SCIENCE AND THEOLOGY IN THE TWENTY-FIRST CENTURY

by John Polkinghorne

Abstract. The current interaction of science and theology is surveyed. Modern physics describes a world of intrinsic unpredictability and deep relationality. Theology provides answers to the metaquestions of why that world is rationally transparent and rationally beautiful and why it is so finely tuned for carbon-based life. Biology's fundamental insight of evolutionary process is to be understood theologically as creation "making itself." In the twenty-first century, biology may be expected to move beyond the merely mechanical. Neuroscience will not have much useful interaction with theology until it attains theories of wide explanatory scope. Computer models of the brain do not meet this requirement. A theological style of bottom-up thinking comes closest to scientific habits of thought. Complexity theory suggests that information will prove to be an increasingly important scientific concept, encouraging theology to revive the Thomistic notion of the soul as the form of the body. Another gift of science to theology will lie in providing a meeting point for the encounter of the world faith traditions.

Keywords: bottom-up thinking; chaos theory; creation; dualism; EPR effect; evolution; Stuart Kauffman; metaquestions; natural theology; quantum theory; relativity; John Searle; soul; world faiths.

There is currently a vigorous exchange taking place between science and theology, and one may go on to consider how this will develop in the future. However, before we can know where we are going, we have to be sure about where we are coming from. Accordingly, I begin by looking at what has been happening in the conversation between science and theology in the closing decades of the twentieth century.

John Polkinghorne is a former Professor of Mathematical Physics at Cambridge University, a Fellow of the Royal Society, and an Anglican priest. His mailing address is 74 Hurst Park Avenue, Cambridge, CB4 2AF, England.

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The frontier between Science Land and Theology Land is a long one, and the contacts and traffic across the border vary along its length. The most active sector has been that where physics abuts theology. Gifts have been exchanged from both sides. From physics has come a revised picture of the fundamental nature of the physical world and its process, resulting from discoveries in which widespread intrinsic unpredictabilities and deep-seated relationalities have come to light. Quantum theory was the first branch of physics to make it plain that the laws of nature do not always have a tightly predictive character; rather, sometimes they can take only probabilistic form. This aspect of quantum physics is too well known—notorious, one might say—to need further elaboration. It was a considerable additional surprise, however, to learn that even the apparently predictable realm of Newtonian physics also contains many systems whose extreme sensitivity to the fine detail of their circumstance makes their future behavior intrinsically unpredictable. This discovery, that classical everyday physics has more clouds than clocks among its entities, has been given the actually rather ill-chosen name of "chaos theory." I say "ill-chosen" because there is an orderly disorder about chaos theory, a point to which I shall return. For the moment, let us note that, whatever the physical world may actually be, we have seen the death of a merely mechanical account.

Unpredictability is an *epistemological* property, for it concerns what we can know about what is going on. How we relate what we know to what is actually the case is a central problem in philosophy, and perhaps *the* problem in the philosophy of science. There are a variety of options, but the one chosen, consciously or unconsciously, by the vast majority of scientists is the strategy of realism. This seeks the closest possible alignment between epistemology and ontology, what we know and what is the case. After all, if we did not believe that what we know about the physical world is telling us what it is like, why should we bother to do pure science at all? I have coined the slogan "Epistemology models ontology" to encapsulate this metaphysical stance.

In the case of quantum theory, this realist strategy has been followed almost universally. Almost all physicists, and even most philosophers, take Heisenberg's uncertainty principle to be a statement of indeterminacy and not just a statement of ignorance. The fact that this is not a forced move but a metaphysical choice is made clear by David Bohm's alternative interpretation of quantum theory (Bohm and Hiley 1993), which has empirical consequences identical to those of the conventional interpretation, but which has an underlying deterministic ontology. For Bohm, uncertainty arises simply from our ignorance of certain causal factors, usually called hidden variables.

In the case of the intrinsic unpredictabilities of chaos theory, the realist option has been a far less popular move so far. Only a minority of us have

made it (Polkinghorne 1998; Prigogine 1997). We have done so not only because it accords with a certain scientific instinct but also because we see here the possibility of the metaphysical gain of describing a physical world whose process is not only subtle but also supple, in a way that may offer a *glimmer* of a hope of beginning to be able to accommodate our basic human experiences of intentional agency and our religious intuition of God's providential interaction with creation. It is not my purpose now to argue these points in detail, but I think we can confidently expect that the lively debate currently going on about the nature of divine agency will extend well into the twenty-first century.

