

RESPONSE TO CRITIQUES OF *RELIGION IN AN AGE OF SCIENCE*

by Ian G. Barbour

Abstract. In replying to the four thoughtful critiques of my first Gifford volume I try to clarify the differences among us. I defend my use of Kuhn's concept of paradigms against Nancey Murphy's use of Lakatos's concept of research programs and then compare both of us with advocates of the "strong program" in the social construction of science. Sallie McFague identifies me with the empiricist, objectivist, "modernist" tradition and contrasts it to her own "postmodernist" acceptance of cultural relativism and the social construction of science, but I argue that I am seeking an intermediate position that redefines objectivity rather than rejecting it. Some themes common to feminist and process theology are also examined. In dialogue with Bob Russell I discuss the metaphysical and theological implications of the unity of space and time in relativity, the beginning of time in recent cosmology, and the thesis that God acts by determining events in indeterminate quantum systems. Finally I compare John Cobb's indebtedness to Whitehead with my own and suggest that I am more willing to adapt or modify process thought in the interpretation of scientific theories and religious experience.

Keywords: cosmology; methodology; process philosophy; quantum physics; relativity.

I am deeply appreciative of all four of these critiques. Their authors have read the volume carefully and raise significant questions about it. As they have done, I will focus on the points of difference among us, neglecting our shared assumptions and vast areas of agreement. I am very grateful for the sense that we are engaged in a common endeavor as part of a community of inquiry that is much larger now than when I started writing about science and religion forty years ago.

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RESPONSE TO NANCEY MURPHY

In commenting on Part 1 (“Religion and the Methods of Science”), Nancey Murphy suggests that we should compare scientific theories with theological doctrines. I prefer to talk in general terms about religious beliefs rather than theological doctrines in order not to exclude Buddhist and nontheistic traditions, though in practice I too look mainly at the Christian tradition and its theology. I may indeed have been influenced by my location in a department of religion rather than a department of theology, but we agree that religious beliefs and theological doctrines are intimately connected with a community’s stories, scriptures, rituals, religious experiences, and ethical norms. We both insist that systematic reflection and conceptual articulation must not be divorced from the total life of the religious community, which provides the data for interpretation. I have tried to portray science also as the activity of a community, though I suspect Murphy is right that I need to give more attention to what she calls “the penumbra of scientific culture” and its broader worldview.

We do differ as to whether Thomas Kuhn’s concept of paradigms or Imre Lakatos’s concept of research programs is a better description of scientific inquiry on the one hand and theological inquiry on the other. Despite her objections, I would argue that there really is a spectrum of views in the philosophy of science. At one extreme is Karl Popper’s version of empiricism, the claim that theories are conclusively falsified when they disagree with data. For Popper, theories are tentative, but the data are objective and independent of theory. In his view science is an autonomous enterprise with its own internal criteria of rationality. Kuhn, by contrast, claimed that all data are theory-laden and all theories are paradigm-dependent. Paradigms are in turn influenced by wider cultural beliefs. Here the historical and cultural context of science is taken to be important. Moreover, there are no rules for the rational choice of paradigms. But the choice is not subjective, because criteria of judgment are shared by proponents of rival paradigms and because an accumulation of discordant data can undermine the acceptability of a paradigm.

According to most interpreters, Lakatos is intermediate between Popper and Kuhn. Lakatos suggests that there are criteria for judging whether a research program is progressive or degenerative, and so scientific judgments are more rational than Kuhn acknowledges—but the judgments take a longer span of time than Popper envisions, and they are applied to whole programs rather

than to individual theories. Lakatos also distinguishes two components of a program, the hard core, to which its proponents are firmly committed (much as they would be to a Kuhnian paradigm), and a set of auxiliary hypotheses that are held tentatively and can be modified more easily (resembling Popper's account in that respect).

