NATURE, REALITY, AND THE SACRED: A MEDITATION IN SCIENCE AND RELIGION

by Langdon Gilkey

Abstract. Many scientists now recognize the participation of the knower in the known. Not many admit, however, that scientists rely upon intuitions about reality commonly attributed to philosophy and religion: that sensory experience relates us to an order in nature congruent with our minds and of value congruent with our fulfilled being. Nature has disclosed itself to scientists—albeit fragmentarily—as power, life, order, and unity or meaning. In science these remain limit questions, raised but unanswered. In the unity of these qualities, assumed by science, the sacred begins to appear. Addressing the limit questions, not only of scientific but of human experience, is the province of philosophy and religion.

Keywords: intuition; philosophy of science; the sacred; science and religion; truth.

Science and religion together almost cover the universe, known and unknown. We shall, therefore, chew off only a small part of their interrelation; and even then we will have to get into our topic by very broad strokes and large statements. Both science and religion are, I believe, essential aspects of our common life, necessary for that life and for each other. This used to be a debatable point for science; now it is for religion. But the radical reappearance in power of religion in a scientific age—and its surrogate, ideology—indicates my thesis: they are both here to stay, and thus the way in which they understand and cooperate is of vast importance. For the facts show they will cooperate under all sorts of unexpected and bizarre conditions, as they did in Shinto Japan, Nazi Germany, and Stalin's Russia: and thus the *way* they do so is all important.

Science is now utterly basic for our understanding and knowledge of our world, and for our control, such as it is, over the forces in that world. Since culture is in significant part composed of the ways we

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know and the ways we use our world, science dominates our cultural life: our politics, our industry, our medicine and self-defense, our education. We live in an age of science. In our thoughts here this is not an issue. But religion in the broadest sense is also necessary. Every community, even a scientific one, lives in and from a certain general understanding of the reality that surrounds it; it shares therefore a common set of symbols descriptive of the whole of reality and the whole of experience. And each such understanding of the whole of things is, and must be, penetrated with (or better, intertwined with) some scheme of meaning, some vision of fulfillment that resolves the pressing dilemmas, tragedies, and evils that also characterize our existence, and that gives realistic direction and hope to our life. In both our existence and our action we participate in reality *through* our deepest understanding of it, of the truth about it and the values within it.

Further, knowing raises questions of its use; power creates fearful dilemmas. To our astonishment we now realize that the more we know, the more ambiguous and yet the more crucial is our action in the future: knowledge as power drives towards ethical dilemmas, and both drive towards searing questions of meaning. At the deepest level, therefore, symbols of *structure* and symbols of *meaning*, of fulfillment and hope, interpenetrate one another into some coherent whole. This is true even in a so-called secular society, as the Marxist vision on the one hand and the liberal progressivist vision (adhered to by most scientists) show on the other. These visions essential to human existence are in the broadest sense religious visions, though the classical tradition of philosophy has shared them. Both are trans-scientific and yet central to science. In any case, clearly for both science and religion so understood the question of the relation of each to reality, of the *truth* each holds, is crucial—for both essentially represent a relation to reality that is cognitive or believed to be so. And thus, since science and religion are mutually interdependent, the issue of the truth of science and of religion, and the relations between these sorts of truth, represents a central issue to each of them. It is this issue of knowledge and so of truth which I wish here to address.

The question of this relation is raised *negatively* from both sides in our day; on each side there are those who would eliminate or silence the other. Consequently any real resolution of the problem, any definitive movement towards an accommodation of mutual understanding and cooperation, can come only when each side is able to deal creatively with these "negators" in its own group. Those from the side of religion who deny the truth or the relevance of a scientific knowledge of nature are, unfortunately, on the increase. Regarding religious knowledge as omnicompetent formally and in content extending far into the

domains of scientific and historical knowledge, they flatly deny that scientific knowledge, where it contradicts their so-called knowledge, is valid; in fact science at this point is to them a hidden form of religious knowledge—it is essentially atheism. Politically and sociologically these views are important, unfortunately, especially when they claim their religious knowledge to be "scientific." But theoretically they are not. Since these are the views and the policies of religious groups, they are, so to speak, our responsibility, though it is difficult at the moment for us to see how we might deal creatively with them.