Let us turn instead to issues of relationality. The first moves in the direction of replacing the Newtonian concept of *container space* populated by isolated atoms with something altogether more relational began with Einstein's great discoveries of relativistic physics at the beginning of the twentieth century. Special relativity showed us that temporal and spatial properties are relative to the state of motion of the observer assessing them, whereas general relativity tied together space, time, and matter in a single package deal.

A totally new kind of relationality then emerged from quantum theory (see Polkinghorne 1985, chap. 7). Again it was Einstein who played a vital role, though he thought the property so strange ("spooky" was his word for it) that he believed it showed that quantum theory was in some way incomplete. (Einstein had been the grandfather of quantum mechanics, but he detested his grandchild.) The property is usually called the *EPR effect* (with P for Podolsky and R for Rosen, Einstein's young collaborators). It asserts that once two quantum entities have interacted with each other, they retain a counterintuitive power mutually to affect each other, however far they may subsequently separate. One may remain here and the other go "beyond the moon" (as we conventionally say), but a measurement made on the one here will have an instantaneous effect on the one beyond the moon. This effect is a genuine causal relationship, as is made clear by the fact that doing different things here will produce different and incompatible consequences beyond the moon. It turns out that there is a counterintuitive togetherness-in-separation about the two quantum entities. In a real sense, they are so entangled with each other that they constitute a single system, despite their great spatial separation. The original suggestion was made on the basis of theoretical arguments alone, but beautiful experiments by Alain Aspect and his collaborators in Paris in the 1980s have shown that this is indeed a property of nature.

Thus, it seems that physical reality fights back against a purely reductionist, bits-and-pieces, account. Even the subatomic world cannot be treated atomistically. I believe that the full implications of the EPR effect, both for physics and for metaphysics, still await further elucidation in the twenty-first century.

This picture that has emerged, of an open, interrelated physical world, is consonant with theology's account of a creation that has a unity because its Creator is one, and whose history is open to divine providential interaction, immanently executed within the open grain of created causalities. These are substantial gifts from modern physics to theology. What could the latter hope to offer in return?

Certainly theology could not presume to tell physical science what to think in its own domain. The one god who is well and truly dead is the god of the gaps. No one should regret his passing. Such a pseudodeity was a bad theological mistake, for the true God is the God of total explanation and not just the one who is useful as an explanation of last resort, only appealed to when all else fails. We have every reason to believe that scientifically statable questions may be expected to receive scientifically statable answers, however difficult these sometimes are to find. But we also have every reason to believe that there are many questions that are meaningful and necessary to ask, but which go beyond science's self-limited power to address. It is these *meta*questions for which the God of total explanation may be found to be the answer. In proffering that answer, theology is offering gifts to science, not rivaling it but complementing it by seeking to set its discoveries within a more profound and more comprehensive matrix of understanding.

Two metaquestions of this kind have been keenly discussed. One asks, Why is science possible at all? Why is the physical world so rationally transparent to us, so that we can understand it not just at the everyday level (where survival necessity clearly favors being able to figure out that it is a bad idea to walk out of a tenth-floor window) but also at the profound levels of comprehending the strange quantum domain of subatomic physics, or the vast cosmic domain of curved space? These regimes are very far away from anything that impinges directly upon daily life, and their natures are very different from what we find familiar. We cannot suppose that our ability to explain and understand these regimes is some happy accidental spin-off from evolutionary necessity. Moreover, the physical world is not only rationally transparent; it is also rationally beautiful. Mathematics—that most abstract of human pursuits—turns out to provide the key for unlocking the secrets of the universe. The search for beautiful equations is a powerful technique of discovery in fundamental physics, because time and again the physics community has found that it is only beautiful mathematics that provides theoretical insights of proven and long-lasting fruitfulness. Einstein discovered general relativity, and Dirac discovered antimatter, precisely through the relentless and highly successful pursuit of mathematical beauty. Experience of this kind is highly significant. It arises from science, but the ability to explain what is really going on exceeds science's limited grasp. Scientists, as scientists, simply rejoice in the deep intelligibility of the universe and get on with the exciting task

of its exploration. As persons, they should also stop and ask themselves why they are so fortunate. There will not be a knockdown answer to a fundamental metaquestion of that kind, but theology can offer an intellectually coherent and intellectually satisfying response. It suggests that the universe is shot through with signs of mind just because it is a creation, reflecting the Mind of the Creator, and that we are joyfully able to discern that this is so because we are creatures made in the Creator's image. Science is part of the deposit of the image of God (*imago dei*).

