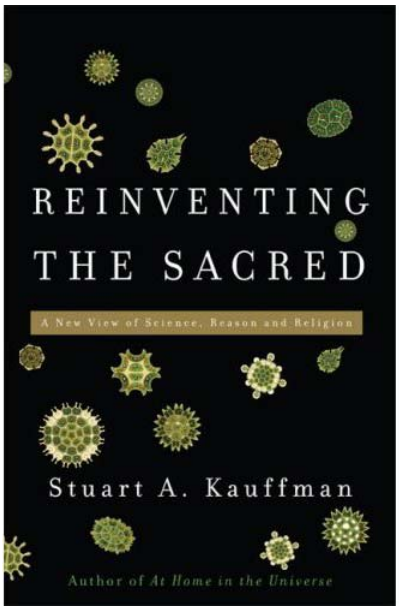
Book Review



Stuart A. Kauffman

Reinventing the Sacred:
A New View of Science, Reason, and Religion

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> Since Darwin's time almost all biologists have felt that selection is the sole source of order in biology. But a growing number of scholars are suggesting that even the abiotic world exhibits astonishing self-organization.... [Kauffman's] theory of autocatalytic sets is an example at the dawn of life itself: complex polymer systems may spontaneously organize into collectively autocatalytic self-reproducing systems. Self-organization may require that we rethink all of evolutionary theory, for the order seen in evolution may not be the sole result of natural selection but of some new marriage of contingency, selection, and self-organization. (60)

In 1999 I published an article titled "The physics of interactionism",[1] in which I argued that if there is a causally efficacious non-material mind, this must necessarily cause

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[1] *Journal of Consciousness Studies* 6 (8–9), 165–184; reprinted in *The Volitional Brain*, edited by B. Libet, A. Freeman, and K. Sutherland (Imprint Academic, 1999).

departures from the "normal," physically determined behavior of matter, quantum indeterminacy notwithstanding. *Reinventing the Sacred* made me realize that a genuine (non-compatibilist) free will does *not* require departures from, or violations of, the laws of inanimate matter. It transcends them. It is entirely beyond their reach. In other words, I was still laboring under the Galilean spell.

Not only does Kauffman dare to think outside the Darwinian box, he even dares to think outside the Galilean box. He calls it "breaking the Galilean spell." To labor under the Galilean spell is to believe that all that happens in the universe is governed by natural law. Kauffman adopts as his definition of "natural law" one that was formulated by Nobel laureate physicist Murray Gell-Mann: a natural law is a compressed/compact description, available beforehand, of the regularities of a phenomenon/process. Thankfully, he does not think of a natural law as the description of a mechanisms or processes *effectuating* the regularities, as so many do.

> My claim is not simply that we lack sufficient knowledge or wisdom to predict the future evolution of the biosphere, economy, or human culture. It is that these things are *inherently* beyond prediction. Not even the most powerful computer imaginable can make a compact description in advance of the regularities of these processes. There is no such description beforehand. Thus the very concept of a natural law is inadequate for much of reality. (5–6)

> Science itself is more limited by the un-prestatable, unpredictable creativity in the universe than we have realized, and, in any case, science is not the only path to knowledge and understanding. (7)

That's music to my ears. How does Kauffman arrives at these conclusions?

> [L]et us grant, for the sake of discussion, that the physicist could deduce all the features of the heart from string theory. Then what? The physicist would deduce virtually *all* the properties of my heart. She would then have no way whatsoever to pick out, from the entire set of the heart's properties, the pumping of blood as the causal feature that constitutes its function. (34)

The function of a part of an organism such as the heart is typically a subset of its causal features. Making thumping sounds is one such feature of the heart, pumping blood is another, and there are more. An organ's function therefore cannot be understood by even the most complete analysis of its physical constitution and the causal features that can be deduced from it. It cannot be understood "except in the context of its entire life cycle in its selective environment, and in the context of the selective history underlying its evolution."

Could a physicist predict the evolution of the biosphere?