I find Murphy's application of a Lakatosian analysis to religion very helpful. One can indeed distinguish between a hard core of beliefs that are held with commitment and tenacity and a set of peripheral beliefs (auxiliary hypotheses) that can be modified in order to preserve the hard core. I appreciate the idea that a program is evaluated by its fruitfulness over a considerable span of time, though judgments of progress are more ambiguous if the criteria are taken to include not only the prediction of new facts but also the interpretation of familiar facts in a new way. I have used Kuhn's concept of paradigm in my writing partly because it is more familiar to readers than Lakatos's concept of programs, but mainly because it seems to me more illuminating in emphasizing the historical and cultural character of the interpretive beliefs that play such a large role in religion. Murphy says that she pursues the similarities between science and theology further than I do, and that I devote too much time to the differences. I think the differences between science and religion are significant and can more readily be explored in a Kuhnian framework than within a more empiricist, Lakatosian analysis. Some theologians would say that to apply a single epistemological approach (of either type) to both disciplines already assumes more similarity than is warranted. One might argue, for example, that Lakatos's methodology is appropriate in science, while theology is inevitably more Kuhnian.

Kuhn holds that paradigm shifts in science are rare and revolutionary. He discusses the shift from Newtonian physics to relativity and quantum theory as an example of the far-reaching scope of a paradigm shift. So too within the history of Christian thought I would want to apply the term to major systematic changes rather than to changes in a particular theological doctrine, because doctrines are always interconnected. Thus the articulation of a Christology in process theology goes with a new understanding of God and of human nature, and I do not see how it could be pursued as a separate paradigm. Paradigms are broad in scope and involve a distinctive way of interpreting a wide variety of data. Most of Lakatos's examples of research programs also are rather broad in scope, though not as broad as paradigms.

In contrast to Murphy, I would argue that the so-called strong program in the sociology of knowledge can be placed on the same

spectrum with Popper, Lakatos, and Kuhn. Proponents of the social construction of science carry a step further Kuhn's contextualism, historicism, and cultural relativism. Cultural forces strongly influence the allocation of funds for research. Ideologies and interests associated with the social location of scientists influence their selection of research problems and the type of conceptual framework they consider promising. Professional recognition is usually much more difficult for anyone working outside the prevailing paradigm. Nevertheless, I believe that the strong program underestimates the constraints exerted by the data. To be sure, theories are underdetermined by the data, especially in highly speculative fields like Big Bang cosmology. But most disputes, even about very broad and general theories such as evolution, can eventually be settled by an accumulation of evidence of sufficiently diverse types.

In the past, I have been puzzled that Murphy endorses Lakatos, who is closer to the empiricist end of the spectrum than I am, while she is also sympathetic with the strong program, which I consider further toward historical and cultural relativism than I am. But now it is clear from her paper that she thinks the strong program does not belong on that spectrum at all because it addresses a different question, namely it asks about the sociological causes rather than the epistemological justification of theories. But this interpretation introduces a new puzzle for me because philosophical proponents of the strong program claim to be dealing with epistemology and not just sociology. They often explicitly criticize empiricist philosophies of science. They give historical examples purporting to show that scientists who thought their preference for a particular theory was based on criteria internal to science actually were influenced by their social location and by cultural assumptions. In other words, they present their externalist account of science as an alternative to internalist accounts, not as an answer to a different set of questions. And empiricists reply to the strong program as if it made competing claims about the nature of science. So I hope I have not been advocating a *via media* on a nonexistent spectrum.

RESPONSE TO SALLIE MCFAGUE

I take it that Sallie McFague does view the strong program in the social construction of science and the empiricist defense of objectivity as competing answers to the same question. These correspond to the two ends of my spectrum, but she doesn't seem to recognize any intermediate positions and puts me with the objectivists. She writes: "His discussion of feminist and two-thirds-world critiques of science

lacks his usual appreciative, open manner. His attitude is one of protecting the modernist [paradigm with its] understanding of objectivity . . .". Perhaps the possibility of a *via media* is ruled out by the very terms she uses. If I am not a postmodernist, then presumably I must be a modernist. But the reformulated notion of objectivity that I defend is not at all the modernist or empiricist version. After all, the empiricists accuse Kuhn of having capitulated to historical and cultural relativism, which are features of postmodernism. McFague wants us to avoid dualistic either/or categorizations, but I wonder if she has avoided them herself in her use of the terms *modernism* and *postmodernism*.