A second metaquestion is, Why is the universe so special? Here, of course, I am referring to the surprising collection of scientific insights that has been assembled under the rubric of the anthropic principle. Although life only began to appear on the cosmic scene when the universe was 11 billion years old, and self-conscious life when it was 15 billion years old, there is a real sense in which the cosmos was pregnant with life from the Big Bang onwards. The laws of nature were finely tuned in a way that alone made the evolution of carbon-based life a possibility. Only if the forces of nature were exactly what they are could there have been stars capable of burning reliably for the billions of years necessary to fuel the development of life on a planet. Only if the nuclear forces were exactly what they are would the first generation of stars have been able to make the chemical elements that are the basis of life, so that in the death throes of a supernova explosion there spewed out the stardust of which we are made. These considerations have been widely canvassed, and I do not need to elaborate them again. Such an unique potentiality is not to be shrugged off by saying, "We're here because we're here, and that's that." As a scientist I want to *understand* our good fortune. Some have made the prodigal metaphysical speculation that maybe there are trillions of different universes, each with different laws of nature, and we just live in the one where, by chance, the laws are such as to have enabled carbon-based life to have evolved. Theology offers a more economical explanation. It suggests that there may be only one universe, which is the way it is because it is not "any old world" but a creation that has been endowed by its Creator with just those finely tuned laws that have enabled it to have a fruitful history.

Considering these two great metaquestions has led to a revival of natural theology, the search for hints of a divine presence discerned from the way the world is. This quest has been pursued by both those who stand within a historic faith tradition (Polkinghorne 1991) and those who do not (Davies 1992). Its proponents do not claim that they are *proving* that God exists. Our claims are more modest, and we simply draw attention to the attractive explanatory power of theistic belief. After all, Kurt Gödel has taught us that one cannot even prove the consistency of arithmetic, so it would be surprising if the existence of God were to be a matter of demonstration. In this modest vein, I believe that this revived (and revised)

natural theology is a valuable exercise. It is surely striking that an intelligible, fruitful, open, and interrelational universe is so consonant with the idea of an immanently active Creator.

As we move down the science-theology frontier toward the region where the biologists live, the scene changes. We hear the sound of gunfire, for there is considerable hostility on both sides of that part of the border. There are two principal causes of dispute.

One centers on the Darwinian theory of evolution. Of course, I am a creationist in the proper sense of that word, believing that the universe is God's creation, but I find this to be perfectly consistent with believing also that the way in which God has chosen to bring about the continuing act of creation is through the unfolding process of evolutionary history. In fact, respect for the truth compels me to that view. We have every reason to believe that life on Earth started about 4 billion years ago, that it started extremely simple, and that it eventually became as complex as we see it today partly through the operation of natural selection. I do not think, however, that we have scientific reasons that compel us to believe that strict neo-Darwinian orthodoxy presents us with the total story of this fruitful history. I shall refer later, in a different context, to some of the ideas of Stuart Kauffman (1995), who has suggested, on strictly scientific grounds, that many of the basic structures that we see in living beings may be consequences of ahistorical ordering principles inherent in nature rather than simply the deposits of historical contingency. As a Christian who believes that God interacts with creation, I also think that there will have been divine guidance, but not tyrannical overruling, of the development of creaturely life. Long ago, just after the publication of *On the Origin of Species*, Charles Kingsley coined a phrase that to my mind perfectly sums up how a religious person may think about an evolving world. No doubt the Creator could have produced creation ready-made, but, as Kingsley said, God has done something cleverer than that in making a world that can "make itself." If you think about it, that is just what one might have expected the God of love to do, giving a due degree of independence to the creatures that are the objects of divine love. The existence of a creation making itself is a great good, but it has a necessary cost. Exploring divinely granted potentiality will sometimes lead to blind alleys and ragged edges. The same processes that enable some cells to mutate and produce new forms of life will also allow other cells to mutate and become malignant. The bitter presence of cancer in the world is not a sign of divine callousness or incompetence. It is an inescapable cost of a creation allowed to make itself. This insight offers us some *slight* help (I say no more than that) with the deep and mysterious problems of theodicy.

