationists assumed it throughout their literature and their testimony. First, they assumed it of their own doctrines: if creation was true, if the Genesis account was valid, then it was or must be science. Next, they assumed it also of evolutionary science: if such science does not in its theories mention God or use God as a cause, then it follows that evolutionary science has excluded and so denied God, that it represents, as the documents repeated, a form of atheistic religion. Also, let us note, on the other side, many if not all supporters of science have thoroughly agreed with

this view. If, said they, science no longer makes use of the hypothesis of God in its tracing of origins, then religious explanations are thereby shown to be anachronistic, outmoded, and false—errors characteristic of an earlier prescientific era and so untenable because incredible in our day. Both sides, therefore, presupposed that natural science provides a total explanation of origins.

Interestingly, despite their other differences, neither side had the slightest inkling of the logical limits of scientific inquiry as a mode of knowing. Nor did either one envision the possibility that a religious understanding and a scientific understanding of origins were quite compatible and not mutually exclusive since they represent distinguishable if not ultimately separable modes of knowing and of speaking. Apparently, in a scientific culture the step for natural science from regarding science as the most immediately useful and so the paradigmatic form of knowing (which it is) to regarding it as the *only* form of knowing is a short but fatal step—and it is especially short when sacral knowledge is involved, knowledge that will heal and redeem as well as inform. Moreover, what we feel we *know*, or can know, represents that which we feel certain is *real*. Correspondingly, that subject matter to which we refuse the label knowledge is taken by us to be illusory, at best the product of our own subjectivity. Thus science in a scientific culture begins to define the extent of reality and of possibility for us all, and thus science itself unwittingly breeds a religious reaction or backlash.

The error, then, that characterized and empowered both sides of the controversy, that therefore led to it, was the error (characteristic of a scientific culture) that truth is all of one kind or all on one level, namely the sort of knowledge or of truth that scientific inquiry generates. The consequences of this error are serious, not only by breeding controversies of this sort but also by its effects across the range of the culture generally. The other aspects of culture (imaginative literature, art, rational speculation, social theory, morals, and religion) then cease to be taken seriously as if they represented complementary cognitive encounters with reality and thus different aspects or different levels of truth. Rather they are regarded as merely subjective, generated entirely out of the psyche—and so irrelevant for the fundamental business of life in its relation to reality. As the humanistic and reflective disciplines are thus pushed aside, science is raised above the other disciplines, viewed as self-generated, independent and autonomous in relation to the other, relatively subjective aspects of culture. While *they* depend on science as providing fundamental knowledge or theory, *it* depends only on itself: on its immediate past traditions, its instruments and laboratories, its methods, and its genius.

Thus develops the myth that the scientific community need not understand the rest of culture, or even understand itself in relation to

the rest of culture, in order to function or to function creatively. This myth is not only psychologically dominant; it also has become embodied in the majority of graduate programs in science which are quite bare of required courses in either the history of science or the philosophy of science. These courses are designed, if properly taught, precisely to relate scientific inquiry and its results to other cognitive and noncognitive aspects of culture. To my knowledge, science is the only university discipline taught without any substantial reference to its own history and to its own relations to the rest of life—a quite extraordinary trait! As theology once thought that because of revelation it was quite independent of culture and of culture's relativities, so now science has seen itself, because of its modes of objective inquiry, to be independent of the ups and downs, the fashions, the paradigms and myths of ordinary cultural life.

This view of itself is, of course, an illusory one as that gadfly Thomas Kuhn has pointed out. Science is also a fully human activity, appearing and developing within a given cultural and historical matrix, at every step dependent upon and so reflecting that culture's presuppositions, its paradigms, its aims, its fundamental convinctions—and completely dependent for its own health, that is, for the creativity of its consequences, on the social, moral, spiritual, and legal health of its society. As in the cases of art, politics, or religion, therefore, to understand science one must understand the history of science and the relations of its sources, its conceptuality, and its possibilities to other aspects of culture, that is to say, the history and the philosophy of science.

