STORYTELLERS AND SCENARIO SPINNERS: SOME REFLECTIONS ON RELIGION AND SCIENCE IN LIGHT OF A PRAGMATIC, EVOLUTIONARY THEORY OF KNOWLEDGE

by Karl E. Peters

Abstract. Asserting that both scientists and religious thinkers are involved in telling stories about the past and spinning scenarios about the future, I first compare and contrast the purposes of scientific and religious storytelling. Then, in light of some recent work on brain and language evolution, I offer a possible story about how humans might have become storytellers. Finally, I discuss how religious stories might be evaluated pragmatically and even scientifically by developing Lakatosian-type research programs.

Keywords: brain evolution; creativity; empirical theology; evolutionary epistemology; human evolution; pragmatism; theology and science.

Human beings are storytellers and scenario spinners. We tell stories of how things have occurred in the past in relation to the present; we develop possible stories about how things will happen in the future. Many of our stories are only verbal narratives, but sometimes the stories and scenarios are acted out in drama or ritual. And sometimes the stories and scenarios are lived out as human beings travel to the moon, lead a civil rights movement, carry out a revolution, or travel a road to Jerusalem and death on a cross.

When we think of stories we usually think in terms of literature, history, and religion—academic areas usually classed as the humanities. We think of narratives of onetime events in the lives of individuals or societies, in contrast to the general propositions of scientists regarding repeatable occurrences. However, we can also think of scientists as storytellers and scenario spinners. On the basis of an array of general propositions

Karl E. Peters is Professor of Religious Studies at Rollins College, Winter Park, FL 32789–4499. He also is coeditor of *Zygon: Journal of Religion and Science*.

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about genes and proteins, the medical scientist may tell a story about neuron development in a particular human being. On the basis of empirically testable ideas about the atomic and molecular structure of energy-matter, a scientist may create a general narrative about the birth of our solar system and the planet Earth. And some scientists now are collecting parts of a grand epic of the history of the universe, the rise of life on planet Earth, the evolution of humans and our capacity for abstract thought and storytelling, and possible scenarios about our future.[1] As more scientists try to conceptualize irreversible or historical processes, scientists become narrators.

Scientific stories and scenarios may also be acted out, sometimes even lived out. The acting out occurs when a technology is developed to transform scientific theory into practice: when laws of physics are used to build bridges and airplanes, when understandings of disease and of the immune system are employed in the practice of medicine, when insights about human development and personality differences are used to inform educational practices that attempt to match teaching with different ways of learning. Scientific scenarios about the future are also acted out in computer simulations or real-life simulation games—and of course in science fiction films and television. And sometimes scientific stories about how the physical universe works and scenarios spun from these stories are lived out—as when human beings travel into space, to the moon, and, probably in the not too distant future, beyond the moon.

More basic than either scientific or religious stories, or than literature and history, are the storytelling and scenario spinning we each do in our daily lives. As we remember and reflect on our own past, we are engaged in storytelling; as we plan a day's events, we are scenario spinning. Neural philosopher Daniel Dennett helps us see the significance of this. He writes that in contrast to other animals, we

> are almost constantly engaged in presenting ourselves to others, and to ourselves, and hence representing ourselves—in language and gesture, external and internal. The most obvious difference in our environment that would explain this difference in our behavior is the behavior itself. Our human environment contains not just food and shelter, enemies to fight or flee, and conspecifics with whom to mate, but words, words, words. These words are potent elements of our environment that we readily incorporate, ingesting and extruding them, weaving them like spider webs into self-protective strings of narrative. Indeed . . . when we let in these words, these meme-vehicles, they tend to take over, creating us out of the raw materials they find in our brains.
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> Our fundamental tactic of self-protection, self-control, and self-definition is not spinning webs or building dams, but telling stories, and more particularly concocting and controlling the story we tell others—and ourselves—about who we are. And just as spiders don't have to think, consciously and deliberately, about how to spin their webs, and just as beavers, unlike professional human engineers, do not consciously and deliberately plan the structures they build, we (unlike *pro-*

fessional human storytellers) do not consciously and deliberately figure out what narratives to tell and how to tell them. Our tales are spun, but for the most part we don't spin them; they spin us. Our human consciousness, and our narrative selfhood, is their product, not their source. (Dennett 1991, 417–18)

This passage from Dennett serves as a text for much of this essay. Although it may not encompass all that makes us human, I think the metaphor of humans as storytellers and scenario spinners is a useful tool to illuminate what and who we are, to give us a sense of meaning and purpose.

Why do we tell stories? What purpose does this activity serve? How did we come to be storytellers and scenario spinners? And how do we determine when our stories and scenarios are good stories or not-so-good stories, the question of truth or validity? I will try to show that the answers to these questions are evolutionary ones, even essentially Darwinian ones. By telling a Darwinian, evolutionary scientific story, we can come to understand how we came to be what we are in a way that has implications for how we think, act, and live both scientifically and religiously.

Some Purposes of Storytelling

We can ask about the purposes of storytelling to compare and contrast scientific and religious ways of knowing when these ways are viewed in light of an evolutionary perspective. We can begin with the following working definition of *religion:* a religion is a system of ideas, actions, and experiences that offers a path toward human fulfillment by relating individuals and societies to what is thought to be ultimate.[2]

A Simple Comparison of the Purposes of Religion and Science. Some parallels between science and religion can be seen by looking at the first part of the definition: "system of ideas, actions, and experiences." In general, science consists of theories that are tested by experiments or controlled observations (the actions of science) against a particular domain of experience. Religions have the same general structure: poetic stories called myths and rational doctrines constitute the ideas; rituals and codes of conduct specify behavior; and both of these lead to as well as respond to a variety of experiences. In science, as in religion, the relation between ideas, actions, and experiences is not one way but interactive: theories influence the kinds of actions undertaken and the character of the resulting experiences; yet experiences can lead to a modification of theories (cf. Schilling 1962, 69–75; Barbour 1990, 32–39).

A basic difference between science and religion can be seen in the second part of the definition: "offers a path toward human fulfillment by relating individuals and societies to what is thought to be ultimate."

What is meant by *fulfillment*, the nature of the path, and the understanding of what is ultimate vary considerably when one examines what has been described as religion (cf. Streng, Lloyd, and Allen 1973). For example, fulfillment may occur in the context of nature—maintaining small-scale societies in harmony with nature, or developing a variety of individual human potentials in a manner integrated with the rest of society and the environment. Fulfillment may be social, the liberation of a people from political and economic oppression, or the gradual development and maintaining of a just and humane social order. Or human fulfillment may be realized independently of nature and society as we know them—merging individuality into an originating cosmic self, or gathering the righteous at the end of history into a peaceable kingdom of a new heaven and earth. Below I suggest that all these may be important in contributing to human viability, when viability is seen from an evolutionary perspective.