Most of the Third World critiques are directed against applied science rather than against "pure" or theoretical science. In my second Gifford volume I do accept the thesis that technology is a social construction that enhances the power of the individuals and nations that control it. I grant that the line between science and technology is not a sharp one. I agree with McFague's statement, ". . . the goals of science might change if those who do it change—from serving the industrial-military complex, for instance, to finding better ways to feed starving people, [and] protect the environment . . .". I also applaud her statement that we should "aim at a greater, not a lesser objectivity for science by broadening the base of who participates in setting scientific agendas, so that science might be emancipatory, liberating, and beneficial for more people—and for the planet that supports us all."

Possibly we part company when it comes to the role of gender in theoretical science. I acknowledge the pervasive role of male perspectives in the selection of problems for study and in the professional life of scientists. I also acknowledge evidence of male biases in the interpretation of data and the evaluation of theories in certain areas of science, especially in reproductive biology and the behavioral sciences. I believe that such biases can be reduced in two ways, first by the participation of people with alternative viewpoints, as McFague suggests, and second by the search for additional data. I consider objectivity in this more limited sense to be a valid ideal for science even if it cannot fully be attained in practice, whereas some feminists (though not McFague herself) have dismissed all notions of objectivity as patriarchal myths. I cannot accept McFague's proposal that in deciding what counts as true we should abandon critical realism in favor of the pragmatic criterion of "what is good for the planet and its life forms." It would be very good for the planet if it were possible to obtain abundant energy from water by cold fusion, as was claimed a few years ago, but that does not tell us whether the theory is supported by reproducible data.

While I have reservations about some forms of feminist epistemology, I have been greatly indebted on substantive issues to feminist theologians, not least to Sallie McFague herself. Two pages of my book are given to summarizing her writing on models of God. I have been impressed by the themes common to feminist and process thought, especially the critique of patriarchal and monarchical models of God and the idea that God's power is not coercive power over us but a persuasive love which empowers us from within. Feminist and process thinkers also share a rejection of dualistic and hierarchical thinking. They both see correlations between several dualisms in Western culture: masculine/feminine, objectivity/subjectivity, reason/emotion, mind/body, control/nurture, domination/submission. In the second volume I indicated my appreciation of feminist insights into the ways in which these dualisms have encouraged both the exploitation of women and the exploitation of nature. I too am seeking a more holistic and ecological understanding of God, human nature, and the world.

McFague says that I do not go far enough in reformulating theology, and that I am not sympathetic to her model of the world as God's body. Since my book was written, her volume *The Body of God: An Ecological Theology* (1993) was published, and there is very little in it with which I would disagree. I am grateful for her critique of reductionism, her organic view of reality as multileveled, her stress on the bodily character of experience, and her treatment of God's vulnerability. She says that the images used by Pierre Teilhard de Chardin were poetical but somewhat esoteric, while process thought is "more conceptually oriented." She wants to develop themes similar to theirs, but making more extensive use of models. She ends by combining the organic model of the world as God's body, which expresses divine immanence, with the model of God as agent, which preserves transcendence. She recognizes that the organic model alone would be equivalent to pantheism, whereas she endorses a panentheism in which God is not totally or necessarily embodied. Instead of saying that God is the soul or mind of the universe, she uses the biblical language of God as Spirit sustaining and empowering and breathing life into the created order.

It is clear from her new book that she is aware of most of the limitations of the organic model to which I pointed in the last chapter of my book. One limitation mentioned there which she does not address is that the cosmos as a whole does not seem to have the intermediate levels of organization or the physical channels for coordination and the communication of information that enable organisms, from amoebas to human beings, to act as integrated units. If God is

omnipresent, the cosmic equivalent of a nervous system would not be needed to unify the world; but without such systems, the organic analogy of the world as God's body would be rather limited, and we would revert to a mind/body dualism in God's case. Instead of the organic analogy of the world and God as *one* being, I find greater promise in process thought, which has a more social, pluralistic, and ecological view of God and the creatures as an interacting community of diverse beings.

The last section of McFague's paper poses a question raised by Martin Marty: How are we to balance universality and particularism in today's pluralistic world? Marty is surely right that in the past our search for universality both in global politics and in culture and intellectual life has usually involved a covert imposition of white, male, Western assumptions on other people. In my discussion of religious pluralism, I advocate dialogue which is genuinely open to the insights of other traditions without abandoning the particularity of the history, rituals, and experiences of one's own tradition. Dialogue will not lead to a universal religion, but it will lead to greater tolerance, cooperation, and common ground among religions, along with respect for differences.

