BEYOND REDUCTIONISM: REINVENTING THE SACRED

by Stuart Kauffman

Abstract. We have lived under the hegemony of the reductionistic scientific worldview since Galileo, Newton, and Laplace. In this view, the universe is meaningless, as Stephen Weinberg famously said, and organisms and a court of law are "nothing but" particles in morion. This scientific view is inadequate. Physicists are beginning to abandon reductionism in favor of emergence. Emergence, both epistemological and ontological, embraces the emergence of life and of agency. With agency comes meaning, value, and doing, beyond mere happenings. More organisms are conscious. None of this violates any laws of physics, but it cannot be reduced to physics. Emergence is real, and the tiger chasing the gazelle are real parts of the real universe.

We live, therefore, in an emergent universe. This emergence often is entirely unpredictable beforehand, from the evolution of novel functionalities in organisms to the evolution of the economy and human history. We are surrounded on all sides by a creativity that cannot even be prestated. Thus we have the first glimmerings of a new scientific worldview, beyond reductionism. In our universe emergence is real, and there is ceaseless, stunning creativity that has given rise to our biosphere, our humanity, and our history. We are partial co-creators of this emergent creativity.

It is our choice whether we use the God word. I believe it is wise to do so. God can be our shared name for the true creativity in the natural universe. Such a view invites a new sense of the sacred, as those aspects of the creativity in the universe that we deem worthy of holding sacred. We are not logically forced to this view. Yet a global civilization, hopefully persistently diverse and creative, is emerging. I believe we need a shared view of God, a fully natural God, to orient our lives. We need a shared view of the sacred that is open to slow evolution, because rigidity in our view of the sacred violates how our most precious values evolve and invites ethical hegemony. We need a shared global ethic beyond our materialism. I believe a sense of God as the natural, awesome creativity in the universe can help us construct the sacred and a global ethic to help shape the global civilization toward what we choose with the best of our limited wisdom.

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A great divide splits contemporary society between those who believe in a transcendent God and those, including myself, who do not. In the West, and now throughout the world, the massive advances of science since Galileo and Newton have given birth to secular society. In the Christian and Jewish segments of the Abrahamic religions, the theistic God who intervened in the affairs of the world gave way in the Enlightenment to a deistic God who wound up the universe, set the initial conditions, and allowed Newton's laws to carry on. This God no longer entered into the affairs of humanity. In the theistic tradition, God became either the God of the gaps, where science had yet to hold sway, or, contrary to science, God intervened in the running of the cosmos.

In the West, those who hold to a view of a theistic God, including the Christian fundamentalists of such power in the United States, find themselves in a cultural war with those who do not believe in a transcendent God, whether agnostic or atheistic. This war is evidenced by the fierce battle over Intelligent Design being waged politically and in the court systems of the United States. While the battleground is Darwinism, the deeply emotional issues are more fundamental. These include the belief of many religious people that without God's authority morality has no basis. For those in the West who hold to these views, part of the passion underlying religious conviction is the fear that the very foundations of Western society will tumble if faith in a transcendent God is not upheld.

A near majority of the Abrahamic peoples are Muslims. I know the Islamic world poorly, but I believe that their fundamentalism again in part lies in these moral issues. Beyond that, reductionism, wrought by the successes of Galileo, Newton, Einstein, Planck, and Schrödinger and all that has followed, preeminently in physics, has, as I will expand upon in a moment, left us in a world of fact—cold fact with no scientific place for value. "The more we know of the cosmos, the more meaningless it appears," said Steven Weinberg in *Dreams of a Final Theory* (1994). And just a few days ago, in a conversation with a humanist professor at the University of Pennsylvania, she astonished me with her account of how we are again a meaningless world in the postmodern worldview rampant in the North American humanities.

