

Are Naturalistic Theories of Emergence Compatible with Science?

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Complexity theorist Stuart Kauffman writes *Reinventing the Sacred: A New View of Science, Reason, and Religion* both as a defense of the theory of ontological emergence and as a denial of “the need for a Creator God.”¹ He is not alone—Philip Clayton, Jaegwon Kim, Arthur Peacocke, Loyal Rue, and William Wimsatt have each made leading contributions to what appears to be a growing philosophical school.² Kauffman aims to offer a naturalistic alternative to a reductionism that views all reality as reducible to moving particles in space.³ Advocates variously refer to this antireductionism as religious naturalism, the theory of emergence, emergentism, and

ABSTRACT: Complexity theorist Stuart Kauffman writes *Reinventing the Sacred: A New View of Science, Reason, and Religion* to defend ontological emergence and refute theism. He argues naturalistic emergentism is the preferable alternative to a naturalistic reductionism that views all reality as reducible to particles in motion. Among the central claims naturalistic emergentists make is that they have built their worldview on the firm foundations of science. In this paper I argue that naturalistic theories of ontological emergence are incompatible with the philosophical preconditions necessary for practicing science.

1. Stuart A. Kauffman, *Reinventing the Sacred: A New View of Science, Reason, and Religion* (New York: Basic Books, 2008), x.

2. Philip Clayton and Paul Davies, eds., *The Re-Emergence of Emergence: The Emergentist Hypothesis from Science to Religion* (New York: Oxford University Press, 2008); Jaegwon Kim, “Making Sense of Emergence,” *Philosophical Studies* 95 (1999): 3–36; Jaegwon Kim, “Emergence: Core Ideas and Issues,” *Synthese* 151 (2006): 547–59; Arthur Peacocke, *All That Is: A Naturalistic Faith for the Twenty-First Century*, ed. Philip Clayton (Minneapolis: Fortress, 2009); Loyal Rue, *Nature Is Enough: Religious Naturalism and the Meaning of Life* (Albany: State University of New York Press, 2012); William C. Wimsatt, *Re-Engineering Philosophy for Limited Beings: Piecewise Approximations to Reality* (Cambridge, MA: Harvard University Press, 2007).

3. Kauffman frequently refers to the paradigmatic encapsulation of reductionism by Nobel laureate physicist Steven Weinberg, *Dreams of a Final Theory: The Scientist’s Search for the Ultimate Laws of Nature* (New York: Vintage, 1994): “All the explanatory arrows point downward, from societies to people, to organs, to cells, to biochemistry, to chemistry, and ultimately to physics. The more we know of the universe, the more meaningless it appears.” For a fuller statement of reductionism and its historical development see also Richard H. Jones, *Reductionism: Analysis and the Fullness of Reality* (Lewisburg, PA: Bucknell University Press, 2000).

complexity theory (hereinafter I shall refer to this family of theories as *naturalistic emergentism*). Roughly defined, naturalistic emergentism holds that although the physical world exhausts reality, the entities and events comprising that reality are not ultimately reducible to the laws of physics. Among the central claims naturalistic emergentists make is that they have built their worldview on the firm foundations of science. Naturalistic emergentism is, according to Kauffman, “a major part of the new scientific worldview.”⁷⁴ Is he correct? Is naturalistic emergence compatible with, or perhaps even entailed by, a scientific worldview? In this paper I shall argue that *naturalistic theories of ontological emergence are incompatible with the philosophical preconditions necessary for practicing science*. We proceed by (1) examining some preliminary considerations including what makes a worldview compatible with science and the broad strokes of emergentism; (2) assessing emergentism according to seven philosophical preconditions necessary for the scientific enterprise; and (3) anticipating potential objections to my assessment of emergentism’s compatibility with science.