Another source of universality is science. McFague says that she frequently invokes the "common creation story" because she assumes that "the scientific picture of the world is a coherent, universal one that has the potential to unify the world's disparate people." Her confidence in the universality of science seems to indicate that she too rejects the cultural relativism of the "strong program" and at least some versions of postmodernism, so perhaps we are not so far apart after all. We also agree that ecology provides a good model of the combination of particularity and interdependence.

I feel very ambivalent about whether philosophy in general, or process philosophy in particular, can contribute to universality without jeopardizing diversity. Metaphysics is the search for a set of general categories applicable to entities at all levels of organization in all places and times. Process metaphysics allows for considerable variation in the way its fundamental categories are exemplified at differing levels. But I have some misgivings that the attempt at systematic generality in process thought does not adequately represent the diversity among the entities that are present in the world. Moreover, process writers often use technical terms and abstract concepts which are inaccessible to the general reader unless they are translated into familiar terms and applied to familiar experiences. We can learn from McFague the power of imaginative models and metaphors. Process thought is critical of many aspects of

Western thought, but whether it can find common ground with non-Western cultures remains an open question.

RESPONSE TO ROBERT JOHN RUSSELL

I have been greatly indebted to Bob Russell for his detailed exploration of the theological implications of theories in the physical sciences and for his leadership in organizing a series of research conferences at the Center for Theology and the Natural Sciences in Berkeley and at the Vatican Observatory near Rome. In his critique of Part 2 ("Religion and the Theories of Science"), he starts with a detailed discussion of my chapter on physics. I am glad that he agrees with most of my conclusions and proposes some problems for further exploration. There are few differences between us in our interpretations of quantum theory, but I will respond briefly to his remarks on relativity, where we do differ.

In relativity, observers moving relative to each other do not agree on the measurements they make of the distance and the time interval between two events. But there is a combination of the two measurements, the spatio-temporal interval, which is the same for all observers and hence seems to have an objective reality independent of observation. This suggests that space and time exist together in a four-dimensional space-time continuum which different observers cut in different ways into spatial and temporal dimensions. In the book I said that the unity of space and time in relativity can be interpreted either as the temporalization of space or alternatively as the spatialization of time in a block universe. In the latter interpretation, past, present, and future, along with space, are a single coexisting entity. Russell responds, "The meaning of temporality in light of special relativity is far more complex than the choice between dynamic (or flowing) time and the static (or block) universe conveys." He rejects the more dynamic interpretation partly because "there is no reason to claim that some events are 'yet to come' and others 'already past.'" I would argue that the view of quantum theory that we both accept allows for such a distinction at the local level. Until a quantum measurement occurs, the system contains diverse possibilities; afterward, it has only one value. The future of a system is open, while the past is not. I can influence some events in my future but none in my past.

Russell says that "flowing time requires a unique, global, physical present and there is none in nature." I do not see why the temporal character of any event and its dynamic interaction with other events requires the assumption of a universal present. He is concerned that

there is no universal definition of the future for all observers. But the disagreement among observers concerning the line between the past and the future arises only with respect to temporally and spatially distant events that they cannot possibly influence and by which they cannot be influenced. There is no disagreement about the past and future or about the temporal ordering of events that might be causally related. A cause always occurs before its effect, for all observers. Moreover, the disagreement between observers in defining the present at a distant point would appear only retrospectively when observations were compared—which would take millions of years in the case of communication with distant galaxies. In any case, as Russell notes, the experience of an omnipresent God might be taken to define a universal present (in Charles Hartshorne's view), or the microwave background could be taken to provide a unique frame of reference for global simultaneity (in John Polkinghorne's view).

The block universe resembles the Platonic view that the unchanging world of eternal ideas is more real than the temporal world of our experience. It also resembles the traditional view of God's knowledge of the future: all events are predestined together, though they succeed each other temporally in our experience. I side with process thought in defending the openness of a future that cannot be known even by God. Russell suggests elsewhere that there is a middle ground in Boethius, for whom God is aware of temporality but sees all time as a simultaneous totality. To me that would be a block universe in which temporal order and duration were represented but not novelty or freedom. Russell also suggests that a Trinitarian view introduces a more dynamic element into the inner life of God. Drawing from Karl Barth and Wolfhart Pannenberg, he proposes that "a Trinitarian view of eternity incorporates succession and order without dissolution and corruption" (Russell, forthcoming). My question would be whether succession and order are an adequate representation of temporality unless one also incorporates change, novelty, and freedom both in the world and in God's knowledge of the world and interaction with it.