More hopeful, possibly, is the prospect with those from the side of science who deny the validity and the relevance of religious knowledge, that religion contributes anything at all to "truth" about reality. There are, of course, many in modern culture outside of science who feel this way. Among scientists this dogmatic negation of religion—and one notes that scientists become dogmatic only when they deal with issues bordering on religion—grounds itself in two claims about scientific knowledge: first, that scientific knowledge represents the *sole* cognitive entrance into what is real, the sole source of valid statements about "what is the case." Science and science alone define reality for us. Nature, therefore, is as science defines it, and reality is equivalent to nature as defined by science. These are in our day widespread and important claims.

The second dogmatic claim is that the knowledge science has gained is knowledge of nature as it is in itself; what science describes "is real out there" and, as we noted, all that is real. One finds this naive realism throughout books by scientists on science. For example, as Steven Weinberg, quoted by Heinz Pagels says, "The more we know about nature through science, the more we know that it is all pointless or meaningless" (Pagels 1986, 383); and Carl Sagan intones: "The cosmos—as known by science—is all there is, all there was, and all there will be" (Sagan 1985, 1). According to this realistic view scientific inquiry into nature exhaustively defines reality itself; quite literally there is no room for other dimensions of reality, much less knowledge of them, and even the scientific knower herself seems to have disappeared. One might remark that even René Descartes' frequently lambasted dualism of extension and thought, known and knower, is a relief compared to this objectivist monism of the known, a monism vacant of the knower who thinks this theory about the known. As we shall see, the new philosophy of science radically denies this empiricist realism. However, just as anti-scientific religionists pay no heed to liberal theologians, so many if not most working scientists pay little heed to new currents in the philosophy of science. As Frank Tipler says, "We are ontological reductionists and determinists because this is what is

directly implied by our scientific equations and formulae" (Barrow and Tipler 1986, 138-39).

These two assumptions—namely, that natural science (possibly only physics) alone knows what is real; and that what science through its models and formulas knows is "there," real in itself, the way it all really is—represent pervasive and powerful assumptions in our intellectual world. They are held by many as quite axiomatic and by many quite unaware of their radical implications. As we note, they make it difficult to talk importantly and realistically about knowing subjects and so scientists, not to mention persons. Furthermore, any hint of the sacred—of those aspects of experienced reality that lead in the direction of religion—is interpreted, again exhaustively, as projections onto a real nature (as described by science) by that dubious subject—though *who* does the projecting in this universe is as mysterious as who does the science! The humanities and religion alike, therefore, trace out as disciplines only patterns of subjectivity (note the unexpected rendezvous of dogmatic science with radical deconstruction!). Correspondingly, the moral ideals and social convictions on which civilization depends, bearing no reference to reality, represent only the most ephemeral subjective preferences. Although the responsible men and women who share these scientific dogmas are by no means nihilists but are on the contrary traditional, moral, and humane, nonetheless the implications of their credo lead inexorably in that direction. If one wished to prepare the way for renewed religious dogmatism, scientific dogmatism is surely the way to do it. I wish to challenge this understanding of science, to challenge it not primarily because of its view of morals or of religion, but rather because of its misunderstanding of science, and through that its even more important misunderstanding of nature, of reality as a whole, and of the sacred latent in nature and in reality. Hence our title.

It is, as we noted, fascinating to see the parallel in recent changes in the understanding of religious and of scientific truth—and the failure in both wider communities to keep pace with these parallel changes. Slowly an understanding of religious doctrines as literal statements of matters of fact, frequently in areas covered by scientific inquiry and by historical research, changed into an understanding of that truth as *symbolic*, as disclosive of deeper, often obscure but ultimately important levels of experience, levels so important that they are constitutive of our existence and our powers. Thus largely under the pressure of developments in science, religious truth has since 1800 changed its form into a symbolic but limited, and above all crucial, *perspective* on the real, a disclosure of who we are in the totality of things, a symbolic knowing of the divine in relation to our world and not a factual

knowledge of the world. This is taken for granted—and has been for a hundred fifty years—by those who reflect on religion, by theological, scriptural, historical, and ethical scholarship alike. It is this that fundamentalism repudiates.