On the other side of this vast divide from those who hold to a transcendent God with authority for meaning and values are the innumerable secular humanists, children of the Enlightenment and contemporary science, who hold firmly to reality as revealed by science, find values in their love for their families and friends, a general sense of fairness, and a morality that needs no basis in God's word. Yet we secular humanists have paid an un-

spoken price for our firm sense that (reductionist) science tells us what is real. First, we have no well-wrought scientific basis for our humanity, despite the interesting fact that quantum mechanics on the Copenhagen interpretation assumes free-willed physicists who choose what quantum features to measure and thereby change the physical world. The two cultures, science and humanities, remain firmly un-united. Equally important, we have forfeited our deep capacity for spiritualism. We have come to believe that spirituality is inherently co-localized with a belief in God and that without such a belief spirituality is inherently foolish, questionable, without foundation, wishful thinking, silly. We also lack a global ethic to constitute the transnational mythic value structure that can sustain the emerging global civilization. We tend to believe in the value of democracy and the free market. We are largely reduced to consumers. Here it is telling that Kenneth Arrow, brilliant Nobel laureate in economics and friend, took part in a commission to "place a value" on preservation of national parks and was stymied in his attempt to find a way to calculate that value based on utility to citizens. Thus, even in our enjoyment of the wild we are reduced to consumers in our current *Weltanschauung*.

Two fine authors, Richard Dawkins and Daniel Dennett, have written recent books, *The God Delusion* (2006) and *Breaking the Spell* (2006), arguing against religion. Their views are based on contemporary science. But the largest convictions of contemporary science remain based on reductionism.

In this brief article I wish to discuss the first glimmerings of a new scientific worldview—beyond reductionism to emergence and radical creativity in the biosphere and human world. This emerging view finds a natural scientific place for value and ethics and places us as co-creators of the enormous web of emerging complexity that is the evolving biosphere and human economics and culture. In this scientific worldview, we can ask: Is it more astonishing that a God created all that exists in six days, or that the natural processes of the creative universe have yielded galaxies, chemistry, life, agency, meaning, value, consciousness, and culture without a Creator? In my mind and heart, the overwhelming answer is that the truth, as best we know it, that all arose with no Creator agent, all on its wondrous own, is so awesome and stunning that it is God enough for me and I hope much of humankind. Thus, beyond the new science that glimmers a new worldview, we have a new view of God, not as transcendent, not as an agent, but as the very creativity in the universe itself. This God brings with it a sense of oneness, unity, with all of life and our planet—it expands our consciousness and naturally seems to lead to an enhanced potential global ethic of wonder, awe, and responsibility within the bounded limits of our capacity for all of life and its home, Earth, and beyond as we explore the solar system.

Reductionism

Like any other worldview, reductionism is hard to pin down. The modern worldview of reductionism clearly grows from the success of modern physics but finds its roots in ancient Greek philosophy, that all is made of earth, air, fire, and water, or from atoms. Roughly, reductionism is the view that, as Nobel laureate Weinberg (1994) eloquently puts it, the "explanatory arrows always point downward," from society to small groups to individuals to organs to cells to chemistry to physics and ultimately to something like Weinberg's *Dreams of a Final Theory*—a single set of laws, elegant in their form, like General Relativity, which, in Weinberg's sense, explains all. A large majority of contemporary scientists are reductionists. If pressed, most would say that the behavior of complex wholes is nothing more than the laws governing the behaviors of the parts and their interactions. An example well known in physics is the purported successful reduction of classical thermodynamics to statistical mechanics. Here temperature is equated with the mean kinetic energy of particles, pressure with the energy transfer to bounding walls, and the famous second law of thermodynamics with a "flow" of an isolated thermodynamic system from less to more probable macro states. I have used the caveat "purported" because the reduction requires the truth of the "ergodic hypothesis," and there is some evidence that it might be false.

With reductionism comes the conviction that a court proceeding to try a man for murder is "really" nothing but the movement of atoms, electrons, and other particles in space, quantum and classical events, and ultimately to be explained by, say, string theory.