Paths to this completion may be primarily ritualistic, devotional, ethical, or meditational and experiential. They may involve only human effort, a complete reliance on a reality greater than human beings, or both to some degree. The understanding of what is ultimate may be in terms of a state of existence to be attained or an agent that is the source of existence and goodness. And the state or agent may be simple or complex, personal or nonpersonal. However, the state or agent is usually considered to be the highest value; it is the greatest good.

In all this religious variety the idea is implied that humans do not exist in a state of greatest good; there is more to life than has been realized so far. Obstacles to fulfillment have to be overcome; potentials have yet to be actualized; various actualized aspects of life have to be integrated into wholes. Although *fulfillment* may mean that things need to be brought to completion in some final culmination of nature and history, it also may include an ongoing succession of states of relative completion here and now. Thus, underlying many of the differences in religion is a common quest for greater value or goodness. Stories are told about key past events and persons that have fulfilled the quest, and scenarios are spun about how further good can be sought and attained by those alive today.

Stories about the quest for increasing value are the most important thing distinguishing religion from science. In oversimplified terms, we might say that the narratives embodying the theories and practices of science are focused more on reality than value, on the way things are rather than the way they ought to be. Religion seeks greater value and hence is concerned with maintaining and enhancing human well-being. Scientific accounts offer understandings of humans and the world in which we live, regardless of whether the knowledge attained is beneficial to humans; this is one important aspect of the so-called objectivity of science.

A More Complex Statement of Interrelated Purposes of Religion and Science. In more complex terms, we must recognize that even in science there is a commitment to increasing value—the value of knowledge. But we can still distinguish religion from science by saying that religion seeks not just knowledge for its own sake, as does science, but knowledge which is "salvational," knowledge that lights the path toward greater good. Even this distinction, however, needs to be qualified in a number of ways. Although it fits much of traditional religion and what has been called pure science, it does not fit exactly what often happens today when the distinctions between pure and applied science, and between truth and beauty, are blurred. As such distinctions are blurred, the purposes of religion and science become more complementary; religion and science become more yoked together as a team, which is what the title of this journal, *zygon*, means. In what follows I attempt to illustrate some of this complexity by suggesting, first, that religions need to take reality as it is into account, and second, that science even as it seeks objective knowledge of reality, often does so in ways that contribute to human well-being and fulfillment.

In discussing how religious ideas (in the form of stories called *myths*) are salvational, John Bowker insightfully draws out one implication for knowledge that differentiates science from religion. He notes the fact that many religious traditions have a variety of stories of creation, some of which even contradict each other. This means that, in contrast to science, religions are not interested primarily in describing the way things are. Speaking of creation stories, Bowker says that "in religions, the *descriptive* account of origins is subordinate to the way in which the conceptualization of cosmos and cosmic origins contributes to the *salus* (the health and salvation) of the society which it sustains" (Bowker 1990, 10; italics in original). This does not mean, however, that religious fulfillment is entirely out of touch with reality; rather the reality that concerns religion is that which is vital for human survival, viability, and fulfillment. Bowker explains

> that religious stories and behaviors were *not* addressed to the same aims and purposes as modern science: they were (amongst much else) mapping the cosmos in ways that made it habitable, particularly by mythologizing and often personifying the nonnegotiable constraints. . . . Religious accounts of the origins of the cosmos were not much concerned with origins *as such*: they were linking the *cosmic* context, however imagined, to the *local* context in which particular people had to live. Religious cosmologies (never divorced from their anthropologies, their accounts of human nature) related communities to the nonnegotiable terms in the cosmos, terms they must respect—or perish. (Bowker 1990, 10; italics in original)

The reality that concerns religious storytelling, and we might add, if we think of cosmic ends as well as origins, religious scenario spinning, is the reality of ultimate concerns.

Of course, from an evolutionary perspective there is more than one way to find fulfillment, health, and salvation—demonstrated by the wide variety of religious thought and practice in human history. Nevertheless, all this variety must still come to terms with reality, with the way things are, insofar as reality sets the boundary conditions for human living. Some of those boundary conditions are natural—physical, chemical, and biological. Human fulfillment must occur in sufficient harmony with nature so that human life and culture are sustainable. Humans in small-scale hunting-gathering and simple agrarian societies certainly realized this. Today, with the increasing awareness of emerging global environmental crises, we are becoming aware that large-scale developed civilizations also are subject to the boundary conditions of the planet if humanity is to be sustainable for the long-term future. Other boundary conditions are social. For societies to be viable or stable, the political-economic order must meet the biological and psychological needs of its members in an equitable manner. As Langdon Gilkey has argued, social justice is not just a luxury; in advanced educated societies it is a basic boundary condition for long-term human viability (Gilkey 1991).

Finally, the boundary conditions presented by reality are psychological —some might say spiritual. As religions have recognized, human beings seem to require some sense of meaning and purpose in order to be fulfilled. More specifically, our highly developed brains and our languages give us the capability to wonder why things are the way they are and not some other way, and the capability to worry about the future. As Paul Tillich has argued in *The Courage to Be* (Tillich 1971, 40–57), humans face reality when they deal with the following problems: Why was I born at this time and place and not somewhere else? (fate); why is my existence only for a few years? (death); why do I need to keep updating and changing my thinking? (crises of spirituality); is there any permanent meaning to things or is life simply absurd? (meaninglessness); why can't I accomplish the things I want to accomplish? (guilt); and can't I do anything right? (self-condemnation). Questions such as these need to be resolved in some way or other as humans seek a sense of fulfillment. Even though these life problems might be handled in a variety of ways (just as humans can live harmoniously with the natural environment and in society in a variety of ways), such questions point to psychological realities with which humans must come to terms. Thus, religions, even as they proclaim paths of salvation or fulfillment, cannot be completely divorced from reality. Science can help us better understand some of the real boundaries that are relevant to humans trying to realize fulfilled lives.