Correspondingly the understanding of scientific truth, perhaps a hundred years later, itself has changed with the developments of the new physics around the turn of the last century. I can only in a very amateurish way summarize some of these developments. First—a new and puzzling indeterminism has appeared: no absolute prediction of the behavior of the quantum was possible, and this seemed to represent an essential limit; but whether this limit is instrumental, epistemological, or ontological could not definitively be known. Reality seemed to proceed, or at least to reveal itself, in jumps—which was bizarre indeed and subversive of the mechanical, caused, deterministic understanding of reality that preceded the new science. Second—all observations manifest themselves as radically observer-dependent. At the micro level we cannot perceive and know things as they are in themselves but only as they are in relation to us, the observer. Our knowledge here is not only inadequate: it is relative, a perspective, in part therefore a construction—and again this seemed an essential and not an accidental limit. Third and finally, what we know seemed impossible as clearly and as coherently to conceive as, say, we had with the atom. Smallest particles seemed infinitely elusive and to exist in "jumps"; "fields" of force appeared; waves and particles seemed to dance along together; matter seemed to fuse into energy and back out again. As Niels Bohr and Werner Heisenberg agreed, our models and concepts no longer apply, only our mathematics (see Heisenberg 1971, esp. chs. 10 and 11). What are "jumps" at this level, "fields" without dirt, "waves" without an ether, a convertible matter and energy?: is all that is, "dynamic force" without substance, "events" without matter or substance? Seemingly so. It seemed impossible any longer precisely to specify the nature of nature. The referents of our theories are no longer available either phenomenally or even conceptually to us: the more we know of nature, the clearer it is that nature in itself has become a mystery.

These developments have been as radical as those in religion a hundred years before. The primary qualities of classical physics: mass, velocity, position and distance, the matter in motion "out there real," have become in effect secondary qualities dependent on the observer. And clearly, what is out there has only partially disclosed itself in our cognitive relation to it within scientific inquiry. While scientific knowledge has shown itself—and now *there* is a mystery!—as more and more trustworthy, its relation to its real object has become less and less clear.

As many scientists reiterated, "Nature as a phenomenal object is gone.... The new truth about nature is our epistemological distance from it" (Rolston 1987, 59, 61-63). Science seems to translate the nature it experiences and charts into symbols expressive in some deep way of the contours of the real but by no means into a literal copy or mirror of it, nor exhaustive of its richness. Both nature and reality have in principle again become mysteries: that is to say, *not* to be fully known "in themselves" by science.

It is therefore no surprise that not long after the development of this new physics, the understanding of science itself, the philosophy of science, also began dramatically to change. Previously scientific method had only been *logically* interpreted as induction of an hypothesis from data, deduction towards an experimental situation, and verification in the light of new data; the "subject" here represents only a logical thought process—though where she was in the universe was left out! In the light of the new science, however, it made sense to focus on the scientific subject, the observer who is now seen as contributing so much to the results of science, the observer as a historical being on the one hand and as an experiencing, knowing, evaluating, and projecting being on the other. Edwin A. Burtt, R. G. Collingwood, Herbert Butterfield, and Thomas Kuhn showed the influence of cultural and so of historical presuppositions and paradigms not only on the development of empirical science as such, but on each one of its changing epochs; science here as observer-dependent became science as culture-dependent. In turn Michael Polanyi, Norwood Hansen, Bernard Lonergan, Paul Feyerabend and now Harold Brown have shown in various ways the contribution of the experiencing, knowing subject—the person who knows—to the conclusions of science; we are a long way from the analysis of the scientific method as carried on only by a logical and not a human subject.