The Logical Limits of Science

Perhaps the main consequence of the idolization of science and of the resulting error that truth is all of one sort is the ignoring or unawareness of the logical limits of science—characteristic as we have seen of both sides of this controversy. The rules or canons of scientific method define the modes of explanation that are scientific. These canons thus support or guarantee the reliability of scientific conclusions; they provide the logical grounds for our confidence in the relative validity of inquiry. However, they also rule out as nonscientific clearly religious "doctrines," such as the concept of creation out of nothing embodied in creation science. I refer to such canons as, first, the *empirical* canon that no concept is permissible except one that grows out of and can be checked in sensible and so sharable experience; second, the *naturalistic* canon that no supernatural explanatory cause is permissible in scientific explanation, that only natural or human causes may be appealed to; and third, that scientific explanations are in terms of *universal* and so *necessary* relations and not purposes or intentions.

In the trial we used these rules of method to exclude creation science from the domain of science—since creation science inescapably referred to a transcendent God, to His purposes, and to a quite transnatural action to explain the world. To speak, as they did, of a sudden and recent creation of all things *out of nothing*, to postulate an Absolute Beginning not only to the universe but to each "kind" within it, to refer to supernatural causes of geological formations such as the Flood—these concepts defy the canons of scientific method we have mentioned and transcend its mode of explanation. They represent examples possibly of philosophical and certainly of religious and mythical speech, not a set of scientific propositions.

Let us note, however, that these same rules clearly *limit* scientific explanations. They limit it to the domain of finite, material, and objective causes; and they necessarily presuppose that this domain or system of natural causes is already existent and at work. When the scientist looks for origins, therefore, he or she can only ask, how did state A arise out of state B, *and* how can I interpret these changes in terms of natural processes? They cannot ask how did the entire system originate, and why? Nor can they ask, what other transnatural or even inward, intentional factors may be at work in natural processes, historical events, or personal lives—processes other than these objective, invariable, and sensible factors? The scientific question of origins only concerns, therefore, the question of *proximate* origins, of how one process led into another one in the ongoing development of the world system. By its very nature, scientific inquiry cannot ask about the *utimate* origin or the *ultimate* ground of the natural process itself, nor can it inquire about transnatural (or personal) factors within these processes. As a consequence, a scientific explanation of origins and of development is related to but distinct from a metaphysical or a religious interpretation of origins and development. Thus science is methodologically nontheological or nontheistic; *a priori* it cannot as scientific inquiry raise the question of God, no matter how religious the scientist may be or how firmly he or she believes in the presence and activity of the divine.

The same is true, interestingly enough, of the logical limits both of historical inquiry and of law. In neither case can God be appealed to as an explanation. I made this point about the law in the trial: no defending lawyer in a murder trial can advance in court (even in the faithfully orthodox state of Arkansas) the hypothesis that God instead of his client is responsible for the murder under consideration. The judge firmly agreed: "God" is not an acceptable explanatory factor in terms of Arkansas law. These are thus *secular* disciplines, and this is the meaning of that term. It is not that they are atheistic or entail atheism,

for surely in Arkansas God establishes and supports the law. Rather these disciplines are confined by their logical rules to natural and historical causes, to what the scholastics helpfully called secondary causes; and these disciplines can in the construction of their theories appeal only to that secondary level of explanation. Thus scientific inquiry is distinct from any general consideration of the whole of things and from inquiry into knowing subjects as well as known objects, that is, from investigation of the nonobjective yet experienced levels of our own personal and historical being. Scientific inquiry and reflection are in this way enterprises different from reflection in metaphysics and theology, as well as from artistic and moral experiences of reality. Science in this sense is limited, a most important aspect, but nontheless *an* aspect, of our whole contact with and so our understanding of reality. For this reason scientific explanation neither excludes nor replaces a religious explanation or a metaphysical one—although it may well imply changes in the formulations of theories in either discipline.

"Breeding" Creationists

The forgetfulness of, or obliviousness to, this limitation quite dominated the controversy, as it tends to dominate our wider cultural life. To creationists, as we noted, evolutionary science was essentially atheistic because it never mentioned God in its explanation of origins. They did not realize that the special sciences *could not* have mentioned God as an explanation and remained science, nor that their own religious statements, like metaphysical ones, functioned on a different level of discourse and conceptuality than did the scientific ones they had learned in their training. After all, to speak of an object in its relation to other objects within the natural system represents a different mode of speech than to speak of the ground of all objects and all relations, to speak of God whether at the beginning, during the process, or at the end of all things.