On the other hand, some contemporary science explicitly seeks to understand the way things are in order to assist human well-being and fulfillment. Medical research, agricultural science, psychology, and psychiatry are examples of this. A good illustration is the work of Mihaly Csikszentmihalyi. As the result of extensive research Csikszentmihalyi concludes that "people feel more happy, satisfied, strong and creative when involved in activities that require the use of skills (mental and physical). Work is better than free time because it has clearer goals, challenges, feedback" (Csikszentmihalyi 1991, 3). Such satisfaction can be achieved in a variety of ways, some moral and some immoral, some mundane and some religious. Still, such scientific results help us understand more objectively an aspect of our own reality that seems relevant for how we think about living religiously.

At a deeper level, a scientist's search for the way things are may be intrinsically related to one form of human fulfillment—coming to an appreciation, acceptance, and awe of the universe that creates and sustains us. In discussing the "spirituality of science," Lindon Eaves suggests that Einstein's statement about "cosmic religious feeling" is an example of the affective element in scientific motivation. Einstein writes: "I maintain that cosmic religious feeling is the strongest and noblest incitement to scientific research. Only those who realize the immense efforts and, above all, the devotion which pioneer work in theoretical science demands, can grasp the emotion out of which also such work, remote as it is from the immediate realities of life, can issue. . . . You will hardly find one among the profounder sort of scientific minds without a peculiar religious feeling of his own" (Einstein 1979, 28; quoted by Eaves 1989, 198). Eaves continues his discussion of the spirituality of science by suggesting that scientists are motivated by three expectations: First, "rightly or wrongly, scientists believe they are engaged in exposing *reality* itself." Second "is the expectation of simplicity. . . . The most informative theories are those which encompass the greatest range of data with the smallest number of parameters." Third "is the aesthetic principle. . . . The scientist's sense of what is 'ugly' keeps alive the quest for a better solution. The sense of what is 'beautiful' plays a significant part in deciding when a truth is at hand. A sense of what is 'elegant' determines the degree of enthusiasm for a new scientific strategy. The passion for simplicity and the appreciation of beauty are closely allied in scientific spirituality" (Eaves 1989, 199–200).

Motivated by the hope of understanding reality and the aesthetic sense of beauty, the scientist, one might say, is seeking one type of fulfillment, and hence the scientist is on a religious quest. In attempting to see things as they are, the so-called pure scientist, who is interested in knowledge not just for the sake of improvement but for its own sake, may also be affirming the intrinsic value of energy, matter, and life in their various forms. In their own rational-empirical, precise, cognitive manner scientists may be affirming what Zen Buddhists try to grasp more intuitively, an enlightenment that involves a direct seeing into the nature of things. Or they might exhibit, if we follow psychologist Erich Fromm, a kind of "mature love" that accepts other parts of the universe as they are rather than trying to make them serve one's human interests and therefore controlling and dominating them (Fromm 1962, 20–21).[3]

This raises a profound question for religion and theology: To what extent is the goal of living a coming to terms with the way things are, regardless of their impact on human well-being; and to what extent is the goal a reshaping things for human improvement? To echo Karl Marx: What is the human quest about, to understand the world or to change it? Scientists such as Eaves seem involved in the quest for understanding; for others more technologically oriented, the goal may be to understand in order to change things for some perceived greater good. Such alternative goals will be embodied in the kinds of stories a culture tells and the kinds of scenarios it spins. Incorporated within an evolutionary story is the general fact that millions of species have or have not survived, depending on how well they adapted to the conditions set by their environments. The same evolutionary story narrates that only one species has used its knowledge to try extensively to adapt the environment to itself. However, is this human strategy of trying to remake our planet to serve human wants and desires the best one for long-term human viability?

Elements of a Story: How We Became Storytellers and Scenario Spinners

Storytelling and scenario spinning offer mental constructions of the way things have been and the way they can and ought to be. One construct, a scientific one, that answers the question of how we became storytellers and scenario spinners is the story of the evolution of the brain. This story tells how a species came to possess the capacity to invent and use languages to construct representations of its experienced world, including itself to itself; to construct memories of the past; to anticipate conceptually the future consequences of its behavior; and to decide what it should do, think, and experience. In this section I follow the outline of Daniel Dennett's chapter on the "Evolution of Consciousness" in *Consciousness Explained* (1991, 171–226). I supplement his ideas with those of neurobiologists William Calvin (1990, 1994), Paul MacLean (1985), Terrence Deacon (1990a, 1990b), and Harry Jerison (1976), and of anthropologist Ward Goodenough (1990).[4]

So far, my dominant metaphor is that human beings are storytellers and scenario spinners. To begin our discussion of how we became these, I want to introduce a second metaphor, namely, that the process that creates life, human culture, and the human brain and that can guide human thinking is like a dance, the particular dance that some biologists call the

Darwinian two-step. The Darwinian two-step consists of a set of processes that brings about new variations and a second set that selects some of these as more viable than others.[5]

One way to exemplify this Darwinian dance is to imagine a lecturer and his or her audience, with the members of the audience able to respond to the lecture. Although they have general expectations regarding what is likely to be said, there is no way the members of the audience can anticipate exactly what the lecturer is going to say in detail; nor can the lecturer anticipate how the people in the audience will respond. In Darwinian terms, the interactions between a speaker and listeners are unpredictable or random. Yet one can be almost 100 percent sure that these random interactions will generate some new ideas for the people at the lecture. Of course, no one will accept all the new ideas; each person's evaluation or selection is the second step in the Darwinian dance. How we do this is a fascinating activity to reflect upon, and in the third part of this essay I discuss some of the dynamics of the human selection of ideas when I describe how we can decide the validity of various stories.

For now, let us develop elements of a scientific story of how the Darwinian two-step works in nature and culture to develop brains capable of language, so they can talk about the Darwinian two-step. The details of this evolutionary story are not completely worked out by biologists, neural physiologists, and anthropologists; there are important issues yet to be resolved. One, for example, is whether human language is in part directly responsible for the fourfold increase in brain capacity from mammals to humans related to body mass, or whether the evolution in brain size occurred well before the rise of human language because of other selective pressures, thus making language a secondary, serendipitous effect. How this issue is resolved depends in part on what is meant by language. Neural physiologist Deacon and anthropologist Goodenough see language as more of a direct factor in brain evolution than do neural physiologists Jerison and Calvin and philosopher of mind Dennett. Another issue is whether human language was selected because it gave humans an advantage in representing and modeling the experienced world, or whether it was selected primarily because it allowed for survival benefits from social communication. Jerison favors the former; Goodenough and also MacLean (insofar as he roots language in the limbic system separation call), the latter. I offer these examples only as a warning that the evolutionary story about how human storytellers came into being is far from settled or complete. Nevertheless, there seems to be enough agreement to give us something like the following much-abbreviated account. Following Dennett I discuss first, how brains become in part hardwired for some specific tasks; second, how brains of higher mammals and humans are also somewhat plastic and can be shaped by learning; and third, how human language shapes human brains so that we become self-conscious by becoming storytellers and scenario spinners.