The new philosophy of science has, I have said, emphasized the contribution of the scientist as knower and as person to the knowledge that constitutes science and so to the historical developments of science. All scientific inquiry is, as they say, *theory-laden*. The picture of science as merely a matter of the objective, theory-free gathering of pure data and then the marshalling from them of an induction which is finally tested, represents a sheer logical abstraction, the product of an after-the-fact analysis. On the contrary, significant data appear out of the infinite welter of experienced facts only to trained minds, minds already prepared by a host of prior assumptions; such prepared minds, moreover, are bothered by certain crucial questions or puzzles which prior theory has disregarded and which these "significant" data can illumine and the new hypothesis can perhaps resolve. Data appear,

then, in relation only to pre-understanding; and pre-understanding of the world is presumed and is now placed under challenge by a new hypothetical re-structuring. Correspondingly, it takes training and expertise, insight and art, to read the data so as to see in them the problem; even more it takes a leap of imagination to perceive what is not there, namely a new answer, and to recognize a new constellation of facts as a confirmation or a falsification of that new answer. Inquiry, whether it be discovering or falsifying, is as much a matter of layers of presuppositions and assumptions, of tacit knowing, of intuition, imagination, and flashes of personal insight, as it is of logical brilliance; science is strangely like diagnostic medicine, more an art than it is a science. In any case the subject, the personal being of the scientist, is crucial.

Science, however, concerns not only the intuitive, imaginative, intellectual subject. It also requires—as Polanyi (1964) has shown—a communal, a moral, and so a committed subject. To be a scientist is to be brought into, in fact trained and inducted into, a community of expertise, in effect a guild; in graduate school and the laboratory one learns how to do science by imitating those who do it. This is hardly "objective," impersonal learning; it is more like the communal, tacit person-to-person relation of an apprentice to the master, an intern to the head resident. Moreover, the apprentice-scientist thereby absorbs the standards and expectations of the community she is entering, the (so to speak) spiritual requirements for this role: its commitments, its tacit rules, its fundamental do's and don'ts; without this moral learning there is no scientific community and so no science. Finally—and here Paul Tillich (1951; 1957; 1963) is particularly clear—there must be an ultimate concern if science is to be possible. "Objectivity" is a moral and spiritual, and so a *subjective*, achievement; it does not come either with a diploma or a white coat. It is the result of passionate personal attachment to the truth, as Polanyi put it, of ultimate concern for uncovering the truth, for Tillich. Without this the scientist can be "bought" by the lures of fame and of grants, and in the end of cheating, falsifying evidence, plagiarism. As money and power nearly destroyed the church, so these two can and do lure science away from itself.

The scientific subject, then, is an intellectual-imaginative subject, a communal and moral subject. She is also—and here Collingwood, Toulmin, and Kuhn's emphases appear—a historical subject. The pre-understanding that shapes a scientist's mind as she conceives and creates an experimental situation is constituted by the many-layered presuppositions about the world which she shares with contemporary science. Many of these presuppositions are unconscious; many go way, way back in cultural history. Science would be quite impossible without them. These include presuppositions about what is real and how expe-

rience signals that reality to us, for example through the senses; presuppositions about the continuities of experience over space and over time, about universal order and of what sort that order is; paradigms or forms of order which have dominated that epoch of scientific theorizing. These are not discovered inductively from the data; they are the necessary conditions of there being organized data at all and so of there being induction. This preunderstanding is also constituted—and here is the real rub—by models and images common in the wider culture and borrowed for use in scientific conceptuality. For example, the model of the early industrial machine so important from Isaac Newton to William Paley; that of population increase and of mortal struggles for survival so important for Charles Darwin; that of computers and programming so crucial for modern genetic biology. These *cultural* phenomena imaginatively conceived provide analogous (and note *how* analogous!) conceptuality for scientific innovations. Like religious metaphors, once these analogous models are established, their metaphorical character is forgotten and they become simply and literally what is there.

Thus science is subject-dependent; and since the knowing subject is herself culturally and historically dependent, science has become itself (like religion) in part a function of wider cultural and historical change rather than the self-sufficient and steady accumulation of objective knowledge it once thought it was. As theology hit the turf with a thud when in the early nineteenth century it no longer was able to consider its contents to be directly revealed, so contemporary late-twentieth century science is having to face the uncomfortable fact of its own cultural and historical relativity. And this is perhaps why the new philosophy of science is so unpopular, in fact ignored, except by humanists.