> One approach would be, following Newton, to write down the equations for the evolution of the biosphere and solve them. This cannot be done. We cannot say ahead of time what novel functionalities will arise in the biosphere. Thus we do not know what variables — lungs, wings, etc. — to put into our equations. The Newtonian scientific framework where we can prestate the variables, the laws among the variables, and the initial and boundary conditions, and then compute the forward behavior of the system, cannot help us predict future states of the biosphere. (36–37)

Is this merely an epistemological problem? Kauffman's reply — an emphatic No —

is backed by the occurrence of "Darwinian preadaptations," by which he means more or less the same as Gould and Lewontin do by "exaptations."

> [A]n organ, say the heart, could have causal features that were not the *function* of the organ and had no selective significance in its normal environment. But in a different environment, one of those causal features might come to have selective significance. By "preadapted" Darwin meant that an incidental feature with no selective significance in one environment might turn out to have selective significance in another environment.... Preadaptations are abundant in biological evolution. When one occurs, typically, a *novel functionality comes into existence in the biosphere* — and thus the universe. The classic example concerns swim bladders in fish. (131–132)

To predict the evolution of the biosphere, we would have to "prestate, or specify ahead of time, all possible preadaptations," and "to do so we would have to prestate all possible selective environments." But this means we cannot follow Newton's mandate in the evolution of the biosphere

> for the very deep reason that we do not know all the relevant variables beforehand. While we know the billiard balls on the table and the table with its boundaries, we do not know beforehand about swim bladders.... But if we cannot prestate, let alone predict, Darwinian preadaptations before they occur, and yet they occur, then we can have no law, in Gell-Mann's sense of a law, for the evolution of the biosphere by Darwinian preadaptations.... Then Darwinian preadaptations are literally partially lawless, though not in the sense that laws of physics are violated.... Darwinian preadaptations are not sufficiently covered by any natural law. Laws do still apply and are constraints. (133–134)

Laws are merely *constraints* on "the ceaseless creativity of the biosphere."

> Thus the heart is both epistemologically and ontologically emergent. It is epistemologically emergent because we cannot deduce it from physics alone. It is ontologically emergent because the very existence of its specific organization of structures and processes ... was assembled by heritable variation and natural selection, which cannot be reduced to physics. (p. 86)

Hence natural selection is "epistemologically and ontologically emergent" — and so is "the attribution of functions to parts of organisms as due to natural selection." What else is epistemologically and ontologically emergent? For one, agency. "In physics, there are only happenings, no doings. Agency has emerged in evolution and cannot be deduced by physics."

Kauffman reminds us that computation cannot be reduced to physics: a computer's ability to compute does not depend on its particular hardware. By the same token, natural selection does not depend on the physical constitution of biological species or the physics of heritable variations (about which Darwin knew zilch):

> natural selection transcends any specific physical realization of it.... Since natural selection can 'run' on many physical realizations of life, it cannot be reduced to anyone of them.... Darwin's idea stands on its own as a statistical "law" that applies wherever there are restricted resources and descent with heritable variations. It does not need physics to be understood. (41)

Likewise, agency or doing does not depend on the platform on which it is realized, and therefore cannot be reduced to any specific platform. In other words, teleological language cannot be reduced to the language of physics: "teleological language, the lan-

guage of agency, cannot be eliminated and replaced by a physical account of events. Teleological language is beyond reductionism."

At what point in the evolution of life does teleological language become appropriate? Kauffman considers a bacterium swimming up a glucose gradient. To be able to fulfill the biological function of obtaining food, it needs at least one receptor for glucose. It must have the capacity to detect the glucose gradient.

> Without attributing consciousness to the bacterium, we can see in this capacity the evolutionary onset of choice and thus of meaning, value, doing and purpose.... [T]he bacterium detects a local glucose gradient, which is a sign of more glucose in some direction. By altering its behavior and swimming up the gradient, the bacterium is interpreting the sign.... With agency, with the bacterium swimming up the glucose gradient, values enter. Once this is true, meaning and "ought" enter the universe. To say it simply, in order to get the glucose, the bacterium "ought" to swim up the glucose gradient. (86–87)

At this point my enthusiasm for Kauffman's "new scientific worldview" vanished in a puff of smoke. Does he actually believe that without consciousness there can be *choice*, *meaning*, *value*, *doing*, *purpose*, or *interpreting* in any but the shallowest metaphorical sense? Whom is he trying to fool by declaring that "this agency-borne 'ought'" is not reducible to "the language of bare facts"? It is one thing to argue with Wittgenstein that "we cannot deduce algorithmically the language game of law and guilt from the language game about intentional human actions," as almost all philosophers agree. It is quite another to pretend that a bacterium swimming up a glucose gradient has anything to do with an "ought."