Evolution of Hardwiring. Turning to the evolution of some hardwiring of the brain, the general story begins with the origin of life, with creatures that are self-replicating. In contrast to most molecules and minerals, self-replicating creatures (microorganisms, plants, and animals) have nonconscious, biological interests; and they take an active role in maintaining and furthering these interests.[6] The primary interest (we might say the primary good being sought) is continuation by reproduction, or self-replication. To reproduce, creatures also need to be interested in nourishing themselves (becoming in most cases predators) and defending themselves from becoming prey to other living things, who also are trying to nourish themselves. Those who evolve effective reproductive mechanisms and strategies, and who also have evolved mechanisms and strategies for eating and self-defense, will live long enough and effectively reproduce.

In terms of the Darwinian two-step, these mechanisms and strategies are, first, the result of errors in reproductive processes that alter the genes. Altered genes can alter the resulting organism so that it is a more or less effective eater, self-defender, and reproducer. Thus, in a given environment of other genetically changing individuals, other species, and inanimate changes such as alterations in climate, some organisms are selected by their ability, more effective than others', to reproduce themselves and their genetically based biological mechanisms and functional strategies. Selection is the second phase of the Darwinian two-step.

There are numerous examples of mechanisms and strategies that are thus genetically hardwired in the nervous system. Any nervous system mechanism that will help organisms distinguish what is good for them (food) from what is bad (a poison or predator) is likely to be selected. Organisms need to be biological evaluators. One example of biological evaluation is the development of visual systems that are very sensitive to a vertical axis of symmetry. Dennett suggests that in earlier stages of animal evolution, "about the only things that showed axes of vertical symmetry were other animals, and only when they were facing you. So our ancestors have been equipped with a most valuable alarm system that would be triggered (mostly) when they were being looked at by another animal" (Dennett 1991, 179; following Braitenberg 1984). "Being informed (fallibly) that another animal is looking at you is almost always an event of significance in the natural world. If the animal doesn't want to eat you, it might be a potential mate, or a rival for a mate, or a prey who has spotted your approach" (Dennett 1991, 179–80). In short, nervous systems that are genetically wired to be sensitive and responsive to vertical symmetry gain capabilities that help animals survive and reproduce.[7]

Related to vertical symmetry is a more general "orienting response" that according to psychologist Odmar Neumann serves as the "biological counterpart to the shipboard alarm 'All hands on deck!'" (1990; Dennett 1991, 180). The activities of most animals (and of humans much of the time) originate in the brain below the level of self-awareness. Specialized modules or subsystems process information and initiate actions in response (Gazzaniga 1985). When a specialized alarm is triggered, for example, by sudden vertical symmetry, or a more generalized alarm by anything sudden or surprising, all sensory systems are mobilized to gain further information. If this information confirms a possible threat, or perhaps a meal or mate, the whole body of the animal (or human animal) is mobilized as a result of hormone secretions and modulations in brain subsystems, and the creature becomes engaged in appropriate flight-or-pursuit behavior.

According to Dennett, Neumann speculates that once established, these orienting responses proved useful in, first, provoking an update regarding the animal's environment. Then they were used more frequently to acquire information. Finally, this led to regular exploration and the birth of curiosity, or "epistemic hunger." Some animals, including humans, became what the psychologist George Miller has called *informavores*: organisms who had gained an adaptive advantage because they were hungry for further information about the world they inhabit (and about themselves) (Dennett 1991, 181).

I have given only a few examples of the Darwinian evolution of hardwiring capabilities in animal nervous systems that will have a bearing on our human capability as storytellers. There are many others. According to Ward Goodenough, before the emergence of the earliest hominids, there were six nervous system capabilities in place that underlie the later-developed capacities for human language and beliefs: "(1) categorization of experience; (2) perception and categorization of things in structural arrangements; (3) abstraction of higher-order categories from lower-order ones on the basis of common features, while overlooking a perceived difference; (4) potential for analogizing, largely underdeveloped in the absence of language; (5) intuitive grasping or perceiving of relationships that would, if expressed in language, constitute propositions; and (6) the ability to act on these perceptions in the definition and pursuit of goals" (Goodenough 1990, 599).

Brain Plasticity and Learning. Some of these genetically based, hardwired capacities offer the capability for learning. They allow nonhuman animals, in varying degrees, to construct their world by integrating sights, sounds, and smells so that the experiences of some senses become symbols of anticipated experiences with other senses. For example, when my dogs hear barking, their brains and bodies become mobilized to search for and to anticipate seeing another canine. In a limited way, animals construct a reality that is consistent with the particular social, reproductive, and survival contents of their evolutionary past. Without what we call language but with experiential symbols, they seem to construct the analogues of short narratives and spin scenarios for the immediate future.

With a brain that is to some degree plastic, wired for learning and individual development, it is possible for individuals to learn different things as their particular environment changes. But how exactly does each individual brain become designed so that it is not exactly like all other brains of the same species? Of course, genetic variation within species leads to individuality even in the hardwiring. But our unique experiential histories also play a role in forming how each of us thinks and acts. Dennett calls the process by which humans learn everything from how to focus their eyes to how to ride a bicycle to learning quantum mechanics "postnatal design fixing," because such learning helps structure the physiological development of the nervous system itself (Dennett 1991, 183).

A clear example of this is offered by William Calvin in his review of Gerald M. Edelman's *Neural Darwinism* (Calvin 1988, 1802–3). Noting that several decades ago biologists began to realize that a lot of cell death was going on in developing nervous systems, Calvin says the modern mainstream view among scientists is that the selective elimination of synapses creates long-term memory patterns—a kind of sculpting of the nerve networks of the brain. Even though there is a great deal of dendritic growth and synapse formation after birth, "there is an imbalance in the rates of making and breaking synapses during childhood. It causes us to reach adolescence with little more than half the number of cortical synapses that we had eight months after birth" (Calvin 1988, 1802). Learning is thus not so much a building of brain tissue as of editing it, of (in Dennett's terms) fixing the design of a particular brain.