The second issue I will take up is the relation of the doctrine of creation to the Big Bang theory. The Genesis account and the most widely accepted theory of the Big Bang both assume an initiating event "in the beginning." In Big Bang cosmology, $t = 0$ is a singularity inaccessible to science. The whole cosmos would have been a point of zero size and infinite density and temperature to which the laws of physics would not apply. Science seems to have vindicated at least two features of the biblical account: finite past time and a beginning.

In Stephen Hawking's theory, however, past time was finite but had no beginning. In his theory, time becomes fuzzier and fuzzier as one goes back to earlier and earlier moments, and it has no sharp cut-off or temporal boundary that one could call a beginning at $t = 0$. Hawking says that real time emerged from imaginary time, which was spacelike. This assertion seems to me problematic since *emerged* is a temporal word, and the theory is indeed highly speculative. Russell has pointed out that if Hawking's theory were accepted, we could still keep one of the two traditional assumptions, the finitude of past time, though we would have to give up the second, the beginning of time. Even the finitude of past time would have to be given up if we had an eternally oscillating universe in which the Big Bang was preceded by a Big Crunch at the end of a previous cycle. But we could never test such a theory since all evidence of previous cycles would have been wiped out in the meltdown.

If standard Big Bang theory prevailed, we could rejoice in its consistency with the biblical account in the assumption of finite time and a beginning. But I am hesitant to emphasize such similarities, partly because cosmological theories are very speculative and may change in the future. More importantly, when I ask about the role of creation stories in various cultures I see that they serve to locate present human life in a wider context of meaning. I believe that the authors of Genesis were making assertions about the relation of the world to God at all times, though they did so by telling a story of the cosmological past. Biblical authors accepted the cosmology of their times, including a three-decker universe and a short time span, which we have long since abandoned. I do not think they had scientific insights that would have led them to anticipate any particular features of twentieth-century cosmology. But their theological insights endure: the world is orderly, purposeful, good, and dependent on God. The doctrine of creation *ex nihilo*, which is not explicitly stated in the Bible, was elaborated by the early church—not to exclude any scientific theories but to exclude alternative metaphysical systems such as pantheism, which identified God with the world, and gnostic dualism, which said that matter is evil.

The cosmological argument as it was articulated in the Middle Ages started from the existence of the universe. The argument answers boundary questions or metaquestions that are raised by science but cannot be answered by science: Why does the universe exist at all? Why is the world intelligible, and why are these particular laws present? Why is there a universe for the equations to describe? Aquinas said that even if the world had existed for an infinite time, it would not be self-explanatory. I grant that if time were infinite, it,

would be more difficult to express the theological idea that the world's history has a purpose and a goal, which has been associated with the idea that time had a beginning and will have an end. But I am not sure that faith in a purposeful God requires even the finitude of past time. I see greater theological significance in the finitude of human life and that of other creatures—their limited life spans, limited powers, and ambiguous actions. Science has indeed helped us to recognize the contingency of the world; the initial conditions and the laws of nature were not necessary, and the sequence of events in the world is not determined. All of this means that I will be glad if scientific evidence for finite time continues to accumulate, for it provides a dramatic way of talking about dependence on God. But I do not have as great a theological investment in the idea as Russell does.

On the third topic, continuing creation and God's action in the world, I do think that some kinds of scientific theory conflict with some theological affirmations. In the deterministic world of Newtonian mechanics, God could only design the process, sustain it, and perhaps intervene at discrete points. To be sure, there is new evidence that can be cited for the argument that design is built into the process, for example, the fine-tuning of fundamental constants (the so-called anthropic principle) or research showing that in thermodynamic systems far from equilibrium new forms of order and new levels of complexity will emerge. The protein molecules which make life as we know it possible were the product not of chance alone but of the built-in affinities and bonding angles of amino acid components. But even if one finds the argument for design persuasive, the deistic view of God the cosmic designer is a long way from the biblical view of a God who acts.