Correspondingly—and the parallel is strange yet precise—to innumerable spokesmen and teachers of science the new, exciting, and plausible scientific explanations of origins have simply replaced traditional religious explanations of origins. They understand Genesis and the doctrines of Christianity or Judaism as prescientific attempts to understand the natural world cognitively, as prescientific efforts to know as science knows. This is an interpretation of religion natural to a scientific culture. As a consequence, now that much more reliable information about the natural world has come to us, this whole panoply of religious understanding is out of date. "Science tells us that Genesis is wrong"—with each such statement by the biology teacher in class,

repeated at home that night to father and mother, two new creationists are generated! Creationism is not a reaction to Protestant liberalism as was the older fundamentalism. It is a reaction to the establishment of modern science insofar as science has claimed to provide a total explanation of our existence and of the world in which we exist. It has been the expansion of science from a reliable method into a speculative world view and a humanistic faith, an expansion assumed as quite natural by much of the intelligentsia, that has led to this controversy. It is, therefore, primarily the *religious* dimension of modern or evolutionary science that the creationists have reacted to—and in that reaction they have been in their own way quite right.

Now that we are aware, as never before, of the permanence of the religious within culture and its renewed vigor in a time of troubles, the interface of science and religion becomes much more important. Religion is not about to wither away, nor is science. Each culture, modern ones included, unites the ever present factors of rational inquiry and of ultimate commitment in a wide variety of ways—but it always unites them. The relations, therefore, of a scientific understanding of origins to a religious understanding of origins is a most significant cultural question as the heat generated by this controversy shows. To deal creatively with the relations of science to the religious dimensions of any cultural matrix, more than a knowledge of science is necessary; and to deal with the specific issues in this controversy, namely the relation of current scientific views of origins to Hebrew and Christian beliefs about origins, requires also an acquaintance with philosophy of religion, with current biblical studies, and with the way modern Jews and Christians understand their fundamental symbols. Above all, a refashioning of the modes of training of the scientific community—a restoration of philosophy of science and the history of science—is absolutely vital if that community is to fulfill the creative role that its intellectual and social dominance forces upon it.

The Growth of Religion in Advanced Cultures

Let us return to the unexpected persistence rather than the expected decline of the religious as modern culture develops—an important theme in this controversy. This has been a surprise because it was long assumed that, as science and technological powers expanded, the "need," as we liked to put it, for religion would recede. This has turned out to be wrong. The evidence shows that religions are on the increase. In fact their rise, and their subsequent conflicts—as new religions, as social ideologies, or as old revitalized religions—represent perhaps the predominating social and historical factors of our century. How are we to understand this; or, differently put, what did we *not* understand

about the religious and society, about the religious and history, that led us to be wrong about the destiny of religion in the twentieth century?

First of all, every culture, to be a culture or to be itself, needs a unifying, organizing, and directing set of symbols that gives to all common experience an intelligible and meaningful pattern. This is a symbolic pattern that explains our dilemmas and suffering and that promises to resolve them; it is thus a pattern that provides us with a common goal, with norms pointing to that goal, and with grounds for hope in its achievement. We see this clearly in the crucial social and political role played in archaic and premodern societies by organized religions; we see it today in the corresponding role played by modern ideologies, East and West. In a scientific epoch wherein each culture is scientific, it is thus intelligible that such sets of symbols will build themselves, at least in significant part, on science—as is evident both in Marxism, which calls itself a science, and in the liberal doctrine of progress, based largely on developments in science.

The view that religion as such was an aspect merely of past, prescientific societies, and thus of ignorant and vulnerable societies, has been a part of this scientific and technological self-understanding characteristic of modern cultures, an aspect in effect of the founding "mythos" constitutive of modern scientific culture. This view understood the major cultural activities of the past as if they had been solely cognitive endeavors, and thus it saw all forms of past cognition as either prescientific or pseudo-scientific, based on the pattern of its own dominant form of knowing. Thus the religious myths of the past were seen as prescientific efforts to explain natural events, to provide the sort of important but limited understanding science provides. For this reason, it was reasonable to believe that all forms of religious "knowing" would dissolve away as science itself was developed and replaced them.

Unexpectedly, however, the historical development of this scientific culture has itself shown the one-sidedness if not the falsity of this latest cycle of scientific myths establishing that culture. Out of that culture's own advances have arisen dilemmas which raise religious questions and which call for religious answers.