What principles control such design fixing? Calvin, Edelman, and Dennett all agree that they are Darwinian principles—natural variation and selection—but now internal to the workings of an individual brain (within the phenotype rather than on the genotype). With the multitude of experiences presented to the individual and initially processed through sensory apparatus and encoded in sets of neuron synapses, only some are finally encoded in long-term memory. Dennett suggests that "something already fixed in the individual by ordinary natural selection [hardwired by the genes] has to play the role of mechanical selector, and other things have to play the role of the multitude of candidates for selection" (Dennett 1991, 183). What this suggests to me is analogous to the vicarious selectors hypothesized by psychologist Donald T. Campbell in his work on evolutionary epistemology (Campbell 1977). At the level of selection within brains, such hardwired tracks related to self-preserving, sexual, and parenting behavior in the limbic system (MacLean 1985) could well be some of the selectors that contribute to learning. Other selectors might involve simply a kind of neural coherence, a democratic kind of competition among the different experiences and their responses encoded in different neural nets that vie with one another until one achieves dominance.[8]

Writing primarily about decision making, Calvin summarizes this kind of selection within the brain with the metaphor that the brain is a "Darwin machine" working largely below the level of self-awareness, first to generate variations on a theme (alternative courses of action) in alternative sequences that serve as competing serial buffers. Then, still below the level of self-awareness, the various alternatives are judged against a perceived situation (or perhaps against internal criteria) until the various buffers are reorganized so that they act in concert. Calvin argues that this process explains the human ability to throw a ball or spear with great speed toward a distant target. It also explains what he hypothesizes as the derived capability of ordering words into sentences and even ideas into papers.[9] With the Darwinian two-step (variation and selection), the brain functions more like a committee without a chair trying to reach consensus than like a hierarchically organized system with one central authority doing the judging. Calvin uses the musical analogy of a chorus (I suggest a smaller group such as a quartet): at first individuals do not all sing in unison, but after repeated attempts they adjust to one another and begin to sing as a coherent and unified whole. He suggests that

> this step, of ganging into a chorus, is the neural networks' version of speciation in biological evolution, and of the amplification step in the immune response. In biology, new species usually come about because of discovering a new niche, and so a restricted number of genotypes (DNA sequences) have a population explosion. In the immune system's use of Darwinism, the sequence of amino acids that best fits the foreign antigen undergoes a population explosion. And so the best of the lot of the sequencing tracks in the left brain, were it replicated in other planning tracks . . . would be similar to speciation. (Calvin 1990, 250)

What I have been suggesting with examples is not only a Darwinian variation-selection model for the evolution of the genetically based, hardwired aspects of the brain but also an internal Darwinian two-step that helps fix the design of the more plastic aspects of individual brains. Such a Darwinian story may well account for brain evolution and experiential learning among animals prior to humans. With humans the story is similar but with the important addition that we have evolved the capability not only of constructing our world with experienced natural symbols but also with humanly created symbols called language.

Evolution of Language. Some animals besides humans are capable of learning some forms of language, including some human language. However, with the structural evolution of the vocal tract, especially the larynx, from *Australopithecus* (where it is more like that of the monkeys and apes) to *Homo erectus* (where it is intermediate between that of *Australopithecus* and *Homo sapiens*) to *Homo sapiens*, the utterance of a variety of human symbols with syntax and grammar became possible (Goodenough 1990, 600; following Laitman 1983).[10] This allowed humans to do three things, all having some survival value. First, it allowed for a more complex, detailed, and accurate representation of the world. Jerison thinks this is the primary factor in the natural selection of language. Second, it allowed for human communication that contributes to cooperation among groups of humans. Goodenough thinks communication is a key factor in the selection for language (Goodenough 1990, 605). Third, once developed, language provides an information system that becomes part of the experience of each developing human brain, encoding that brain with understandings and values of the current culture. Following Dawkins, Dennett sees this as a large part of the creation of consciousness with a system of memes, so that the individual not only is able to represent the world to itself and others but also can represent *itself to itself* and others (Dennett 1991, 199–208; Dawkins 1976 and 1982).

When this happens the individual human being becomes a full-fledged storyteller and scenario spinner. Calvin and Dennett argue that this is a necessary condition for self-consciousness. Echoing Dennett, quoted in my introduction, we have reached a point where we can say: with the evolutionary developments of hardwiring, brain plasticity, and language, we are self-conscious in that we "are almost always constantly engaged in presenting ourselves to others, and to ourselves . . . representing ourselves—in language and gesture, external and internal" (1991, 417). Like spiders spinning webs and beavers building dams, we do this as part of our evolved nature. Initially without much effort, thought, or deliberation, we do it by taking words and more words from our cultural environment and weaving them into strings of narrative. We spin tales about ourselves and our place with others in our immediate world, "but for the most part we don't spin them, they spin us. Our human consciousness, and our narrative selfhood, is their product, not their source" (Dennett 1991, 417–18).

As we grow as individuals in society, and as our societies evolve, the tales become more elaborate. Stories and scenarios are spun about our human place in the overall scheme of things, goals for human fulfillment, and ways of attaining fulfillment. Religious and cultural traditions become epics of the human journey in time and space, and sometimes beyond. There are a variety of such narratives guiding various human individuals and societies on our planet. As our world becomes more unified, our stories and scenarios compete with one another and with more recently evolved stories from the sciences. And in the brains of some individuals (many of whom are authors and readers of *Zygon*), the memes of these various stories compete in neural buffers. Those buffers of their own accord attempt to harmonize with one another to give birth to a "cerebral symphony" of words that unites elements from religious traditions and the sciences into a new "universe story."[11]

Deciding the Validity of our Stories and Scenarios

What I have just presented is one possible, scientifically based, much abbreviated story of how we humans came to be storytellers and scenario spinners, which is possibly a part of the universe story to which I have just alluded. Because of the brain's plasticity, it is capable of learning and generating many stories. This is borne out by the variety of cultural traditions, including the relatively new cultural tradition of modern science and its theories and practices. With all this plasticity and pluralism, how do modern-day human beings begin to validate their stories?

Tradition and Innovation in Deciding the Validity of Stories. If human self-consciousness is constructed as a system of memes encoded in older, evolved neural networks, then a large part of what we are, of who we are, is the meme system we inherit from our culture. In settling conflicts between ideas, a part of our task is to remain true to the past, because that is what it means to be true to ourselves. Even if we rebel against the memes that have shaped us, they still are a part of how we think and live. The past system of information that has created and shaped our minds becomes a cultural selection pressure in resolving conflict; that selection pressure is to be true to what we have been. Along with our genes, our cultural past encourages us to be storytellers, giving us much of the content of our own personal self-defining narratives.