But someone may wonder, how does this sibling rivalry internal to naturalism concern the Christian philosopher? Does naturalistic emergentism even warrant our attention? Whereas most of the apologetic energy in recent Christian philosophy has responded to the polemic of the “New Atheists,”⁷⁵ Kauffman’s work shows that twenty-first century naturalism assails Christian theism on not one but two fronts. And the “newer atheism” of naturalistic emergentism may well prove the more challenging of the two for evangelical thinkers to overcome. Where Dawkins, Dennett, Harris, and Hitchens undermine their persuasiveness by defaming the very notion of sacredness, Kauffman and other emergentists repurpose the undeniable rhetorical power of sacredness for the cause of naturalistic scientism. Insofar as Western culture needed a worldview to undergird the venerable, clergy-like status scientists now enjoy, naturalistic emergentism’s timing is impeccable. But if Christian philosophers can show, as I aim to do here, that naturalistic emergentism is altogether incompatible with the very practice of science, then we may yet stall its advance in Western thought.

4. Kauffman, *Reinventing the Sacred*, x.

5. Monographs published in just the first half of 2017 include Michael Azkoul, *The New Atheists: An Eastern Orthodox Critique* (Bloomington, IN: Xlibris, 2017); Travis J. Bond, *Inconvenient Faith: A Gospel-Rooted Dialogue with New Atheism* (Raleigh, NC: Lulu, 2017); Phillip Brown, ed., *Disbelieving Disbelief: How the New Atheism Makes Atheism Unbelievable* (New York: Wipf and Stock, 2016); Christopher R. Cotter, Philip Andrew Quadrio, and Jonathan Tuckett, eds., *New Atheism: Critical Perspectives and Contemporary Debates* (New York: Springer, 2017); Brian Johnston, *If Atheism Is True . . . : The Futile Faith and Hopeless Hypotheses of Dawkins and Co.* (Swindon, UK: Hayes, 2017); Daniel Ventress, *What the New Atheists Didn’t Tell You: The Intellectual Shortcomings of Misinformed and Misguided Misotheism* (2017).

Preliminary Considerations

We require some initial groundwork before assessing naturalistic emergentism (NE). In the sections that follow I propose a set of philosophical preconditions by which we might evaluate a worldview's compatibility with practicing science, describe emergentists' motivations for rebutting naturalistic reductionism (NR), and identify the key tenets comprising Kauffman's form of NE.

Assessing a Worldview's Compatibility with Science

A satisfying definition of science is notoriously elusive. Philosopher Alvin Plantinga provides, if not a definition, at least an adequate description of the enterprise: "Science is at bottom an attempt to learn important truths about ourselves and our world."⁶ So science is a truth-seeking effort. But is that all we can say? We might further observe that science occupies a broader class of other truth-seeking efforts including philosophy, religion, and so on. And science is distinguishable within this class by virtue of being concerned with a certain kind of truth not pursued by the other efforts, namely the kind of truth characterized by empirical typologies and physical causality. Simply stated, *science is empirical truth-seeking*.⁷

A worldview (by virtue of being a worldview) is either compatible or incompatible with empirical truth-seeking. This is what I mean by a worldview's compatibility with science. Stated somewhat more formally, my *scientific compatibility principle* is as follows:

- (1) Worldview *W* is compatible with science if and only if
 - (a) *W* holds some philosophical presuppositions that affirm the discoverability of empirical truths and
 - (b) *W* holds no presuppositions that preclude the discoverability of empirical truths.

6. Alvin Plantinga, *Where the Conflict Really Lies: Science, Religion, and Naturalism* (New York: Oxford University Press, 2011), 267.

7. We might put a finer point on "empirical truth-seeking" by saying that science is seeking the truth concerning the causes of empirical states of affairs. Methodological naturalists may take this a step further to put empiricism both in the effect and the cause, something along the lines of science seeking the truth concerning *empirical* causes of empirical states of affairs. I join friends of intelligent design in rejecting this strong empiricism, but of course do not have the space to defend this view here.

If we accept this as our compatibility requirement, then what philosophical presuppositions might qualify as affirming the discoverability of empirical truths? Plantinga proposes seven:⁸

Reliable knowledge: We human beings possess *adequatio intellectus ad rem* (the adequation of the intellect to reality) such that the interface between our cognitive faculties and reality makes authentic and reliable knowledge possible.

Natural regularity: The world displays a high degree of regularity and predictability, and we implicitly assume this regularity in how we approach the world.