On the one hand, Kauffman promises his readers "to demonstrate the inadequacy of reductionism." On the other, he thinks that "we can define agency as the uniting of molecular reproduction with work cycles." What is that if not reductionism? Molecular reproduction and work cycles may well be necessary for agency, but that's a long way from being sufficient for it.

What, then, does Kauffman mean by "reductionism"? In the Preface we learn that "the heart of reductionism" is the belief that "all that happens in the universe is governed by natural law." In addition, "[r]eductionism teaches us that, at its base, the real world we live in is a world of fact without values." (8) So far so good. But then we are told that "[f]or the reductionist, only particles in motion are ontologically real entities" (3): "the most important part of reductionism" is that the world is "nothing but particles in motion." (16) In actual fact, there are few if any theoretical physicists who believe that all there is to the world is particles in motion. Kauffman seems to be setting up a straw man. In fairness, however, I must say that many of his arguments are intended to refute the kind of physicalism that rules out (ontological) emergence, and that, as far as I can tell, they succeed — as do his arguments against the naturalism that holds that all that happens in the universe is governed by natural law.

But then again, what is meant by "emergence"? Consider the handedness of biological sugar molecules. Mirror symmetry is "broken" by them in one of two *a priori* possible ways. Kauffman regards this broken symmetry as an "emergent phenomenon" because it "is literally a fact of life" — neither in violation of nor predictable by physical laws. This is playing with words.

If natural laws describe the regularities of a phenomenon or a process, then the phenomenon or process does not violate any natural law (assuming that all natural laws are mutually consistent) but at the same time its *existence* cannot be predicted by the natural law describing its regularities, for the simple reason that a law that describes *presupposes* the existence of that which it describes. Can one say that the phenomena or processes whose regularities are described by natural laws, and whose existence neither violates nor is implied by natural laws, are *emergent*?

If a phenomenon is what the word originally meant, it presupposes conscious experience, and in this case natural laws describe regularities in conscious experience. They *presuppose* conscious experience and therefore they cannot *account* for it. Is this the reason why we think that conscious experience is emergent?

Whatever else a natural law may be, it is first of all a mental or rational construct. As such, a natural law *presupposes* mind or reason and therefore cannot *account* for its existence. Is this the reason why we think of mind or reason as emergent?

As a mental construct, a natural law has meaning. It *refers* to something, namely a phenomenon, a process, or a certain regularity in experience. A natural law therefore *presupposes* meaning. As a consequence, it cannot *account* for meaning. Is this the reason why we think that meaning is emergent?

Whatever else truth may be, it is — like beauty and good — a value *par excellence*. Since science's chief concern is to make statements of natural laws that are true in *some* sense, science presupposes truth and thus, along with it, value. But if it presupposes value it cannot account for it. Is this the reason why we tend to think that value is emergent?

What puts us in a position to make true statements of natural laws is the experimental method. Such statements often take the form of a conditional: if this happens or is the case then — all relevant "other things" being equal — that happens or is the case. How could we discover or verify a natural law (to the extent verification is possible) if we could not reproduce identical conditions and the relevant "other things"? And how could we do this if we were not agents? In sum, science presupposes agency and therefore it cannot account for it. Is this the reason why we think that agency is emergent?

So could it be that Kauffman is putting the cart in front of the horse? That agency, value, meaning, reason, and conscious experience all existed *before* the universe came into being? That it was the material world that emerged — the part that conforms to natural laws as well as the part that doesn't?