Beyond Reductionism

We begin with the growing doubt among many physicists that reductionism itself suffices. Nobel laureate Philip Anderson wrote a famous article, "More Is Different," some decades ago (1972), arguing that reductionism is wonderful but not enough. A computer computing a complex algorithm can be made of transistors or water buckets—it is able to run on multiple physical platforms. Hence reducing the computer to any particular physical basis is insufficient to explain the computer. The drift away from reductionism among physicists is most pronounced among solid state physicists, who deal with such things as metals, glasses, spin glasses, and systems with many "broken symmetries." Robert Laughlin, solid state physicist and Nobel laureate, argues strenuously against the full efficacy of reductionism in *A Different Universe* (2005).

The physicists who hold out for a firm reductionism are, like Weinberg, largely high energy particle physicists, seeking that final theory—say, string theory. But it is precisely in the province of string theory that doubts are arising. The early hope was that a single string theory would be found that would explain quantum gravity and all the known particles and forces.

Such a single theory would be the answer to Weinberg's dream of a final theory. But at present, it appears that there are as many as 10^{500} string theories. Hope for a single one is fast fading, and a number of high energy physicists are abandoning reductionism in the sense of finding such a single theory. Leonard Susskind, in *The Cosmic Landscape* (2006), suggests a multiverse of "pocket universes," each with a randomly chosen string theory, and a landscape over these pocket universes with respect to those whose laws are life-friendly. As a critical side note, part of Susskind's move is an attempt to explain the roughly twenty-three physical constants in physics, such as the speed of light, the ratio of electron to proton mass, and so on. No one knows where these constants come from or how to explain them. Weinberg himself uttered the *A* word—anthropic. According to this idea, there are many universes, and only those with constants that support the evolution of intelligent life would have such life to wonder at the values of the constants.

In short, many but not all physicists are giving up on the adequacy of reductionism alone as a scientific principle to explain the properties of the world. In its stead a new scientific worldview is arising: emergence.

Emergence

Roughly speaking, emergence breaks into two subviews—epistemological and ontological emergence. The former says that complex systems are too complex to be explained by reductionistic practices but that ontologically, reductionism holds. The ontological view is that new entities with their own properties and causal powers arise and are part of the furniture of the universe. I hold strongly to this latter view and present a number of cases that appear to support it.

The Origin of Life and Its Nonreducibility to Physics. We do not know how or where life started, although most scientists believe that life started on earth some 3.8 billion years ago, shortly after the planet cooled enough for liquid water to form. As an alternative, life might have started elsewhere and arrived here through space, Crick's panspermia concept.

There are several alternative views about how life emerged on earth, none established. In short summary, the first view notes the remarkable properties of the DNA and RNA double helix. This view hopes that a single strand of RNA can serve as a template primer to add A, U, C, and G nucleotides to Watson Crick match those of the template and be ligated into proper 3'-5' phosophodiester bonds to replicate the template, then the two strands melt apart, and cycle again. Forty years of hard work have not succeeded, for good chemical reasons. Most now doubt that life started this way.

The second view is the "RNA World" view. It was discovered that RNA molecules not only can carry genetic information but also can act as enzymes, speeding chemical reactions. Work is underway to create an RNA

enzyme, or "ribozyme," that can copy any RNA molecule including itself. The probability that an RNA molecule can catalyze a given reaction is roughly 10 divided by 10^{15}. It is conceivable that such a molecule can arise by chance, but it faces the difficulty that were it to copy itself and make errors, those error copies would be more error-prone than the initial copy and a runaway error catastrophe might ensue. In short, such a molecule might not be stable in evolution.

The third view is the "lipid" view, in which hollow spheres of bilayered lipids, called liposomes, can grow and divide. This has been demonstrated experimentally. It may plausibly be part of the origin of life.