In a strange way we have traced a path from the naive realism of nineteenth-century and many contemporary scientists back almost to Immanuel Kant. As this whole description of science shows, science is a *human* endeavor, a part of culture and thus of historical time, a creative and an imaginative construction by human subjects, by knowers. It is therefore deeply dependent on the instrumentality of that knower: on her mechanics of perception and so her sense organs, on the nervous system and brain characterizing such complex organisms, and above all on the forms of consciousness, of thought, and the modes of self-consciousness of the knower. What is known—and in being known, is shaped into a theory, then used and tested—is a magnificent creation of spirit, of mind: unifying and organizing its data with equal amounts of precision, intellectual clarity, and imaginative wildness—and fidelity. Through its imaginative creation by spirit, science creates a "world."

Out of the environment, said Tillich (1963), the self as spirit creates a world, an ordered, unified cosmos over against the observing self, a cosmos laced with the theoretical rationality and with the mathematics characteristic of the self, and thus a world now potential for the technical use of the self. As there is in our experience no organism without environment or self without world, *and* no spirit without bodily organism, mind without brain, so in turn there is no world, no ordered cosmos without self and spirit. Nature, as science defines and as technology uses it, therefore, is not so much "nature in itself" as it is a magnificent and dangerous construction of embodied spirit, a construction incited by our sensory contacts with nature as it is. As a complex body of theory, science represents and signals as much our *distance* as minds over against nature as reality—that is, the *translation* of reality into the terms of our minds—as it represents in its conclusions our dependence on an participation in nature. It is ironic that scientists—and here I cite especially the cosmologists and the sociobiologists—who present us with a magnificent theoretical vision of nature as science sees it, a wonderfully accurate edifice of scientific theory, should find in that vision of the whole no place for the scientist, for the scientific subject who through dependence on communal tradition, through training, inquiry, imagination, commitment and testing, has created that "subjectless" cosmos. In its wonder at the objects spread out before the gaze of its inquiries and its brilliant theoretical understanding of that system of objects, science tends to forget—as Kant reiterated—that the entire vision is itself in part a creation of the scientific observer. As Rolston has said: "The most astounding entity in the universe which the astronomer surveys lies just back of the eyes looking into the telescope" (Rolston 1987, 66).

Science, then, is dependent on the subject in knowing as well as on the object known: and that subject is a perceiving, experiencing, unifying, categorizing, theorizing, imagining, and projecting subject practiced in its art and loyal to its commitments. It is an intellectual, imaginative, communal, moral and projecting subject—one free to manipulate the given in new experiments, free to project new hopes for future testing, and above all free to assent on rational grounds alone to the probable validity of that new hypothesis. Let us note that much of the heralded modern sense of freedom—free to assent to the truth, free to manipulate the given and so free to change the world, arose from this experience *of* science *in* the community of scientists.

Let us note three important implications from this analysis, semi-Kantian and new-philosophy-of-science as it is. First: the process of scientific knowing is throughout radically dependent on *self-awareness*. I refer to the self-awareness of the scientist of his or her own opera-

tions, "that I see this datum," that this experimental situation is adequate, that the hypothesis is not falsified—in short the awareness that now I am knowing and thus that I *know*. Without this self-awareness as valid and so as cognitive, no cognition by the scientist herself of her own operations is possible. Here cognition becomes possible; thus it is impossible to doubt the validity of this sort of cognition and hold to any *other* sort of cognition. Here is an *extra*-scientific basis for science: the self-awareness of the subject that it experiences, sees, organizes, validates, and knows. Here we have, at the basis of science, a knowledge of being, of our *own* being as experiencing, understanding, and validating—as knowing—an awareness, so to speak, of reality from the inside.