I am therefore sympathetic to the idea that God acts by determining the outcome of indeterminate quantum systems. Quantum physics predicts only a range of probabilities for a quantum event, such as the time at which a particular radioactive atom will decay; it might occur a second or a thousand years from now. God would not have to intervene to push electrons and atoms around but would instead actualize one among the many potentialities already present in the system. This would require an input of information but no input of energy, since the diverse potentialities have identical energy. Small differences at the quantum level can result in large-scale differences through various amplification and trigger effects, including the butterfly effect in chaos theory, mutations in DNA, and perhaps neurons in networks in the brain. God's control of quantum events within the probability distributions that science predicts

would not be detectable by the scientist. What appears to us to be chance would be determined by God.

But if God controls all events, we would have replaced physical determinism with a combination of physical and divine determinism, and there would be no room for real novelty or human freedom. As Russell points out, the problem of evil and suffering in the world would be acute, as it was for earlier versions of predestination. Another alternative is suggested in his concluding paragraph: "What we take as quantum chance involves both divine action and genuine novelty in combination, so that we really have three independent principles of causation: divine action, the causal past, and genuine novelty at the quantum level. [This] would tend more toward a process metaphysics such as Barbour endorses." Of course, process metaphysics postulates these three factors (divine action, the causal past, and genuine novelty) not just at the quantum level but in every integrated entity at whatever level. The novelty of indeterminacy at lower levels becomes the novelty of self-determination at higher levels.

Moreover, I am hesitant to imagine God's influence confined to quantum events, because that seems to concede the reductionist thesis that the behavior of all entities is determined by the behavior of their smallest components. Of course, God could anticipate higher-level consequences when deciding how to influence quantum events. But a bottom-up view of the causal relationship between levels has serious shortcomings when applied to organisms and human beings, in which I think we need to speak of top-down causality. Events at higher levels of organization in integrated systems impose constraints and boundary conditions on events at lower levels without violating the physical and chemical laws applicable at those levels. We interpret patterns of behavior in another person in terms of the purposes of an agent, which may be expressed through the motion of molecules but cannot be translated into the vocabulary of chemistry. My feelings and thoughts about love and beauty require the activity of neurons in my brain but cannot be articulated in concepts applicable to neurons. In a similar way, we cannot talk about God's love and forgiveness in the language of quantum physics. I would want to conceive of God as interacting with the higher level of integrated psychosomatic activity that we call the human self. I will suggest in a moment how process thought encourages such an approach.

RESPONSE TO JOHN B. COBB, JR.

Since John Cobb's paper starts in an autobiographical mode, my response will follow his example. He said that Daniel Williams was one of his mentors at Chicago. I first encountered process thought through Dan Williams, who was a member of a group of scientists and theologians organized by Harold Schilling and Roger Shinn that met twice a year from 1961 to 1970 for a weekend of discussion at Union Theological Seminary in New York. In the early 1960s when I was on leave from teaching, I attended a seminar on Whitehead led by Gordon Kaufman at Harvard. I did some reading in Hartshorne and appreciated his clarity in comparing process views of God with classical doctrines. I was also very grateful for several books by John Cobb and David Griffin that creatively explored Christian doctrines in a process framework. Over the years I have particularly appreciated Cobb's interdisciplinary interests and his ability to relate process thinking to biology, environmental ethics, economics, and a variety of other fields. Earlier in my life I had met Pierre Teilhard de Chardin, who had been my father's close friend and scientific colleague in China. In the sixties I read many of Teilhard's writings interpreting God and human nature in an evolutionary framework. His idea of "the within" and his understanding of God were in many ways similar to process views, though they were articulated more poetically than philosophically.

When I wrote *Issues in Science and Religion*, published in 1966, I developed process themes in a number of chapters scattered throughout the book. But in writing the first Gifford volume, I discussed the implications of science in the first seven chapters without using process terminology, though I was developing a view of nature that was supportive of process thought. Then I devoted a separate chapter to a systematic presentation of process philosophy. I thought this format would be easier for the reader to follow and more useful for courses on science and religion. But Cobb is right that my interpretation of science was from the start influenced by a process perspective. I should perhaps have acknowledged this more explicitly, though I did indicate my own commitments at the end of the first chapter.