The fourth view is my own and that of Freeman Dyson, and may also be part of the origin of life. I noted that cellular life is based on collective autocatalysis, where catalysis is the speeding up of a chemical reaction. Imagine two polymers, A and B, where each catalyzes the formation of the other out of fragments of the other. That is collective autocatalysis. No molecule catalyzes its own formation; rather, the set as a whole is collectively autocatalytic and achieves catalytic closure. Cells are collectively autocatalytic today. Reza Ghadiri has made collectively autocatalytic small protein systems, and Gunter von Kiederowski has made collectively autocatalytic DNA systems. Thus, self-reproduction of polymers has been achieved experimentally by good chemists in a lab. My own theory starts with stating this as a possibility, then goes on to ask whether, in a large set of polymers that can act as substrates and products of reactions and also act as catalysts of those very reactions, one would expect such autocatalytic sets to arise "spontaneously." Strikingly, the answer can be yes, depending on the ratio of reactions among the polymers in the system to the polymer diversity itself and the distribution of catalytic capacities for those reactions among the same set of polymers. In simple models, as the diversity of polymers increases, so many reactions are catalyzed that autocatalytic sets form spontaneously with high probability. This theory remains to be tested, but can by use of libraries of random RNA and proteins.

The fifth view is "metabolism first." Harold Morowitz believes that metabolism can form autocatalytic cycles on its own—and indeed it does—and that metabolism and autocatalysis arose first.

Clearly none of these theories is adequate. But one gets the firm sense that science is moving in on possible routes to the origin of life on earth. If some combination of the metabolism, polymer autocatalysis, and lipid-first view can be formulated and tested in a new "systems chemistry," we may find the answers we seek.

Suppose we do. It will be a scientific triumph, of course. But if such self-reproducing and, via heritable variations, evolving, systems are formed, are they ontologically emergent with respect to physics? I believe that the answer is yes. Darwin taught us about natural selection and evolution. He did not know the basis for self-reproduction or heritable variation. But,

given these, evolution by natural selection follows. Such evolving life forms would be subject to Darwin's law, which arises only for entities capable of self-reproduction and heritable variation. This seems clearly to be ontological emergence, not reducible to physics. Like Anderson's computer able to run on transistors or buckets of water, Darwin's natural selection can run on multiple physical platforms, where the entities under selection have their own causal powers, and natural selection cannot be reduced to any specific physical platform. Indeed, it is possible that minor changes in the constants of the physicists would still yield universes in which life, heritable variation, and natural selection would obtain. Note that while the physicist might deduce that a specific set of molecules was self-reproducing and had heritable variations and instantiated natural selection, one cannot deduce natural selection from the specific physics of any specific case(s), or even this universe, alone. In short, Darwin's natural selection is a new law operating on the level of self-reproducing entities with heritable variation, regardless of the physical underpinning. In contrast to Weinberg's claim, here the explanatory arrows point upward from molecules to the evolution of living systems of molecules via natural selection.

Agency. You are now reading this article, presumably on purpose. You are able to act on your own behalf. You are the clearest example we have of agency. It is utterly remarkable that agency has arisen in the universe—systems that are able to act on their own behalf; systems that modify the universe on their own behalf. Out of agency comes value and meaning. This article either is or is not interesting to you, hence is or is not valuable. It may change your worldview, hence, have deep meaning.

It becomes interesting to ask what the minimal physical system is that can act as an agent. In my *Investigations* (2000) I sought to answer this by proposing that a minimal molecular agent is a system that can reproduce itself and carry out at least one work cycle in the thermodynamic sense. I will not go into the ramifications of this, which are puzzling and I hope important. On this account, a bacterium swimming up a glucose gradient and performing work cycles is an agent, and glucose has value and meaning for the bacterium without assuming consciousness. Of course it is natural selection that has achieved this coupling. But teleological language has to start somewhere, and I am willing to place it at the start of life. Either here, or later in the evolutionary pathways, meaning and value arise in the biosphere. They too are ontologically emergent. We have a natural place for value in a world of fact, for the world is not just fact; agents *act* on the world, and actions are not just facts, for the action itself is a subset of the causal consequences of what occurs during an act, and that relevant subset cannot be deduced from physics.

We Are, in Fact, Conscious. We have experiences of the world. The philosophers call these *qualia*. For years, philosophers of mind have tried

to argue that such experiences are "ghosts in the machine." This is just false. We are, in fact, conscious. Whatever explains consciousness, it is clearly ontologically emergent.