On the topic of evolution, the aggression has not all come from certain elements on the religious side. Proclaiming that evolution involves the interplay of chance and necessity, and annexing to chance the tendentious

adjective *blind*, Jacques Monod (1972) asserted the meaninglessness of the universe, its history being, in his view, no more than a tale told by an idiot. Such rhetoric can be dismantled by careful analysis. By *chance* is not meant the capricious acts of the goddess Fortuna but simply historical contingency: this happens rather than that. This particular genetic mutation occurs and consequently turns the stream of life in this particular direction. If a different mutation had occurred, then life would have turned out somewhat differently. There is no intrinsic implication of meaninglessness in such a shuffling exploration of potentiality, as Arthur Peacocke has so clearly brought out in his writings (Peacocke 1979). It is simply the way in which creation makes itself. And remember that *necessity*—that is, lawful regularity—has to take a very specific, anthropically fruitful form if evolution is to be able to lead anywhere at all. This biological attack on theology is easily repulsed.

The metaphysically reductionist assertiveness of Monod, and of his disciple Richard Dawkins, illustrates the second principal cause of conflict along this length of the border. In the last forty years, biology has scored its first great quantitative success in the discovery of the structure of DNA and the consequent unraveling of the molecular basis of genetics. It is a truly great discovery, worthy of being compared with Newton's discovery three centuries earlier of the universal inverse square law of gravity. Like that grand advance, Crick and Watson's discovery was essentially mechanical in character. They actually made a metal model of DNA, and you cannot get much more mechanical than that. In any subject you make the mechanical discoveries first, because it is much easier to understand clocks than it is to understand clouds. We have seen, however, that physics has moved beyond the merely mechanical, and that will surely happen in biology also in the twenty-first century.

The generations of physicists in the middle of the eighteenth century who were the successors of Newton were somewhat intoxicated by all this apparent mechanical success. They had explained the solar system; they could explain everything. The solar system appeared to them to be mechanical (actually we now know from chaos theory that it is not, but that was well into the future); everything is mechanical. In their exuberant self-confidence, they wrote books with titles like *Man the Machine*. It could not last, and it did not. Physicists are much more sober and realistic today, which is why their part of the frontier is the scene of largely peaceful activity.

Biologists post-DNA display characteristics very similar to those of the eighteenth-century physicists. They proclaim a confident mechanical reductionism. They write books that tell us that human beings are "genetic survival machines." However vexingly obtuse all this is, we may expect that this too will pass, particularly when more biologists recover an interest

in organisms again, and not just molecules. We can hope for a more fruitful exchange across the frontier when this happens. Let us hope that will be early in the twenty-first century.

Moving down the border further still, we enter the region of the human sciences, particularly neuroscience and psychology. Clearly this is potentially a most important interface for exchange. Unfortunately, the landscape is shrouded in thick fog.

Neuroscience is a young and extremely active discipline. We should welcome its many investigations into the workings of that most complex of all physical systems of which we are aware, the human brain. At present, and perfectly understandably, neuroscientific endeavors seem to concentrate on the nitty-gritty of the subject. Most studied has been visual perception. Typical results involve the identification of the neural pathways by which input is processed, leading to the recognition of a triangle or finding the word that corresponds to a big animal with a long trunk. Interesting and important as these investigations undoubtedly are, they fall far short of anything that would inspire or constrain metaphysical theories concerning the nature of the human person. To get the point, consider a Platonic dualist like the late Sir John Eccles (1984). He was a Nobel Prize winner for discoveries in neurophysiology, and so no doubt he would have been very interested in these results obtained by his successors. However, they would count for little either for or against Eccles's metaphysical position. He separated spirit and matter, mind and brain, but of course he also postulated a region in which interaction between the two took place. Calling this the "liaison brain," he assumed that it was quantum events, which he believed effected certain vesicle discharges, that gave mind its room for maneuver in relation to brain. Be that as it may, Eccles would never have believed that there were not neural information-processing pathways, of the kind that neuroscientists currently study, which carried out the brain's side of this combined operation. Thus, it seems to me that Eccles's position would be largely metaphysically invulnerable to the results of contemporary neuroscience.