Natural law: We can discover, simplify, and communicate the world's regularities through universal laws expressible in human language.

Mathematics: We find reliable and efficacious means for describing and predicting the world's regularities through the abstract symbols and relations that comprise mathematics.

Experiential explanation: We take for granted the innate conviction that future events will resemble past events, which is the basis of all linguistic explanation.

Preference for simplicity: We have an innate preference for explanations that involve a minimal number of variables, agents, exceptions, assumptions, and causal steps.

Empirical observation: We humans have sense perception useful for directly observing or indirectly inferring data about the world's regularities.

Plantinga originally proposed the foregoing list for the purpose of showing the deep concord between theism and the scientific enterprise. I have a broader utility in mind: I want to repurpose Plantinga's list as a rubric by which to evaluate the compatibility of any worldview with the practice of science. Specifically, I shall evaluate NE against each presupposition and thereafter synthesize an overall assessment of NE's compatibility with science.

Motivations for Kauffman's Theory of Emergence

Before doing so, it serves our present purpose to become better acquainted with one specific variant of NE, namely that posited in numerous

8. I reformulate the titles and groupings somewhat from Plantinga, but preserve the spirit and descriptions that run throughout his discussion.

books by Stuart Kauffman. In his most recent title, *Reinventing the Sacred: A New View of Science, Reason, and Religion*, Kauffman laments three inadequacies of reductionism that motivate emergentism. First, entities prove stubbornly difficult to reduce across disciplines within the physical sciences (for example, biology to chemistry, chemistry to physics, and so on). Kauffman illustrates this idea by way of extended discussion about the human heart. It performs a function: it pumps blood throughout the human body. But is the heart *reducible*, first to chemistry and then to physics? Concerning its existence and movement, the heart is indeed reducible. “Presumably,” says Kauffman, “such a reduction can and eventually will be carried out.” What is not reducible, however, is the heart’s *causal function*. No reductive explanation can account for a certain configuration of matter taking on the causal role of life-giving blood-pumper. Kauffman writes, “Hearts, by virtue of the organization of structure and processes that they have due to their evolution by natural selection, do have causal consequences as hearts. Hearts are thus real entities.” In other words, according to Kauffman, a heart’s capacity for physical causation earns it an ontological status just as real as the fundamental particles that comprise it.⁹

Second, social realities prove similarly difficult to reduce to the physical sciences. Kauffman illustrates with the work of Nobel laureates Kenneth Arrow and Gerard Debreu:

In a brilliant mathematical theorem, Arrow and Debreu prove that however the future unfolds, . . . all markets will clear, meaning that all goods will be exchanged, supply will match demand, and some value will be received by everyone. This market clearing is known as equilibrium, hence the theory is called competitive general equilibrium. This theory is the foundation of economic thinking today. It is beautiful. Notice that it is not reducible to physics, because the economic rational agents have foresight and use their knowledge to calculate the probabilities of each dated contingent good.¹⁰

So in the same way hearts merit ontological recognition by virtue of their role in *physical* causation, economic agents merit similar recognition by virtue of their role in *social* causation. In this sense, most of the abstractions to which we typically refer—the New York Yankees, China, vegetarians—have ontological status. For Kauffman, they are real entities.

The third and most important motivation for Kauffman is his belief that teleological realities are ontologically necessary. Life, agency, value, and meaning are real in the universe, but they are irreducible to the empirical fact base from which they emerge. Kauffman develops these concepts sequentially: (1) Life emerges inexplicably from nonlife; (2) agency emerges

9. Kauffman, *Reinventing the Sacred*, 36.

10. *Ibid.*, 155.

from life; (3) value from agency; and (4) meaning from value.¹¹ As with physical and social causation, Kauffman is committed to the genuineness of *volitional* causation. He cannot imagine a world bereft of teleology.¹² As sociologist Jeremy Sherman and biological anthropologist Terrence Deacon put it, “we must imagine how, within a universe devoid of contamination by life or *telos*, life’s *telos* could emerge.”¹³ On this account, abiotic fragments of the universe naturally evolved into agents that value things and subsequently act on those evaluations.