There are three radically different views on the cause of consciousness, none known to be true. The first, in the West, is that mind derives from direct connection to the mind of God—St. Augustine's view, and, to my astonishment, not far from that of Erwin Schrödinger, one of the inventors of quantum mechanics. In Tibetan Buddhism, consciousness is continuous and thus underwrites reincarnation.

The second view, predominant among cognitive scientists, is that consciousness arises when enough computational elements are networked together. In this view, a mind is a machine, and a complex set of buckets of water pouring water into one another would become conscious. I just cannot believe this. I cannot disprove it, but I can offer arguments against it. On this view, the mind is algorithmic. With Roger Penrose, in *The Emperor's New Mind* ([1989] 2002), I believe that the mind is not algorithmic, although it can act algorithmically. If it is not algorithmic, the mind is not a machine and consciousness may not arise in a classical—as opposed to possibly a quantum—system. Penrose bases his argument on the claim that in seeking a proof a mathematician does not follow an algorithm himself. I think he is right, but the example is not felicitous, for the proof itself is patently an algorithm, and how do we know that the mathematician did not subconsciously follow that algorithm in finding the proof? My arguments start from humbler conditions. Years ago my computer sat on my front table, plugged into a floor socket. I feared that my family would bump into the cord and pull the computer off the table, breaking it. I now describe the table: three feet by five feet, three wooden boards on top, legs with certain carvings, chipped paint with the wood surface showing through with indefinitely many distances between points on the chipped flecks, two cracks, one crack seven feet from the fireplace, eleven feet from the kitchen, 365,000 miles from the moon, a broken leaf on the mid board of the top. . . . You get the idea that there is no finite description of the table, assuming for example continuous spacetime. I invented a solution: I jammed the cord into one of the cracks and pulled it tight so that my family would not be able to pull the computer off the table. Now, it seems to me that there is no way to turn this Herculean mental performance into an algorithm. How would one bound the features of the situation finitely? How would one even list the features of the table in an infinite list? One cannot. Thus it seems to me that no algorithm was performed. As a broader case, we are all familiar with struggling to formulate a problem. Do you remotely think that your struggle is an effective mechanical or algorithmic procedure? I do not. I also do not know how to prove that a given performance is not algorithmic. What would count as such a proof? So I must leave my conviction with you—unproven but powerful, I think. If true, the mind is not a machine.

The third view of mind and consciousness, which I tentatively favor, is that it is related to quantum behavior. The standard physicist's answer is that quantum effects cannot occur at body temperature. Indeed, Schrödinger says this, then says of consciousness, "I am become God." However, recent theorems in quantum computing and facts about cells cast doubt on this conclusion. The theorems show that, if measurements are made and work is done on a quantum computer, its qubits can remain "quantum coherent" when they should "decohere" toward classical behavior. Thus, if work is done on a system, parts of it may remain quantum coherent at body temperature in principle. But cells do thermodynamic work and might be able to carry out such measurements and work to maintain some variables quantum coherent. Second, cells are crowded by proteins and other molecules, and the water between these molecules is largely ordered, not like an ordinary liquid. This may permit quantum coherence physically in cells. No one knows. It seems worth investigation in its own right. Meanwhile, my approximate theory is that mind is acausal, that quantum mechanics is acausal on the familiar Born interpretation of the Schrödinger equation (to the grief of Einstein), that consciousness is due to a special state where a system is persistently poised between quantum and classical behavior, that the emergence of classical behavior in the mind-brain system, perhaps by decoherence, is the mind making something actual happen in the physical world, and—big jump—that consciousness itself consists in this quantum coherent state as lived by the organism. This is a long jump, but not impossible. I don't even think it is more stupid than other theories of consciousness, and it may be true. Whatever the case, consciousness is ontologically emergent in this universe.

Ceaseless Unpredictable Creativity

The further astonishing theme that is emerging in this new worldview is that the biosphere and human culture are ceaselessly creative in ways that are fundamentally unpredictable and presumably non-algorithmic or machinelike.