It is for this reason that the twentieth century, a century of the reappearance of the religious, has shown the prophecy of the decline of religion to be in error. This is because the role of religion in cultural life shifts and becomes even more crucial and much more apparent in what Arnold Toynbee called "Times of Trouble," periods of increasing conflict and apparent disintegration and thus periods of possible decline. Such times of trouble appear when those structures which founded the culture's life, which were once the secret of its strength and vitality, turn and become destructive or partly destructive, and so

lead to the disintegration of the common life rather than to its support. In our time we have, to our shock, seen this apparently beginning to happen with the advances of theoretical science, with the developments of technological power, and with the expansion of industrialism—and with capitalist and Marxist social theories. These create the deepest dilemmas, the unsoluble yet lethal dilemmas, that dominate *our* horizon. Naturally, in such times the most basic symbols undergirding shared confidence become themselves shaken, and the assumed values of the culture suddenly appear vulnerable; every basis for serenity itself seems now precarious. The Hellenistic period illustrated all of these modes of doubt, uncertainty, and anxiety about its cultural foundations; as a consequence it tended to welcome a whole new range of religious cults, new levels of religious enthusiasm, and quite new depths of mystical knowing.

It is, therefore, no surprise that in our period literalistic fundamentalism should be on the rise. Vast new anxieties have appeared in our time and must be appeased. These anxieties have arisen, not despite our scientific, technological, and industrial culture but precisely because of it, out of its own mounting dilemmas. In any case, what is crystal clear is that a scientific culture is by no means immune to the expansion of the religious, nor is it invulnerable to a massive takeover by some form of the religious. In strange and unexpected ways in our century, not only has the scientific community found itself breeding religion, but also, even more importantly, old and new religious forms have united with and used the forces of science.

Perhaps our most vivid and disturbing contemporary experience is that the social and historical effects of science depend on their *use* and that in turn the uses of scientific knowledge and technological power depend on the character and intentions of their users. Science has had, as expected, vastly benevolent effects wherever it has been creatively employed. Yet our predominant present awareness probably concentrates on its possibly devastating consequences—if it is used in ignorance, in error, in bad faith, in heedless self-concern. This means that any progressive and benevolent consequences of science and technology are utterly dependent on the moral and spiritual situation of the persons within a scientific culture and dependent as well on the legal, political, and educational health of that society. Ironically these aspects of culture on which science is totally and explicitly dependent—lest it prove demonic—are precisely those elements most ignored, set aside, even scorned as the technological society has developed, namely, its humanistic studies, its social theories and beliefs, its modes of philosophical and ethical reflection, and its religious traditions. A scientific culture cries out precisely for its sibling, the humanities, lest despite

itself it destroy itself. The myth of an independent, self-sufficient, and yet creative scientific and technological tradition has vanished without a trace.

Correspondingly, a religion as it appears in an advanced culture, is itself by no means always creative. Religion too can be destructive, in fact demonic. Whenever science generates evil consequences, it is, as we just noted, largely because of the *spiritual* ambiguity of the culture in which it is used, the ambiguity of society's legal and political structures and of its ultimate aims and commitments, and the partiality of its perspectives. It is, after all, the claim to ultimacy and sacrality, the absoluteness and the infinity provided by the religious dimension, that breeds in the political realm—by national and social ideologies alike—fanaticism, cruelty, and terror. Thus, again, as this controversy in a microscopic way shows—for here trained scientists have been shaped and driven by their fundamentalist convictions—the danger is that a scientific community, with all the massive power under its control, might be taken over by a rising religious movement, whether it be a traditional movement as in Japan and Iran, a secular one as in Germany, Italy, or Russia, or "home-grown religion" as with our own religious and political Right. The scientific community, conscious that it looks *back* with disdain on its culture's *own* traditional forms of religion which it has abandoned, has literally not believed this to be a possibility. However, the evidence shows it is. To see this point, scientists should look *forward* to the possibility of new nationalistic, ideological, and cultural modes of religion, for the varieties of relevant religious commitments range far beyond their home town's list of church services on Sunday.

In a time of troubles such as we are in, the religious tends to expand and to become more and more fanatical, intolerant, and violent. Science in turn tends to become more and more in theory positivist, intensely specialized in inquiry; and in actual practice—since these are above all funded—it tends to develop greater and greater means for destruction and for the exercise of repressive power. Such a cultural existence split at its center—*long* on theoretical knowledge and destructive know-how but *short* on self-understanding, self-criticism, and a transcendent ground for love and hope—provides a sure recipe for self-destruction. Let us stem this tide: let us begin again to speak together—for unless religion and science unite in reasonable and humane ways, they will unite as partners in disintegration.