However, human beings have also inherited neurological systems in their brains that support curiosity and cognitive exploration. Even simple organisms have biologically learned that sometimes it is better to move around in the search for food than to stay put; at least this is one strategy for survival. In moving around, they often make new discoveries, because the environment is always changing. For humans, biological mechanisms may be supported in some societies by cultural memes that also encourage exploration; an educational system that encourages thinking for oneself and that presents a variety of viewpoints in effect gives us a tradition that is open to innovation. To be true to ourselves, to what we have been, can also mean being open to innovation and progress, to new discoveries and creative constructions of ideas. Along with our genes, cultures can encourage us to be scenario spinners.

This tension between tradition and innovation (capacities for being both biologically and sometimes culturally inherited) plays itself out in competing types of selection pressures on possibilities for what to think and do. Some people seem to be oriented more toward being influenced by conservative selection pressures, whereas others are influenced more by pressures to accept what is new. Even this difference in orientation may be inherited both biologically and culturally. It is culturally inherited because human beings, even within the same society, grow up in different environments. In some environments it is safe to be exploratory and innovative; in others it is safer to be conservative and repeat the past.

However, cultural environments do not explain the fact that some individuals growing up in liberal families turn out to be quite conservative, whereas some others growing up in conservative families turn out to be liberal, or even radical. Of course, in contemporary large-scale societies, no one grows up in a single cultural environment. We are subject to competing meme systems, some supporting traditionalism and others progressivism. But perhaps more important than this is what Lindon Eaves and his colleagues discovered: that genetics plays a role in variations in personality regarding degrees of emotional stability, extroversion and introversion, and being dependent on or independent of others. These personality variables in turn can have an effect on whether individuals tend to be true to themselves in a conservative or more innovative mode. In fact Eaves suggests that shared family environment plays no role at all in shaping personality along such variables; the models best fitting the data are those suggesting that personality is determined by a combination of biological factors grounded in the genes and by unique experiences that happen to each individual (Eaves, Eysenck, and Martin 1989, 121–22). This was surprising to Eaves and his colleagues, but even more surprising was their finding that social attitudes, which usually are thought to be entirely grounded in cultural influence, have 30–40 percent genetic input conditioning them (Eaves, Eysenck, and Martin 1989, 360, 363). Among the most important attitudes so affected are degrees of political and religious conservatism or liberalism.

The point of all this is that as storytellers and scenario spinners, when it comes to deciding between conflicting alternatives about what to think and do, depending in part on the topic or issue, some individuals are more likely to be true to their biocultural selves by more easily affirming the security of traditional ways of thinking, acting, and living, whereas others may be more inclined to go with what is new. However, if human fulfillment is understood in terms of completeness, some kind of balance must be struck between the selection pressures of tradition and innovation. If achieving systems of relative completeness is a basic life task, one must be able to incorporate in unified systems of thought and practice as much of the past and as many new possibilities for the future as one can. Fitting old and new together in the neural-cultural system within each individual human being can thus be seen as an underlying criterion for deciding the validity of stories.

Expanding One's Valuing Consciousness. One way of expressing this, in the terms of the empirical theologian Henry Nelson Wieman, is to speak of human fulfillment as a successive series of completions that expand the valuing consciousness of persons (Wieman 1968, 10–15; cf. Wieman 1946, 54–69). Expansion of the valuing consciousness can be understood as coming to see and appreciate an ever-richer set of relations of mutual support and the qualities so related. These richer relations may be cognitive, aesthetic, interpersonal; they may involve other individual humans, other communities, other species, or the wider natural world. Hence, the valuing consciousness may be expanded not only in knowledge and formal beauty (as in mathematical science) but also in love and justice in regard to other persons, other types of people, other animals, and the rest of the natural world. Such expansion of the valuing consciousness is often gradual and continuous, but it may also occur suddenly as a gestalt switch, a eureka experience, a religious experience such as conversion in which a guilt-ridden, divided self is transformed into an integrated, self-affirming person in loving relationships with others, or as a mystical experience of being unified with the creative ground of existence with feelings of joy, harmony, serenity, and peace.[12]

In science, the valuing consciousness is expanded with an increase in rational-empirical knowledge. Knowledge is increased when proposed theories are justified according to a number of criteria. First, they should be rationally consistent with previously justified theories. Second, they also should fit with the body of observations that are regarded as significant in a particular scientific discipline. These two criteria are equivalent to selection pressures from established scientific tradition. Third, theories are evaluated on the basis of their simplicity: theories with fewer assumptions are better than theories with a greater number of assumptions to account for the same set of experiences. Fourth, theories that are more comprehensive in their scope or ability to explain a wide variety of phenomena are better than theories that are more limited in what they explain. Finally, theories are evaluated for their fertility or ability to provide a framework for an ongoing research program that leads to the discovery of new facts and the development of more refined theories. This is equivalent to a selection pressure that calls for continual innovation insofar as it leads to a growth of knowledge.

Lakatosian-type Research Programs. The notion of an ongoing research program has been developed by philosopher of science Imre Lakatos (1978). According to Lakatos, a research program contains two basic features: a hard-core or basic theory and a set of auxiliary hypotheses. The auxiliary hypotheses serve as a protective belt around the hard-core theory. They may be modified or replaced due to observations that falsify them, but because this happens, they prevent the hard-core theory from being falsified in any direct manner. As long as the auxiliary hypotheses of the research program can be modified in a manner that allows for the emergence of new observed events or facts, the hypotheses being modified become part of a progressive research program. Progress is due to the uncovering of new, unforeseen facts, even as the program's system of hypotheses continues to explain already established facts. On the other hand, if the auxiliary hypotheses are simply ad hoc explanations made to protect the basic theory and there are no predictions of new facts, the research program is degenerative. If this continues for a period of time, the core hypothesis, although not directly falsified, may be abandoned.[13]

In a *Zygon* article, Lindon Eaves gives some examples of hard-core hypotheses of both degenerative and progressive research programs.[14] Theories such as that the earth is flat and the world was created in six days may indeed appear to explain observed phenomena; however, they are degenerative because they do not lead fruitfully to new facts. Eaves writes, "indeed, the earth may be flat, but the theory does not produce many good experiments and has not produced much insight. Indeed, the world may have been created in six days, but there are few papers in scientific journals which describe experiments based on that theory. As Claude Bernard observed, 'Theories in science are not true or false. They are fertile or sterile'" (Eaves 1989, 195; the quotation by Bernard is from Eysenck 1965). One theory that has become the core of a progressive research program is the double-helix model of DNA. Eaves calls this kind of theory an "icon"—a part of reality that serves as a window to a much more extensive picture of reality.