I begin with Darwinian adaptations and preadaptations. Asked what the function of the heart is, Darwin would have replied, "To pump blood." That is, the causal consequence of the heart, by virtue of which it was selected by natural selection, is pumping blood. But the heart also makes heart sounds. These are not the function of the heart. Thus, the function of the heart is a subset of its causal consequences and must be analyzed in the context of the whole organism in its selective environment. Again, this says that biology cannot be reduced to physics, for while the string theorist might (actually could not) deduce all the properties of a given heart, he/she would have no way to pick out as the relevant property that of pumping blood. But it is that property that accounts for the existence of hearts in the biosphere.

Now, a Darwinian preadaptation is a causal consequence of a part of an organism of no selective significance in the normal environment but that might be of use in some odd environment and hence become the subject of natural selection. Here the organ was "preadapted" for this *novel* function in the biosphere. A fanciful example concerns the squirrel Gertrude, who happened to have a single Mendelian dominant mutant that gave her flaps of skin from front to back legs on both sides. (Darwinian preadaptations need not rely on new mutations in general, but I use them for my friend Gertrude, who lived 65,394,003 years ago in Guatemala.) Gertrude was so ugly that the rest of the squirrels would not play or eat with her. She was in a magnolia tree eating lunch sadly and alone when Bertha, an early owl in a neighboring pine, spied Gertrude, thought "Lunch," and dived toward Gertrude, horrid claws extended. Gertrude was terrified. Suddenly she jumped from the tree, arms and legs flung wide. "Ghaaaa!" cried Gertrude, then looked, incredulous, as she *flew*. And she escaped the befuddled Bertha. Well, Gertrude became a heroine in her clan, was married in a lovely civil ceremony to a handsome squirrel not a month later, and, thanks to her dominant mutation, all of their offspring had similar flaps of skin. And that is how flying squirrels came to exist in the biosphere.

It is critical that virtually any extant feature of an organism can become the subject of natural selection in the appropriate environment, and typically, if selected, a novel functionality arises in the biosphere and universe. Now the critical question: Do you think you could say ahead of time, or finitely prestate, all possible Darwinian preadaptations of, say, species alive now, or even humans? I have not found anyone who thought the answer was yes. I do not know how to prove my claim that the answer is no, but part of the problem is that we cannot finitely prestate the relevant features of all possible selective environments for all organisms with respect to all their features. But the failure to prestate the possible preadaptations is not slowing down the evolution of the biosphere, where preadaptations are widely known. Thus, ever novel functionalities come to exist and proliferate in the biosphere. The fact that we cannot prestate them is essential, and an essential limitation to the way Newton taught us to do science: Prestate the relevant variables, the forces acting among them, and the initial and boundary conditions, and calculate the future evolution of the system, say of a projectile. But we cannot prestate the relevant causal features of organisms in the biosphere. We do not know now the relevant variables! Thus we cannot write down a set of equations for the temporal evolution of these variables. We are profoundly precluded from the Newtonian move. In short, the evolution of the biosphere is radically unknowable, not because of quantum throws of the dice or deterministic chaos but because we cannot prestate the macroscopic relevant features of organisms and environments that will lead to the emergence of novel functions in the biosphere with their own causal properties that in turn alter the future evolution

of the biosphere. Thus, the evolution of the biosphere is radically creative, ceaselessly creative, in way that cannot be foretold.

I believe this fact shows that the evolution of the biosphere is nonalgorithmic. It cannot be simulated, certainly with continuous spacetime and quantum mechanics playing a role.

The same Darwinian preadaptations occur in the evolution of the economy. The story concerns engineers trying to invent the tractor. They would need a massive engine block. They tried it on chassis after chassis, all of which broke. Finally one of the engineers said, "The engine block itself is so massive and *rigid* that we can use the engine block itself as the chassis." And that is how tractors are made. Now, the rigidity of the tractor was a Darwinian preadaptation, a causal feature useful for a new function. Its discovery was a true invention. But this means that the technological evolution of the econosphere is also not finitely prestatable or presumably algorithmic. It too is ceaselessly creative, expanding from some one thousand goods and services say fifty thousand years ago to perhaps ten billion today.