I do not share Eccles's dualist views. It seems to me that knowledge of the effects of drugs and brain damage on mental behavior, together with consideration of the long evolutionary history that links human beings to animals and ultimately to inanimate matter in early Earth, encourage an altogether more integrated, psychosomatic understanding of human nature, of a kind at least as old as the writers of the Hebrew Bible. Therefore, my metaphysical gropings are in the direction of a dual-aspect monism, a complementary relationship of mind and matter as contrasting poles of the process and organization of the one stuff of the created world (Polkinghorne 1988, chap. 5; 1998, chap. 3). Such a position is easier stated than substantiated, but I will indicate later one small clue that I think points in that direction.

Meanwhile, I think than none of the metaphysical proposals will gain much help or support from neuroscience until the latter is in the position of being able to offer much more overarching interpretations of its subject matter. At present, the only proposal of this kind that seems to attract a measure of support is the computer model, which sees the brain as hardware and the mind as software. Its approach is in functional terms, centering on information processing as the fundamental concept, and it is notably unsuccessful in offering any understanding of the basic experiences of *qualia* ("feels," such as perceiving red or being hungry), which seem to be completely beyond its conceptual range, although fundamental to our actual mental experience. One of the principal proponents of this approach has been Daniel Dennett in his immodestly entitled book *Consciousness Explained* (Dennett 1991). I do not think that his model, based on anarchic parallel processing, even begins to address successfully such issues as the origin of awareness.

A strong critique of the computer approach has been given by John Searle in his well-known "Chinese room" parable (Searle 1984). You are immured in a closed room with a big book and two grills communicating with the outside world. Through one grill you are given bits of paper with squiggles on them. These you match up with identical squiggles in the big book, and then copy onto other pieces of paper the squiggles that are next to them in that book. These other pieces of paper are then handed out through the second grill. You have no idea what is going on. In fact, the incoming squiggles are questions in Chinese, and the squiggles you hand out after looking in the book are the answers in Chinese. You are the computer, and the book is the program, and there is no understanding in either of you. Understanding was located only in the programmer who compiled the book. In other words, computers are good at syntax (logical operations) but hopeless at semantics (what it all means). Meaning is fundamental to thought; we are more than computers made of meat.

So far we have mostly been thinking about the frontier activity that originates in Science Land. What about the theologians? Many of them are wary of dwelling too near the border, but some brave souls have ventured from time to time in that direction. Among them I would mention particularly Thomas Torrance (1969; 1976) , Wolfhart Pannenberg (1993), and Keith Ward (1996; 1998). One of my greatest wishes for the twenty-first century is that more theologians will be attracted to take part in the science and theology exchange. Of course, one can never expect there to be more than a minority with this particular interest. Theologians are in a difficult situation intellectually. To speak of God is to speak of the One who is the ground of all that is. Therefore, all that is must to some degree be relevant to the theological task. In principle, everything is grist to the theological mill. Obviously, any one theologian can only address a small part of this immense task. However, I would hope that rather more will

choose to include some of the insights of science in what they are able to consider. We have seen, I think, how relevant much of the material on offer actually is.

Science can influence theology not only through its content but also through its style. The study of science certainly teaches one that reality is surprising. Just think of the counterintuitive quantum world, so different from the everyday world of common sense. Consequently, scientists do not think that they know beforehand what is reasonable. They are open to the promptings of the physical world about what is actually the case, however strange that case may prove to be. They do not believe that we have the rational power to know a priori how to think about reality. The scientist's instinctive question, therefore, is, What is the evidence that makes you think this might be so? The scientific strategy is what I have called bottom-up thinking, the desire to proceed from experience to understanding in an open-minded way. Many theologians are instinctively top-down thinkers, seeking to proceed from general principles to the understanding of particular phenomena. There are many different legitimate styles of theological thinking, but I hope that the twenty-first century will see a wider recognition of the value of the bottom-up approach. I am not claiming that it is uniquely insightful, but I do believe that it offers its own perspective, in a way not dissimilar to the offerings of other perspectives, such as black or feminist theologies. Three of us—Ian Barbour, Arthur Peacocke, and I, who are scientist-theologians in the sense that we all had research careers in science before turning to theological concerns—have recently given Gifford Lectures that sought to function as mini-systematic theologies, each in his contrasting way presenting a kind of bottom-up approach to central matters of Christian belief (Barbour 1990; Peacocke 1993; Polkinghorne 1994).[1] I hope that this style of theological thinking will continue to be explored in the twenty-first century.