Second, many presuppositions about reality are necessary for science: that, for example, sensory experience relates us to reality; that experience is characterized over both space and time by a coherent and intelligible order; that thought done according to its own rules is congruent with that order and so reveals the character of the real; that there is meaning and value in understanding that order; and that there is wisdom and unwisdom, right or wrong, in the way we use that knowledge. These presuppositions are necessary for science. None of them, as David Hume ([1748] 1986) showed, can be derived from sensory experience; and certainly in providing the necessary conditions for induction and so for scientific theory, they cannot be induced by scientific investigation itself. Kant (1943), of course, thought these to be provided by the subject, a "timeless" subject providing therefore universal and changeless conditions of knowing. To me the history of religion and of philosophy shows them to be general and pervasive *intuitions*, first of nature and then of reality as a whole, surely as old as human culture, expressed in each religion and appearing in explicit rational form in all early philosophy. These intuitions—or *disclosures*, one could call them—of order, rationality, and value are, first, human constructs, shaped by the subject, and as a consequence (since the subject is *historical*) they take a different form in each culture. In the development of modern culture, because of its Greek, Hebrew, and Christian roots, they took the particular form needed for modern empirical science to develop. These cultural roots represent, therefore, the necessary preconditions in cultural history for the development of modern science.

Now my point is that again science is dependent on a form of *non-scientific cognition*, or trans-scientific cognition; the intuition as valid of an order in nature congruent with our minds, and of value congruent with our fulfilled being. These have been both religious and later philosophical intuitions; I suspect they can be validated, if at all,

by religious and/or philosophical arguments. For this reason a positivist account of science which finds meaningless all such arguments is self-contradictory. Without this level of cognition science is impossible, as impossible as it is without self-awareness. Both are necessary for science—as is awareness of the other person in responsible community. It is, therefore, a self-contradiction for science to maintain that it alone "knows"; it could not know what it knows without this tacit, intuitive level of knowing—without these disclosures of order and value within the mystery of being.

Third, we have emphasized the importance to science of the *subject*, the knower who constitutes and creates science—the central precondition of science. This is the subject who very early distances herself in distinction from "world" and looks at the world in wonder and curiosity; this is the perceiving, organizing, naming, wondering, thinking, understanding, and judging subject; the subject who remembers and ponders past experience and who imagines what is not yet, manipulates the given experience, and projects future hypotheses and future plans and uses of knowledge; who is aware, self-aware, of each of these steps or methods—and who is committed, or could be, and so perseveres in pursuit of truth and the good. It is to *this* subject in science and of science that the words spirit, freedom, and self-transcendence as well as mind and reason have been applied. Science is the result of such embodied spirit and mind.

Appropriately, therefore, the *results* of science, its theories, are not "explained" by its genetic, physiological, and neurological *conditions* or causes—all of which are there as "causes" to be sure. On the contrary scientific theories are *judged* or *assessed* as true or false by empirical and logical warrants, by the correlation of these theories with experimental evidence, by their coherence with other theory, and by their fruitfulness. In this sense science is not *understood* when it is "explained" by all the caused factors that produce it; it is *understood* when its theories are understood and are assented to as true or false. The same mode of assessment should be (but is not) the case with regard to philosophy and religion. Currently by most intellectuals and scientists these latter two are *explained* by the genetic, biological, neurological, psychological, and sociological factors that have helped to produce them—as these same factors helped to produce science and in fact these theories about religion! No scientist or social scientist applies exhaustively this same mode of *explanatory* understanding to his or her own theories.

In any case, it is clear that science as an operation demonstrates to all with eyes to see the reality and the effectiveness of spirit: of mind, freedom, and commitment, of transcendence over past, present, and future, of the power to project plans into the future. Ironically despite

this, many scientists say they cannot find any sign of spirit among the objects they investigate. Of course not; what they investigate are *objects*, and all objects of inquiry lack inwardness, and all also already lie in the past of the observer. Spirit is known only by intuitive awareness, by *disclosures*, of self and of others, not by inquiry into objects. This is one important reason scientific knowledge cannot represent all we know; it leaves out the subject of science, the scientist, and thus has, so to speak, only half the story. The subject must be added to reality in any account of nature. The cosmos in that sense is not, as Sagan claimed, all there is; there is also Sagan looking at nature and constructing his Cosmos.