These three motivations combine to form a sort of motivational synthesis for Kauffman, a call to action for humans to embrace a global ethic based on respecting the sacredness of nature. In an impassioned plea at the book’s conclusion he writes,

Can I logically “force” you to see the sacred in the creativity in nature and join in basing a global ethic on that sacredness? No. Hume was right. “Is” does not imply “ought,” even if “ought” is emergent and natural given nonreducible life and agency. Even if the “is” is the creativity in the universe of which I write. No, I cannot logically force you. But I can invite you. The very creativity in the universe, the wholly liberating creativity in the universe we share and partially co-create, can invite you, for that creativity is a vast freedom we have not known, since Newton, that we shared with the cosmos, the biosphere, and human life. Accepting that invitation, while recognizing the evil we do and that happens, may be wise for us all.¹⁴

Kauffman’s aims are ambitious. Far beyond suggesting NE merely as a naturalistic alternative to NR, he suggests that NE holds the curative solution to the world’s greatest ills.

Summary of Kauffman’s Theory of Emergence

On the basis of the foregoing motivations, Kauffman develops the thesis that *humans should universally recast their view of God as the wondrous*

11. *Ibid.*, 78. One of the most fascinating features of Kauffman’s account of agency, value, and meaning is that it denies consciousness is required: “Teleological language becomes appropriate at some point in the tree of life. Let us stretch and say it is appropriate to apply it to the bacterium. We may do so without attributing consciousness to the bacterium. My purpose in attributing actions (or perhaps better, protoactions) to a bacterium is to try to trace the origin of action, value, and meaning as close as I can to the origin of life itself.” In other words, “value” emerges very early in Kauffman’s natural history, perhaps even at bacteria. However, it is far from clear that the bacterium’s swim up a glucose gradient is evaluative in the same sense the word *value* is understood by conscious agents.

12. *Ibid.*, 74.

13. Sherman and Deacon, “Teleology for the Perplexed: How Matter Began to Matter,” *Zygon* 42 (2007): 876.

14. Kauffman, *Reinventing the Sacred*, 276.

*radical creativity of the natural world.*¹⁵ He builds his argument by picking and choosing from the menu of competing philosophical truth claims to assemble what he considers an optimal worldview. His point of departure is NR, which he takes to include the following truth claims:¹⁶

- (2) All entities are natural.
- (3) Some entities are fundamental.
- (4) Some nonfundamental entities are empirically discoverable.
- (5) All nonfundamental entities are ontologically reducible into fundamental entities.

We note first that NR clears the bar set by (1a) of our scientific compatibility principle—that is, (4) affirms the discoverability of empirical truths. In light of (2), it is less clear that NR clears (1b). As Plantinga argues convincingly, “there is deep and serious conflict between naturalism and evolution, and hence deep conflict between naturalism and science.”¹⁷ The fallibility of human cognition as the undirected, chance-driven product of natural selection seems to run counter to the philosophical presuppositions required for genuine compatibility with science. I am tempted to explore this criticism further, but a full critique of NR is beyond the scope of this paper.

So for the sake of argument, let’s assume that NR does satisfy both (1a) and (1b): in other words, we stipulate that *NR is fully compatible with the practice of science*. That being the case, if Kauffman is a committed naturalist, then why is NR an unsatisfactory worldview? Kauffman observes that theistic worldviews are superior to NR in one key respect: theism successfully accounts for important realities that NR discards. He writes,

What about all the aspects of the universe that we hold sacred—agency, meaning, values, purpose, all life, and the planet? We are neither ready to give these up nor willing to consider them mere human illusions. One response is that if the natural world has no room for these things, and yet we are unshakably convinced of their reality, then they

15. *Ibid.*, 286. At this point I must clarify that Kauffman uses terms like “sacred” and “God” for neither rhetorical nor satirical effect. He writes, “If what is moral is not authored by a Creator God, but our own, partially evolved, sense, then there are no self-consistent axioms from which we can derive all moral behavior. Rather, there are convergent and conflicting moral views, and as thoughtful, reflective, mature people, we engage in moral reasoning with our full humanity about situations, laws, practices and ways of life. So, too, with the sacred, if *we* are the authors of what is to be held sacred, then we will engage in mature reasoning about what is sacred. Might it be the case, then, that at this stage in human cultural evolution we are, at last, ready to assume responsibility for our own choices of what it is to be sacred?” For Kauffman, the property *being sacred* is one over which human beings exercise definitional discretion—the choice is ours to make sacred whatever we will.