In the course of our frontier perambulations we have already been able to identify directions for future developments in the exchange between science and theology that we may hope to see pursued successfully at the start of the new millennium. I want now to turn to some additional promising expectations. The first centers on an infant science, in fact one that is really only at the natural history stage of being able to stare at particular examples. It involves an interplay between physics and information technology, for it is concerned with studying the behavior of complex systems for which our only resource at present is provided by elaborate computer modeling. Chaos theory developed in this way, and it is also the basis of the new discipline of complexity theory. I can illustrate its character by an example drawn from the work of one of its leading proponents, Stuart Kauffman (1995). He studied a computerized model whose physical analogue would be a large array of light bulbs, each switching on and off in a way that is influenced by the behavior of two other bulbs in the array. One

might have supposed that if this array were started off in some random configuration, with some bulbs on and some off, it would just continue to flicker away haphazardly for as long as it was kept going. In fact, its behavior is quite the contrary. Soon the system settles down to cycling through a limited number of states of specific order. The number of these different possible states is approximately the square root of the number of elements in the array. If there are 10,000 bulbs, there are only about 100 different possibilities of actual order that occur (out of 10^{3000} possibilities of potential behavior).

Such spontaneous generation of large-scale order is a striking and surprising phenomenon. I believe that we can begin to see that complex physical systems will require for their adequate description and understanding not only the conventional physical discussion in terms of energetic exchanges between constituents but also a complementary discussion in terms of *information*, whose input will specify the generation of holistic pattern. One begins to see here the modern version of an old idea. Aristotle had spoken about matter and form; in a parallel way, we are beginning to talk about energy and information. Thomas Aquinas took Aristotle's ideas and put them to theological use. In place of the Platonic dualism of soul and body, Thomas spoke in psychosomatic terms of the soul as the form of the body. I think that the twenty-first century will see an increasing recovery of this way of thinking. Its value for theology is obvious enough, not least in relation to a credible articulation of the eschatological hope of a destiny beyond death.

To claim that the new millennium's understanding of the nature of humanity will be in psychosomatic terms is, of course, in no way to capitulate to a crassly physicalist reductionism. The matter of our bodies in itself cannot be of abiding significance for what it is to be a person, because that matter is continuously changing, through wear and tear, eating and drinking. We have very few atoms in our bodies that were there five years ago. What continues is the dynamic and developing pattern in which those atoms are arranged. The soul—the real me—is the almost infinitely complex information-bearing pattern carried by the matter of the body. In a word, the soul is the form of the body. That pattern will, of course, be dissolved at death, but it seems to me to be a perfectly coherent hope that God will remember the pattern that is me, holding it in the divine mind, and then reconstitute it in an act of resurrection. The context for that great act of re-embodiment will be the new creation, an eschatological realm already inaugurated in the seminal event of the resurrection of Christ. In other words, the Christian hope is not survival, as if it were the expression of an intrinsic human immortality, but resurrection, the expression of the everlasting faithfulness of God.

I have written more extensively on this theme elsewhere (Polkinghorne 1994, chap. 9) and I cannot go into it in more detail now. I do want to

emphasize, however, that the hope of a destiny beyond death is central to the integrity and credibility of the Christian gospel. The church must not lose its nerve about the proclamation of eschatological hope (see Polkinghorne and Welker 2000).

There is a further theological issue that will, I believe, be of great significance in the twenty-first century, to which science may be able to offer an oblique form of assistance. I refer to the pressing problem of how to understand the interrelationship of the great world faith traditions (see Polkinghorne 1994, chap. 10). Science, in its recognizably modern form, originated in Western Europe in the seventeenth century, but it has subsequently spread worldwide. Ask people in the street in New York, Delhi, or Tokyo what matter is made of, and, provided you have chosen well-informed persons, they will all reply, "quarks and gluons and electrons." Ask someone in the street in those three cities about the nature of ultimate reality, and you are very likely to receive three contrasting responses. There is this critical—and I have to say, unnerving—problem posed by the diversity of the world faith traditions. They are all speaking about the realm of encounter with the sacred, but they seem to have such different things to say about it. These cognitive clashes do not only involve religious issues, such as the status of Jesus or the status of the Qur'an, but also general disagreements about the nature of reality. Is time a linear path to be trodden or a samsaric wheel from which to seek release? Is the human self of unique and abiding significance, or recycled by reincarnation, or ultimately an illusion from which to seek release?