One thing is certain: reality is confusing, and Kauffman is duly confused. I mean this to be a compliment. The more we learn about the world, the more confused we get. We now know, thanks to Kauffman, that science cannot foretell the evolution of the biosphere: "At levels of complexity above atoms, the universe is on a pathway, or trajectory, that will never repeat." *A fortiori*, science cannot foretell the evolution of human culture, technology, history, or the economy. No natural law suffices to describe these things. They are not only emergent but radically unpredictable. "We cannot even prestate the possibilities that may arise, let alone predict the probabilities of their occurrence." And so Kauffman humbly concludes that "we appear

to lack an adequate theory of what we are looking at."

> Without sufficient law, without central direction, the biosphere literally constructs itself and evolves.... Such a self-organized, but partially lawless, set of coupled processes stands unrecognized, and thus unseen, right before our eyes. We appear to need a new conceptual framework to see and say this, then to understand and orient ourselves in our ever creative world. (6)

> [T]he human mind is a *meaning and doing organic system*. How the mind is able to generate the array of meanings and doings it does is beyond current theory.... The human mind, like a ghost ship, keeps slipping free of its computational moorings to sail where it will. It does so because it is nonalgorithmic. (187–188)

> Where, then, do meanings come from?... The mind makes meanings. It makes understandings. We do not yet know very well [?] how it does so.... If we cannot logically derive legal language from language about ordinary human actions, yet we can and do regularly come to understand legal meanings, how do we do so? In truth, we do not know how we do so. (193)

Kauffman is torn between these unsettling Socratic insights and his penchant for speculation. This may be part of the reason why his speculations are so tenuous, so lame. He opens the door to

> a worldview beyond reductionism, in which we are members of a universe of ceaseless creativity in which life, agency, meaning, value, consciousness, and the full richness of human action have emerged. (2)

But he doesn't enter. Despite his protestations, he cannot free himself from science's reductionistic shackles, and this leads to all manner of ambiguities and contradictions.

Consider his stance on origin-of-life research. He believes that "[w]e are likely to succeed in the next hundred years in creating not only molecular reproduction but life itself." What then is "life itself"? Rather than hazarding an answer, he submits that "it seems likely that we will create life by some reasonable definition sometime in the coming century." But what would count as a "reasonable definition," and who would decide which definition qualifies as reasonable? Is a reasonable definition of life even possible, given that "[t]wenty-five centuries after Socrates, Reason has once again led us to see the inadequacy of reason"?

Kauffman considers it "plausible that we will succeed in creating modestly complex self-reproducing chemical nonequilibrium reaction systems capable of heritable variation and natural selection." Are we then to understand that a "modestly complex self-reproducing chemical nonequilibrium reaction systems capable of heritable variation and natural selection" (MCSRCNERSCHVNS) amounts to a reasonable definition of life? Considering that he holds "life to be sacred," one should think not. What would be sacred about a MCSRCNERSCHVNS? But then he believes "at a minimum that it is scientifically plausible that life arose from nonlife," and this again suggests that the difference between "life itself" and a MCSRCNERSCHVNS eludes him. The following passage appears to confirm this:

> My own theory of collectively autocatalytic sets suggests that their formation is highly probable. The theory can now be tested. If correct, the routes to molecular reproduction may be much easier than we have imagined, and constitute a form of

> fully emergent, spontaneous self-organization of a chemical-reaction system. Such emergence would not be reducible to physics. And life, in the sense of molecular reproduction, would be expected, not incredibly improbable. If so, our view of life changes radically. Not only does life not need special intervention by a Creator God, it is a natural, emergent expression of the routine creativity of the universe. (58)

If life, *in the sense of molecular reproduction*, were indeed expected, this would change our view of life — life itself — only if the difference between molecular reproduction and life itself were negligible. But it isn't. Besides, there is nothing routine about the "miraculous creativity" of the universe, this "wondrous radical creativity" which is "stunning, awesome, and worthy of reverence." Nor is this the only contradiction in *Reinventing the Sacred*. On the first page Kauffman promises to "present a new view of a fully natural God and of the sacred, based on a new, emerging scientific worldview. This new worldview reaches further than science itself." How can a worldview be scientific *and* reach further than science?

Moreover, if God is fully natural, then *everything* is natural — there is nothing supernatural — and in this case the word "natural" is left without any particular meaning. Remember Russell's *bon mot* about idealists and materialists?