And human culture, in general, is ceaselessly creative as the biosphere and culture expand into what I call the Adjacent Possible. The point is that at levels of complexity above the atom, the universe has not had time to make all possible complex objects, such as all proteins length 200. The universe, at these levels of complexity, is on a unique trajectory. When my friend Gertrude flew, she changed the material and behavioral features of the evolving universe. So did Picasso.

In short, in wondrous ways, these our universe, biosphere, econosphere, and culture are ceaselessly creative and emergent. The two cultures, science and humanities, stand united in this worldview. Meaning and value have a scientific base. And ethics? At a recent meeting on science and religion on Star Island, we heard more than one lecture on animal emotions and the sense of fairness in chimpanzees. Group selection, we were told, is now making its way into evolutionary biology. With it, natural selection can get its grip on behaviors that are advantageous to the group, like fairness, so it emerges. Far from evolution being anathema to ethics, evolution is the first source of human morality—but not the last, for we can argue whether we should want what we want.

God and a Global Ethic

God is the most powerful symbol we have created. The Spaniards in the New World built their churches on the holy sites of those they vanquished. Notre Dame sits on a Druid holy site. Shall we use the God word? It is our choice. Mine is a tentative yes. I want *God* to mean the vast ceaseless creativity of the only universe we know of, ours. What do we gain by using the God word? I suspect a great deal, for the word carries with it awe and reverence. If we can transfer that awe and reverence from the transcendental Abrahamic God of my Israelite tribe long ago to the stunning reality

that confronts us, we will grant permission for a renewed spirituality, and awe, reverence, and responsibility for all that lives, for the planet.

Does one know that such a transformation of human sensibilities will happen? Of course not. But the sense of justice matured in the Abrahamic tradition from ten eyes for an eye, to an eye for an eye, to Love thine enemy as thyself. Then can a heightened consciousness bring about a global ethic? I believe so. I believe, I hope correctly, that what I have sketched above is true, points to a new vision of our co-creating reality, that it invites precisely an enhancement of our sense of spirituality, reverence, wonder, and responsibility, and can form the basis of a transnational mythic structure for an emerging global civilization.

Coevolving Traditions

To ever succeed, this new view needs to be soft spoken. You see, we can say, Here is reality; is it not worthy of stunned wonder? What more could we want of a God? Yes, we give up a God who intervenes on our behalf. We give up heaven and hell. But we gain ourselves, responsibility, and maturity of spirit. I know that saying that ethics derives from evolution undercuts the authority of God as its source. But do we need such a God now? I think not. Nor do we need the spiritual wasteland that postmodernism has brought us. Beyond my admired friend Kenneth Arrow, natural parks are valuable because life is valuable on its own, a wonder of emergence, evolution, and creativity. Reality is truly stunning.

So if you find this useful, let us go forth, as was said long ago, and invite consideration by others of this new vision of reality. With it, let us recreate spiritual community and membership. Let us go forth. Civilization needs to be changed.

Note

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References

Anderson, Philip. 1972. "More Is Different." *Science* 177:393–96.
Dawkins, Richard. 2006. *The God Delusion*. Boston: Houghton Mifflin.
Dennett, Daniel. 2006. *Breaking the Spell: Religion as a Natural Phenomenon*. New York: Viking Adult.
Kauffman, Stuart. 2000. *Investigations*. Oxford: Oxford University Press.
Laughlin, Robert. 2005. *A Different Universe: Reinventing Physics from the Bottom Down*. New York: Basic Books.
Penrose, Roger. [1989] 2002. *The Emperor's New Mind*. Oxford: Oxford Univ. Press.
Susskind, Leonard. 2006. *The Cosmic Landscape: String Theory and the Illusion of Intelligent Design*. New York: Little, Brown.
Weinberg, Steven. 1994. *Dreams of a Final Theory*. New York: Vintage.