Cobb says of me, "Process thought functions for him, not as his basic perspective, but as a way of dealing with certain problems. . . . For me, on the other hand, process is the perspective in terms of which I view both science and theology." It is certainly true that I started from a loyalty to the Christian tradition and to the scientific understanding of the world, and I was interested in process thought because it helped me relate them to each other. Process thought

provided a promising answer to the question, How can God act in the kind of world portrayed by science, namely, an evolutionary, ecological, multileveled world characterized by both chance and law? The process framework also offered distinctive answers to the long-standing problems of human freedom, mind-body dualism, and the presence of evil and suffering in the world.

Compared to Cobb, I am perhaps less totally committed to Whitehead and more willing to adapt, modify, or depart from his ideas when they do not seem to me adequately to represent important aspects of science, the Christian tradition, or human experience. Of course, Cobb is willing to depart from Whitehead occasionally, as when he supports subjective immortality rather than Whitehead's concept of objective immortality through participation in God's consequent nature. But I have suggested the need for more extensive modifications. The numinous experience of the holy and the ongoing Christian understanding of worship seem to me to require a greater emphasis on transcendence than is found in Whitehead's writing. Some of his terms are misleading unless one has studied his writing in detail, so I avoid using them. Most people assume that reference to the "mental pole" of every event implies that molecules or atoms have minds and are conscious. I prefer Griffin's terminology: all integrated entities are centers of at least rudimentary experience; rocks are aggregates without the integration that is a prerequisite of experience; and mentality or mind is present only at higher levels of organization and complexity.

I have questioned the adequacy of Whitehead's concept of selfhood. Cobb evidently did so early in his career. He says: "I could provisionally experience myself as constituted only of events with no underlying self or I. But this, too, was not an easy perspective to adopt. I could not by an act of will really understand myself in that way, regardless of what words I might use in explaining my opinions." I take it that Cobb outgrew that difficulty, but I have not yet done so. I think it would be possible without reverting to substance thinking to allow for more continuity and a stronger route of inheritance among the fragmentary moments of our experience than Whitehead indicates. Perhaps another reason that I am less firmly attached to the Whiteheadian scheme is that I think one can use a variety of models in thinking about God. In that respect I am closer to McFague, though I want to go further than she does in elaborating the metaphysical categories in terms of which models are developed into conceptually formulated beliefs. Of course, differing models may suggest beliefs that are not compatible with each other, so one cannot be open to all models at the same time. But I agree with

McFague that we have to use metaphors and models in talking about God if we are to avoid the idolatry of claiming that we have God all figured out.

The last section of Cobb's paper asks about a Whiteheadian interpretation of physics. Of course, Whitehead was influenced by twentieth-century physics, especially the episodic and momentary character of events in the quantum world and the interactive character of events in relativity. The recent Bell's theorem experiments show that when two particles are emitted in opposite directions from a single source, their wave functions must be treated as a whole even when the particles are too distant from each other to allow any communication in the time available before they strike the detectors. The experiment is one more example of the holism found at the quantum level. As Cobb notes, David Bohm has developed a formalism that is consistent with all the quantum data, but its holism is so extreme that I believe it is inconsistent with the genuine pluralism expressed in Whitehead's philosophy, though at other points they have much in common. In seeking hidden variables behind quantum uncertainties, Bohm sides with Einstein in endorsing an underlying determinism that seems to exclude both chance and human freedom. Here Bohm as a follower of Krishnamurti may be more in tune with the monism of Eastern mysticism than with the pluralism I find in both Christianity and process thought. After many years, Bohm and others using his theory have been unable to make any testable predictions that differ from the predictions of standard quantum theory, but we cannot rule out further theoretical or experimental developments that would favor it. At the moment I do not see any scientific, philosophical, or theological reasons for abandoning the form of quantum theory accepted by most physicists today.

REFERENCES

- Barbour, Ian G. 1966. *Issues in Service and Religion*. Englewood Cliffs, N.J.: Prentice-Hall.
- McFague, Sallie. 1993. *The Body of God: An Ecological Theology*. Minneapolis: Fortress Press.
- Russell, Robert John. Forthcoming. "Nature and Creation in Modern Physics and Cosmology: A Trinitarian Approach." Paper presented at the Fifth European Conference on Science and Theology, Munich, 23-27 March 1994 (to be published in the conference proceedings).