> Many idealists say that the object is really the subject, and many materialists say that the subject is really the object. They agree in thinking these two statements very different, while yet holding that subject and object are not different. (Bertrand Russell, *A History of Western Philosophy*, London: Allen and Unwin, 1946)

By the same token, if I were to say that nature is fully spiritual (while Kauffman is saying that God is fully natural), both Kauffman and I would be saying that the natural and the spiritual are not different, yet I would have in mind something very different from what Kauffman appears to have in mind. On the other hand, if everything is natural and yet "natural" carries a particular meaning, such as being subject to natural laws, then we are looking at a form of reductionism.

Kauffman makes several references to *underlying* physics, e.g., "an inability to deduce or infer the emergent higher-level phenomenon from underlying physics," or "another way to see the independence of Darwin's law from underlying physics." This chimes with his view that "[t]he creativity in nature is God enough," that "God is our chosen name for the ceaseless creativity in the natural universe," inasmuch as the creativity *in* nature presupposes nature and therefore cannot be the creativity to which nature, or the natural universe (is there another?), owes its existence. Kauffman in fact refers directly to "the emergent creativity in the universe."

I would reverse roles. Creativity existed before the universe emerged from it. The natural laws are *constraints*, precisely as Kauffman says. Creativity subjects itself to these constraints and thereby produces the material universe. It becomes the force that creates and maintains material forms and thereby sets the stage for the adventure of evolution. What we call evolution is its gradual (and sometimes fairly sudden) emergence from its self-imprisonment in what appears to be an unconscious mechanical force. Like a cosmic Houdini it breaks free, transcends its constraints, revels in a frenzy of creative imagination, regains consciousness, revels in a frenzy of creative speculation, wondering what it all means.

It is, in fact, eminently plausible that the well-established laws of physics — the Standard Model and General Relativity — are precisely the constraints needed to set the stage for the drama of evolution.[2] If this is the case, then the laws of physics are underlying *only in this particular sense*.

Quantum mechanics, the fundamental theoretical framework of contemporary physics, reveals more. As a mathematical formalism, it is simply a bunch of algorithms that serve to assign probabilities to the possible outcomes of measurements that may be made (or will be made, or could have been made) on the basis of actual measurement outcomes. One implication of this probability calculus is that everything is possible, in the sense that every conceivable measurement outcome has a probability greater than zero *unless* it violates a conservation law. Physicists therefore never have to explain how something is possible, let alone how something comes to pass. Nor does the quantum formalism let them get away with such an explanation should they feel the need to supply one. They only have to, and only can, explain why something is *not* possible, namely because it would violate a conservation law. If that doesn't tell us straightaway that the force at work in the world is an *omnipotent* force laboring under self-imposed constraints, then at least it shows that physics is entirely consistent with such a notion.[3]

Kauffman admits that "[w]e do not understand consciousness yet," that "[n]o one knows the basis of it." Could it not be that the reason why no one knows the basis of consciousness is that consciousness — a conscious creativity or a creative consciousness — *is* the basis? Kauffman would reject such a thesis on the same basis he rejects Intelligent Design.

> Its thesis is so overwhelming, if true, that it will require extraordinary evidence to support it, and Quine's holism in science thesis powerfully suggests that it is much less of a disruption to our entire understanding of the real world to invoke Darwinian preadaptations, not ID, to explain the flagellar rotary motor. (148)

What would actually be disrupted if we were to grant intelligence to a force (or whatever) capable of creating intelligence? As far as physics is concerned, nothing much, since all there is to it is a bunch of algorithms for assigning probabilities to possible measurement outcomes on the basis of actual ones. As far as chemistry is

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[2] U. Mohrhoff, Beyond Natural Selection and Intelligent Design: Sri Aurobindo's Theory of Evolution, *AntiMatters* 2 (2), 9–31; The Veil of Avidya, presented at the International Seminar on Understanding Consciousness: Recent Advances, The Ramakrishna Mission Institute of Culture, Kolkata, 18–20 January 2008; Inside the Spirit Matrix: A Contextualization of Contemporary Physics, presented at Approaches to Mind Sciences Emanating from Indian Culture, Delhi, January 27-29, 2007; Particles, consciousness, volition: a Vedantic vision, *AntiMatters* 1 (1), 23–53.