> The place of the double helix in biology provides a model system for the interaction between model and matter, the icon, in science. Molecular genetics is unlikely to revise the DNA icon because it has played such a crucial part in making biology a "hard" science. . . . Once James Watson and Francis Crick had "got it right," DNA became the unifying feature which gave coherence to the facts of reproduction, evolution, chromosome behavior, Mendelian inheritance, protein synthesis, mutational change, and other processes. Furthermore, the icon became the key to new horizons—the details of gene regulation and biotechnology. (Eaves 1989, 195–96; referring to Watson and Crick 1953, 737)

In other words, the Watson-Crick model of DNA has become a hard-core (or paradigm) theory of a progressive research program in biological science.

Can this kind of Lakatosian research program also be carried out in religion and theology? Some, including Philip Hefner (1993), Nancey Murphy (1990), and myself, think it can. My own version includes empirical justification in two senses: first, a more general pragmatic sense; second, a more specific sense that leads to what might be called scientific theology and that echoes positivist notions of verification from the middle of the twentieth century.

Let us begin with the more general, pragmatic sense of justification of religious ideas in living, both by individuals and by communities. Because theologians try to understand ways to human fulfillment, because they can empirically attempt to understand what in fact brings about a continuous succession of completed states of living with a growth in what individuals and communities can know and appreciate, and because fulfillment can be conceived partly in terms of what is accomplished in the course of human living here and now, in the final analysis religious research programs are carried out in the fullness of daily life and not only in carefully constructed situations in which experiments or controlled observations can be made. In other words, one justification of a theological concept is a general, pragmatic one of the concept's effectiveness in shaping behaviors that help people to ever-greater richness of experienced value.

This pragmatic form of justification need not conflict with the second, more limited but also helpful, method of justification that has much in common with that of scientific research programs. Yet even in this more restricted sense of justification, there is a difference between what the theologian can do and what most scientists do. Progressive scientific research programs are expected to yield new facts, but theological research programs are also expected to yield a growth in value. Both fertility of facts and fertility of values are criteria for the justification of the claims in what might be called *scientific theology.*

In seeking to understand what increases human fulfillment, one is seeking to understand the source of increasing value, which is one way a theologian can formally define an immanent God. One core hypothesis about the source of increasing value could be that it is a creative system. This core hypothesis is not directly falsifiable, because it is protected with a belt of auxiliary hypotheses generated in terms of the core, and because empirical testing is directed at the auxiliary hypotheses instead of the core. Examples of possible auxiliary hypotheses are: (1) the creative system of value is a two-stage system, one stage being the disruption of the status quo by the experience of new events, the second being a new integration of what formerly existed with the new events, that is, metaphorically speaking, death and rebirth; (2) a mechanism of disruption is seeking out values that are different from one's own, that is, loving the enemy; (3) a mechanism of integration is the deferring critical judgment as one tries out new possible integrating patterns of thought and behavior, that is, faith in things yet unseen. In making such hypotheses about an immanent God as a creative system, one might recognize that I have hypothesized that God is like the dance I have called the Darwinian two-step.[15] The auxiliary hypotheses propose that the Darwinian two-step is not only responsible for the evolution of life and the development of an individual's nervous system but that it also is possibly the source of increasing human value or human fulfillment.

Toward an Experimental Theology. Am I correct? How can we decide if my overall story, now clearly come to light as a Darwinian story, has any validity? Auxiliary hypotheses such as these can be operationally defined as sets of activities in which humans participate in controlled situations, say, a social-psychological experiment in interpersonal relationships and decision making involving small groups discussing a controversial moral or political issue. The objective of such an experiment would be to see the degree to which the valuing consciousness of each person in the experiment is increased or the sense of community among participants deepened as a result of the specific sets of activities. The situation can be controlled by having experimental and control groups that are equivalent in all significant respects except the auxiliary hypothesis to be tested. All groups might be asked to try to resolve the controversial problem; however, half the groups might be instructed to incorporate their opponent's values, regardless of whether they agree with them, into their own way of thinking, an operational definition of love your enemies; the other half, as the control group, would not be so instructed.[16]

The point of this would not be to actually resolve the moral or social problem but to see whether there is a difference between experimental and control groups, before and after the experiment, in the degree to which individual valuing consciousnesses are expanded and the sense of community deepened. A measurement of valuing consciousness expansion could be constructed by operationally defining (partly) this idea as the degree of appreciation for the ideas and values of those to whom members in each group are opposed. A measurement of the deepening of community could be constructed by operationally defining (partly) this idea as the degree of caring that people have for those holding opposing views. Such measurements could be made by constructing attitude scales for these two operational definitions, following the procedures of social psychologists. When this is done, one has defined values as facts to be observed and measured.[17]

That this kind of experiment can be designed suggests that theology, using methods of empirical justification in this more limited sense, can make use of studies of creativity in the social and natural sciences. Like

Eaves's DNA icon, hypotheses about the structure and conditions of the creative event can possibly unite work done in a number of fields, including social psychology, biology, and ecology. Using this work as a source of ideas to some extent already confirmed scientifically, if the creative event research program leads to new auxiliary hypotheses and new ways of observing increases in value, thereby increasing one's knowledge of an immanent God as the creative system of value, the program is progressive. If auxiliary hypotheses about the creative event do not bring to light how an increase in value occurs but some other core hypothesis and its auxiliaries do, then the hypotheses that define God as a creative system, while not directly falsified, should be abandoned in favor of more fruitful research programs.

In this manner concepts of God, including that of God as the creative set of processes of variation and selection, innovation and tradition, can be justified similarly to justification in science. Any hypotheses so justified can then be put into practice in daily living to see if they meet the pragmatic test of leading to greater value in real life. Together, the two methods of justification can help us resolve questions regarding the validity of our stories, even our theological stories about the nature and work of God.

Back to Tradition. What I have just presented as a way of justifying or validating theological ideas in religious stories is relatively new. It may appeal to those who are bio-culturally inclined to find innovations attractive. However, if what I have said about being responsive to both tradition and innovation is correct, then I also should indicate how my proposed theory of God as a system of creation compatible with the Darwinian two-step is also consistent with past theological thinking. Even scientists engaged in Lakatosian research programs expect that their new proposals will be consistent with previously justified theories; and theological theories about what is thought to be ultimate that have stood the test of history by pragmatically giving meaning and guidance for people's lives certainly have to be considered seriously.