Now my point is that if this knowing *subject* with all these amazing powers and properties is there, an embodied, bodily part of reality—and science her child can hardly deny its mother—then this has in turn interesting effects on our interpretation of nature. Classically, the clear discrimination of this dimension of spirit in human consciousness led to a distinction of spirit/reason from nature, a sharp and continuing dualism: nature was object, matter; spirit subject or mind; and the union of the two in cosmos and humans alike remained a puzzle for both religion and philosophy. However, we now know—and I share that certainty—that all there is around us and within us has appeared historically as a product of nature, a product of the development of the cosmos and later of life in this cosmos. Spirit has not been inserted into its present material conditions from the outside. On the contrary, it has developed out of those same natural, even physical conditions as one of their most astounding fruits; and it has developed by the same evolutionary processes through which for biological inquiry all forms of life have developed, via random mutations of genes, recombination and the elimination of those results that are unfit. We are genetically programmed to be what we are, including being geneticists; and the self-transcendence, spirit, and freedom which the geneticist experiences in doing genetics characterize all human endeavor, all the doing which other humans than scientists do, even theology. Nature, evolution, and genetics have produced subjects: subjects who wonder, experience, think, judge, and assent to what freely they know to be true—and produce genetics! To reduce the spiritual dimension of this subject in the name of science is to eliminate the science and the scientist that together effect the reduction.

That nature has produced such a subject is a wonder, a mystery hardly explained by any of our hypotheses. At the least this wonder forces us to reconsider, to redefine nature. One thing we now know is that the processes of cosmic development and the processes of the development of life: of organisms, plants, and later animals, are such that out of that development and from these mutations have come

subjects of the sort necessary for scientific theory about nature and about development. Again, reductionism in order to save the theory, or in order to make scientific theories as a whole consistent, and to render scientific method omni-competent, is nonsense—since then there can be neither a system or scientific theories nor any scientific method to save.

Even matter must now be redefined: matter must now be understood as *capable* of becoming something more than matter, of becoming organic, mobile and sensible, then psychical, and finally spirit or mind—for matter, such as that of the brain, undergirds as the spatial-temporal locus all the instances of spirit we know and that we have outlined. Again the temptation is to reduce, to reduce mind to brain, spirit to flesh, and flesh to matter-energy, because we think we can *then* understand it all. But then there is and can be no real understanding at all. The quest for certainty, for intellectual sovereignty over the world, leads us in science—as it frequently did in religion—to nonsense. No, spirit as the agent of all theory, all *scientific* theory, forces us to rethink nature: nature as cosmos and evolution, as matter and genes, so that each of these is understood as capable of producing the free and rational mind, the committed will, and the responsible person that together constitute the scientist.

Such a redefinition of nature, matter, and evolutionary process in the light of the birth and nurture of spirit is one role of that immense—and ancient—puzzle now termed (by the physicists who are fascinated by it) the Anthropic Principle. This is the question, the limit question, as to how it could be that apparently lifeless and mindless cosmic processes, against all imaginable odds, that is with a literally infinitesimal probability, could have followed so inexorably a path that led to science—and so, I have added—to the spirit constitutive of science. Such a question intrigues the physicists and horrifies the biologists—just why I do not know.

Nature, therefore, is no longer "nature" as exhaustively defined by science. The presence of science forces us to enlarge our concept of nature so as to include the scientist, who along with all of us, is the product of nature's changes. Reality, therefore, is larger, more mysterious than any of our scientific definitions of nature. This is so even if we put all the sciences—astronomy, physics, chemistry, biology, and so on—together. For each on the one hand omits and on the other requires that same wondrous knowing subject. Nature as *reality* transcends whatever our inquiries of her may say of her; and nature is known by *other* avenues than science if there is to be science.

We recall that we already reached this conclusion in our analysis of science itself via the new philosophy of science: science, we said, repre-

sents for a number of important reasons a perspective on its object, an abstraction from the whole of what is real, and also in part a construction by our senses, mind, and intentions into our human images, theories, and projects. The object—what Kant called the "thing in itself," nature as reality not nature as known—thus remains in part a mystery, a mystery known *truly* but only *partially* by the various sciences. But as we have shown, this nature is and must be also known in and through three crucial intuitions that make thought and action—our being in the world—possible.