16. *Ibid.*, 10–11.

17. Plantinga, *Where the Conflict Really Lies*, 309.

must be outside of nature—supernatural, infused into the universe by God.¹⁸

We can schematize Kauffman’s intuition about theism’s existential appeal by listing some of the philosophical truth claims common to many theistic worldviews.

- (6) Some entities are supernatural.
- (7) God is a supernatural entity.
- (8) All natural entities are created by God.
- (9) Some (perhaps all) natural entities are valuable.
- (10) Some natural entities are empirically discoverable.

As with reductionism (at least as we’ve generously stipulated), both (1a) and (1b) obtain. Theism’s (10) affirms the discoverability of empirical truth. Also, no members of the set offend our list of seven philosophical presuppositions necessary for genuine compatibility with science.

But Kauffman is not concerned with these presuppositions necessary for the practice of science. Instead, what he envies most is the theist’s ability to claim (9). Kauffman is “unshakably convinced” that value and meaning do exist, but he suspects (6) is ontologically unnecessary to justify it. Or perhaps he finds divine grounding for value unconvincing. Either way, Kauffman’s axiological envy clearly motivates his entire project. He essentially asks if there is some set of philosophical truth claims that can preserve both (2) (naturalism) and (9) (the reality of value). According to Kauffman, NE accomplishes just that.

So how exactly does this work? First NE imports several core truth claims from NR:

- (2) All entities are natural.
- (3) Some entities are fundamental.
- (4) Some nonfundamental entities are empirically discoverable.

But here NE and NR part ways. The emergentist introduces two novel claims:

- (11) Some nonfundamental entities are not ontologically reducible into fundamental entities.
- (12) Value is a nonfundamental, irreducible entity.

Note carefully that NE trades primarily on (11): *some things exist that cannot be reduced to and explained by their constituent parts*. And if it follows that value is one of those things, as stated in (12), then naturalists have it all: both scientific respectability and the concept of value are preserved. Thus philosopher and leading emergentist Jaegwon Kim describes NE as “a com-

18. Kauffman, *Reinventing the Sacred*, 129.

promise between physicalist reductionism and all-out dualisms.”¹⁹ If humanity would only affirm this view, says Kauffman, we could all enter into a new world of consensus and celebration around the ceaseless creativity of natural emergence.

Compatibility of Emergentism and Science

We return now to our list of criteria for evaluating a worldview’s compatibility with science. To be scientifically compatible, a worldview must hold to philosophical presuppositions affirming the reliability of knowledge, natural regularity, natural law, mathematics, experiential explanation, a preference for simplicity, and empirical observation. In the sections that follow I examine NE’s compatibility with each requisite presupposition.

Emergence and Reliable Knowledge

Certain aspects of NE affirm the reliability of human knowledge. By and large, emergentists seem to be realists regarding the reliability of human faculties to sense the realities of the natural world.²⁰ And it appears that most of NE’s advocates are scientists of note who have built formidable professional reputations using careful reliance on their sense experience (more on this later in the section on “Empirical Observation”). So in a strictly practical sense, emergentists seem to exercise the same trust in the reliability of human knowledge as nonemergentists.

However, when we examine the fundamental doctrines of NE we find greater cause for concern. The mysterious notion of downward causation in particular raises compatibility problems with reliable knowledge. Downward causation is emergentists’ term for phenomena observed in a system where the behaviors of its parts are dictated by the state of the whole and *those behaviors cannot be predicted* from exhaustive knowledge of the state of the parts.²¹ The latter element precludes the discoverability of empirical truths. If the state of our planet (the system) exerts downward causation on oceans, economies, and individuals (the parts), and if those behaviors cannot be predicted by empirical observation, then science is undermined by significant uncertainty. In Kauffman’s own words, the ramifications of downward causation for scientific knowledge are ominous: “We have seen reasons why

19. Kim, “Making Sense of Emergence,” 4.

20. See, e.g., Kari L. Theurer, “Complexity-Based Theories of Emergence: Criticisms and Constraints,” *International Studies in the Philosophy of Science* 28 (2014): 299.