Ideally, to illustrate this, a variety of the world's well-winnowed traditions should be considered. Simply as one example, I invite you to consider a part of the Christian tradition that seems to provide in its own terms metaphors suggesting that God is a two-phase process, one phase disturbing the status quo and generating new possibilities and the other phase selecting and ordering some of the possibilities into new, completed states of order. The two metaphors I am referring to are the Spirit of God and the Word of God.

There are four general ways that *ruach,* a Hebrew Bible word for *spirit*, is used: physically, physiologically, psychically, and supernaturally or extrahumanly (*Hastings Encyclopedia of Religion and Ethics*, s.v. "spirit").

It is thus associated with the wind in all its phases, with the breath of human beings, which is related to the life and energy of the body, with the emotional side of humans (particularly associated with special manifestations of human energy), and with the world of extrahuman agencies that act on humanity for good or ill. In most of these understandings of *ruach*, and also its New Testament counterpart *pneuma*, it seems that spirit is related to that kind of energy or force which on the one hand sustains life and on the other hand disturbs or moves in some manner an existing state of affairs to generate new possibilities. Thus it is compatible with scientific understandings of creation as involving initial variations in the status quo that constitute new possibilities for life or thought—the first step of the Darwinian two-step.

However, disturbances of existing states, creating new possible variations, are only the beginning of creative activity. What are needed to complete a particular instance of creation are selective structures that sort out the possibilities so that some continue while others are eliminated. At the most fundamental level of existence, these selective structures are the physical and chemical laws of nature. At the level of life, they are those requirements that, when met, allow for self-replication. Further requirements are selective structures for individual human development and criteria for sorting out possible ideas and practices. In the Christian tradition a general metaphor for such selective structures is the Word of God—the *logos*. In Greek, for such philosophers as the Stoics and neo-Platonists, *logos* signified not only word but also the reason of the universe. Thus, some Christian thinkers were able to interpret the Word of God, in the beginning with God and through whom all things were made, as the underlying order of the universe. The Word of God from the Christian story thus becomes a metaphor that is equivalent to the second step of the Darwinian two-step—natural selection. For the Word of God represents the underlying selective requirements that govern the evolution of the universe, so that when the Spirit blows where it wills, randomly creating new variations, new stable states that continue to exist and reproduce themselves are brought into being. Together Spirit and Word theologically symbolize the two-step activity—a Divine Dance that is the immanent ground of all becoming.

NOTES

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1. Following physicist Brian Swimme, philosopher John F. Haught argues that science today tells the story of a cosmic adventure (Haught 1990, 172–77). For one of the most recent developments of this see Swimme and Berry (1994). And a special issue of *Scientific American* collects sev-

eral pieces of contemporary scientific knowledge and theory about the evolutionary epic ("Life in the Universe" 1994).

2. This definition makes no claim to encompass all religious activity in human history; nonetheless, it is useful in looking at many of the world's religions.

3. However, Fromm's discussion of mature and other kinds of love is applied only to humans.

4. It is with considerable humility that I, a nonscientist, with my limited knowledge of the findings of neural science, attempt to construct even a partial scientific story on something as complex as the evolution of the human brain. Nevertheless, I think such attempts can be important examples of the kind of storytelling that today's religious thinkers should undertake in relation to the sciences, even if my attempt is incomplete and even though it may be flawed. In order to bring together the knowledge of the sciences and the insights of religions, we must attempt to enter into each others' worlds.

5. The power of the dance metaphor was first suggested to me by Arthur Peacocke (1979). Metaphors of dance and music allow one to deal with the dynamic aspect of evolving nature or with God as continuing creator more effectively than spatial metaphors or personal metaphors of God as craftsman or designer. Dance and music are temporal and hence allow us to capture irreversible processes involving chance and law in the context of story. Although it might at first seem mundane, the two-step dance metaphor seems to me to be a good way to capture what Donald Campbell (1977) refers to as the "decoupled" processes of variation and selection.

6. In mentioning "biological interests," I am taking my cue from Holmes Rolston, III, in environmental ethics (Rolston 1988). Although the term *interests* is meant by some to include only cognitive interests of which we are aware and by others to mean feeling states, I extend the term to include those biological processes interior to organisms that allow them to respond to their world. Such extension of the language becomes important when discussing the possible intrinsic value of micro-organisms and plants.

7. Today, when we encounter unexpected objects suddenly looming up in front of us, we still are likely, as were our ancestors, to withdraw; this illustrates another hardwired nervous system mechanism—the ducking response. However, the sensitivity to the vertical axis may also play a role in how we respond to tall buildings with more of a sense of awe and wonder than to flat horizontal structures; the building of Gothic cathedrals and church steeples may in part be due to this vertical sensibility.

8. This is analogous to "Oliver Selfridge's early Pandemonium architecture in Artificial Intelligence, in which many 'demons' vied for hegemony" (Dennett 1991, 189; Selfridge 1959).

9. Calvin's hypothesis that language and thought are by-products of evolutionary adaptations related to throwing is highly controversial among neural scientists. I present it here because, if true, it raises a major issue for theologians concerning the nature and work of God. From a theistic perspective, if Calvin's position is correct, how then might the work of God be intentional in creating humans with the biblical capability of naming and the associated capabilities of thoughtful analysis and synthesis?

10. For a discussion of some of the same material but perhaps with a different conclusion regarding when language originated, see Deacon (1990, 24–26).

11. The phrases in quotes intentionally refer to the titles of the books by Calvin (1990) and by Swimme and Berry (1994).

12. In his Gifford Lectures early in this century on the *Varieties of Religious Experience,* psychologist and philosopher William James discusses the gradual growth of the "one-born" in contrast to the sudden conversion of a divided self in becoming "twice-born" (James 1961).

13. See Lakatos (1978, 48–52) for his more detailed characterization of scientific research programs.

14. The core hypotheses are basically the same as Thomas Kuhn's *paradigms* (Kuhn 1970).

15. Primary sources for my thinking here are Ralph Wendell Burhoe, especially his essay "Natural Selection and God" (Burhoe 1981, 73–111), and Henry Nelson Wieman, especially his discussion of the "creative event" in *The Source of Human Good* (1946, 54–83). However, neither used the metaphor of dance, as I have done in this essay.

16. For more on the role of operational definitions in this kind of theology, see Peters (1976).

17. For a more complete description of such experiences in the context of moving from a more general empirical theology, exemplified by Wieman (1968, 1946), to a more scientific theology, see Peters (1971).

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