These cognitive disagreements are very perplexing, for they seem to go far beyond anything that could be interpreted as being due simply to differences of cultural perspective. The true ecumenical engagement of the world faiths is only just beginning, and I believe that much of the third millennium will be taken up with this exchange. In the first instance, the faiths will have to encounter each other in relation to issues that are serious, but not so central that their discussion would be threatening to the point of invoking mere defensiveness. Mutual exchange concerning how each tradition views the nature and history of the physical world, and science's understandings of it, will provide, in my view, a meeting place of just this kind. Work in this area has already begun, notably with the Templeton Foundation's support of the first phase of a project entitled "Science and the Spiritual Quest." It culminated in a conference in Berkeley in June 1998, organized by the Center for Theology and the Natural Sciences. I very much hope that activity of this kind will continue in the twenty-first century and beyond.

Finally, we may ask how all this impacts on the person in the pew and the minister in the pulpit. In answering that, I express one of my greatest hopes for Christian life and thought in the new millennium. We are all of us seeking to be servants of the God of truth. That being so, we should

never fear truth but rather welcome it from whatever quarter it may come. Science cannot give us all the truth, by any means, but it can certainly give us some of it. I hope and pray that religious believers will learn more and more to accept the insights of science and to integrate them with the greater truths of faith in the Creator. Ultimately, knowledge and truth are one because God is one. In that belief we can face the intellectual challenges of the future, whatever they may prove to be. "The truth is great and it shall prevail" in the third millennium, just as it has done in all the preceding centuries.

NOTE

1. For a comparative analysis, see Polkinghorne 1996.

REFERENCES

Barbour, Ian G. 1990. *Religion in an Age of Science*. London: SCM Press.
Bohm, David, and Basil Hiley. 1993. *The Undivided Universe*. London: Routledge.
Davies, Paul. 1992. *The Mind of God*. New York: Simon and Schuster.
Dennett, Daniel. 1991. *Consciousness Explained*. New York: Little, Brown.
Eccles, Sir John. 1984. *The Human Mystery*. London: Routledge and Kegan Paul.
Kauffman, Stuart. 1995. *At Home in the Universe*. Oxford: Oxford Univ. Press.
Monod, Jacques. 1972. *Chance and Necessity*. London: Collins.
Pannenberg, Wolfhart. 1993. *Towards a Theology of Nature*. Edited by Ted Peters. Louisville: Westminster/John Knox.
Peacocke, Arthur R. 1979. *Creation and the World of Science*. Oxford: Oxford Univ. Press.
———. 1993. *Theology for a Scientific Age*. Enlarged edition. London: SCM Press.
Polkinghorne, John C. 1985. *The Quantum World*. Princeton: Princeton Univ. Press.
———. 1988. *Science and Creation*. London: SPCK.
———. 1991. *Reason and Reality*. London: SPCK/Trinity Press International.
———. 1994. *Science and Christian Belief / The Faith of a Physicist*. London: SPCK, and Princeton: Princeton Univ. Press.
———. 1996. *Scientists as Theologians*. London: SPCK.
———. 1998. *Belief in God in an Age of Science*. New Haven: Yale Univ. Press.
Polkinghorne, John C., and Michael Welker, eds. 2000. *The End of the World and the Ends of God*. Harrisburg, Pa.: Trinity Press International.
Prigogine, Ilya. 1997. *The End of Certainty*. New York: Free Press.
Searle, John. 1984. *Minds, Brains and Science*. London: BBC Publications.
Torrance, Thomas. 1969. *Space, Time and Incarnation*. Edinburgh: T & T Clark.
———. 1976. *Space, Time and Resurrection*. Edinburgh: T & T Clark.
Ward, Keith. 1996. *God, Chance and Necessity*. Oxford: Oneworld.
———. 1998. *God, Faith and the New Millennium*. Oxford: Oneworld.