[3] Besides, the impossibility of accounting for the quantum-mechanical correlation laws — be it by postulating underlying processes or by transmogrifying mathematical relations into physical processes — is well known, even though some find it hard to accept. The reason for this impossibility might well be that the force at work in the universe is an omnipotent force. An explanation of the working of an omnipotent force would be a contradiction in terms.

concerned, nothing much, since it's supposed to be an extension or application of physics. As far as biology is concerned, nothing but the doctrine that the universe and all it contains results from a combination of blind necessity and blind chance. If ever there was an extraordinary claim, this is it. Why doesn't Kauffman apply the slogan that extraordinary claims require extraordinary evidence to *that* doctrine?

Kauffman states that "[r]eductionism has led to very powerful science. One has only to think of Einstein's general relativity and the current standard model in quantum physics, the twin pillars of twentieth century physics." While this may be true, it doesn't prove anything with regard to reductionism. Instead of assuming that matter is the ultimate reality, we may assume that the ultimate reality is Spirit — Spirit hiding itself from itself so as to be able to experience growth in knowledge and power, the excitement of conquest and discovery, the surprise of the unknown, the challenge of opposition, the triumph of victory — all those wonderful experiences that *you*, the infinite and immortal Spirit, can't have unless you forget, at least for a while, your omniscience and your omnipotence. And it may very well be, as I just indicated, that the Standard Model and General Relativity are the very preconditions of the possibility of such a cycle of involution and evolution.

Kauffman again: "Of course the heart is made of particles and not some mystical stuff. In this sense, reductionism works." Does it? Everything we can know about particles has to be inferred from correlations between measurement outcomes. But these correlations warrant the conclusion that if there is any mystical stuff, it is the particles themselves. Everyone of their properties is either *relational* (like position or momentum) or dynamical in the sense of being descriptive of their *interactions* (like the various types of charge). What can we *say* about a particle by itself? Nothing — nada. What *is* a particle? Something ineffable.[4]

Undeterred by the fact that no one understands consciousness or knows the basis of it, Kauffman proposes his own "prototheory," which "posits a nonmaterial quantum coherent mind that has consequences for the behavior of physical matter, res cogitans and res extensa united in one physical/biological theory." This is yet another instance of what philosopher David Chalmers has called the "law of minimization of mystery": "consciousness is mysterious and quantum mechanics is mysterious, so maybe the two mysteries have a common source".[5] Appealing to quantum mechanics in order to give a scientific explanation of some otherwise unaccountable phenomenon apparently serves as a sort of get-out-of-jail-free-card to be used on all occasions when one cannot come up with anything else, or anything better.

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[4] U. Mohrhoff, The world according to quantum mechanics, *Foundations of Physics* 32 (2), 217–254 (2002) ↗; This elusive objective existence, *International Journal of Quantum Information* 2 (2), 201–220 (2004) ↗; The Pondicherry interpretation of quantum mechanics: An overview, *PRAMANA–Journal of Physics* 64 (2), 171-185 (2005) ↗; Is the end in sight for theoretical pseudophysics?, in *New Topics in Quantum Physics Research*, edited by V. Krasnoholovets and F. Columbus (Nova Science, New York, 2006) ↗.

[5] David J. Chalmers, Facing up to the problem of consciousness, *Journal of Consciousness Studies* 2 (3), 200–219 (1995).

Kauffman aims to "reinvent the sacred as the creativity in nature — without requiring that all that happens is to our liking." He seems to believe that if there were a creative agent or force responsible for the existence of nature itself, then automatically all that happens would be to our liking. What a queer notion!

Equally peculiar is his hope that his view of "a fully natural God" as "the very creativity in the universe" "can be shared across all our religious traditions." A brute, unfeeling creativity without purpose or intelligence? Come on now! It takes a lot of ignorance of the true meaning of spirituality[6] and the sacred to have the nerve to propose such underwhelming substitutes and to believe that they can lead to "a global ethic to orient our lives, and our emerging global civilization."

[6] His idea of spirituality seems to be "the ancient Greek ideal of the good life, well lived."