The first of these other cognitive avenues is our knowledge of nature/reality through *self-awareness*: our knowledge of our own being (a being produced by nature) through self-awareness. Here we know nature as self-aware, self-conscious, sensing its world as world, thinking, judging, willing—and anxious. Reality—our own reality—is as early known and more directly known through self-awareness than through external awareness: the two together make cognitive science, as well as all the rest of human existence, possible. Nature—if it be more than an abstraction—must be understood therefore as capable of spirit, inclusive of the scientist, and now also of her self-awareness, who knows nature as that abstraction. Nature is then a mystery that produces cosmos, life, history, and spirit—self-awareness—and so science.

Secondly, we have uncovered general intuitions of "nature/reality" which make the existence of spirit in community and in nature/reality possible. Perhaps these are better termed *disclosures* of aspects of this mystery. These are *our knowledge (intuition) of the Other*, the other person. This "knowing" of the other is the basis of all community, customs, values, morals (and they are different), and so the commitments, the morals, and the knowledge made possible by spirit—that is, by science.

Closer to our present interests, however, are, thirdly, intuitions, or disclosures, of nature/reality in its own general characteristics. If one looks at the long history of spirit, of the human and so embodied spirit in encounter with its natural world, one sees these general characteristics delineated over and over again: in the earliest primordial and archaic religions, in early and developed philosophy, and now in science. Of course these general intuitions take the specific form particular to their culture—but they show remarkable continuities right up through modern science. Nature has, let me suggest, disclosed itself as Power, Life, Order, and Unity or Meaning. Each of these is expressed in the earliest religious myths and rites, in one form or another in philosophy—and fragmentarily but importantly in modern science.

Such intuitions of order, unity, and value in reality are, we have shown, essential to science: as a human enterprise science presup-

poses them and depends on its own participation in them, that is on its assent and commitment to their validity and importance. In each of these the sacred—the unity of reality, meaning, and value—begins to appear, to disclose itself. Science is not religion, nor does it depend directly on religion; but the most pervasive intuitions necessary for science about order and value represent aspects or glimpses of the sacredness of reality. Nature appears as a mystery characterized by power, life, order, and with hints of meaning and of value. These are for the religious person traces of the divine, traces found throughout reality external to us, inside us, and beyond us. For the religious person and so for the Christian, it is within religious experience that the sacred, manifest fragmentarily here, is fully manifest as God—but that is another story.

These traces of the sacred in nature—power, life, order, and unity—hover over contemporary science not so much as direct intuitions. It is hard in an objectified world, a nature defined as object and used as raw materials, directly to experience these disclosures. Rather these appear indirectly as *traces*, that is as presuppositions and as questions, as so-called limit-questions, questions inescapably *there* in science, raised by science, but seemingly beyond the reach of science.

I have suggested one of these under the general rubric of order. Order is presupposed in science and therefore can only be *described* by science; it cannot be explained there. But it is a wonder: that yardsticks at Yale are relevant in Cambridge; that yesterday's experiment holds true today—and that this same order extends back to the beginning and out into the infinite reaches of space and time. These are wonders, manifestations of the unity of structure and meaning, and essential to science and religious alike. And the character of this order as *developing*, changing its forms but leading towards something, intrigues, puzzles, and troubles the scientific community. How can it be that the cosmos, against all the odds, developed as it did so that life became possible? How is it that life, against all odds, came to be out of non-life and preserves itself? How is it that, quite unexplained either by random mutations or by natural selection, the forms of life changed in a discernable succession towards complexity, towards persons?—towards loving mothers as well as inquiring scientists? These are questions raised by science, raised out of and because of its own inquiries. Yet they are questions which I doubt can be answered by scientific inquiry. I doubt also if proofs of their implications can be marshalled on any basis, philosophical or theological.

These are classic limit questions. They call for philosophical and religious reflection, the formation of a general view of things, of "reality" as a whole, which will coherently and adequately show how

they are present within reality. Above all, they are to me disclosures of the sacred, signs emanating out of science itself of the presence of the sacred as also characteristic of reality. Thus pondering nature as manifested through science leads us to new and wider concepts of reality; and, probing even deeper, we begin, but only begin, to uncover traces of the sacred source, ground and end of all things.

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