21. Rodolfo Gambini, Lucía Lewowicz, and Jorge Pullin, “Quantum Mechanics, Strong Emergence and Ontological Non-Reducibility,” *Foundations of Chemistry* 17, no. 2 (2015): 125; Mikael Leidenhag, “The Relevance of Emergence Theory in the Science-Religion Dialogue,” *Zygon* 48 (2013): 969.

science may be limited in radical ways by the very creativity of the biosphere and human culture.”²²

Moreover, NE’s classification as a species of naturalism renders it vulnerable to theists’ familiar arguments against proper cognitive functioning given naturalism.²³ For the sake of argument, suppose we assume the theory of naturalistic evolution more or less accurately describes biological history; is it conceivable that a creature’s beliefs could convey selective advantages without being true? Of course. Darwin himself confessed “horrid doubt” about his theory’s compatibility with the reliability of human convictions: “Would anyone trust in the convictions of a monkey’s mind, if there are any convictions in such a mind?”²⁴ As Kauffman puts it, NE requires that “we live forward into mystery.”²⁵

For these reasons I conclude that NE fails to cohere with the philosophical presupposition that human knowledge is sufficiently reliable for practicing science. Downward causation calls into question the very causal apparatus on which reliable human knowledge is based. Moreover, emergentists seem to have no warrant for trusting the truth-discerning powers of human brains brought about by undirected (albeit emergent) processes.

Emergence and Natural Regularity

Like the above discussion on reliable knowledge, there are important ways in which NE does presume regularity in nature. In fact, although emergentists hold that instances of true emergence are rare on a universal scale,²⁶ our world boasts many natural regularities that evince emergence. Two distinct human brains exhibit more or less the same kinds of properties, as do two hearts, two marriages, and two economies. In this sense the emergentist relies upon regularity for the same reason as the reductionist, namely for the explanatory potency of demonstrating repeated emergence in nature.²⁷

However, we must take Kauffman and other emergentists at their word when they insist that the universe’s ceaseless creativity is in many ways unpredictable. Kauffman writes, “The idea that the human mind is nonalgorithmic raises the *possibility* that it *might be acausal*, rather than a causal ‘machine,’ and the only acausal theory we have is quantum mechanics.”²⁸ In a later discussion about the “hard problem” of qualia and experiences, he

22. Kauffman, *Reinventing the Sacred*, 232.

23. Plantinga, *Where the Conflict Really Lies*, 314.

24. *Ibid.*, 316; See also Thomas Nagel, *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False* (New York: Oxford University Press, 2012), 5.

25. Kauffman, *Reinventing the Sacred*, 235.

26. Wimsatt, *Re-Engineering Philosophy for Limited Beings*, 304.

27. Elanor Taylor, “Collapsing Emergence,” *Philosophical Quarterly* 65 (2015): 746.

28. Kauffman, *Reinventing the Sacred*, 204.

writes, “Were we to find, for example, abundant correlations of the quantum kind I hope for, we might still be left mystified about the emergence of first-person qualia in the living brain.”²⁹

Other naturalistic emergentists respond similarly when they encounter intractable puzzles in scientific explanation, concluding that these irregularities are wholly new features of an emergently unpredictable universe.³⁰ Again emergentist Jaegwon Kim:

I believe that “new” as used by the emergentists has two dimensions: an emergent property is new because it is unpredictable, and this is its epistemological sense; and, second, it has a metaphysical sense, namely that an emergent property brings with it causal powers, powers that did not exist before its emergence.³¹

In the same article Kim goes on to offer *being a gene*, *being in pain*, and *having a phenomenal experience* as examples of emergent properties with new causal powers. Taken together with Kim’s earlier quotation, what shall we conclude of emergentist views of natural regularity in the fields of genetics, medicine, and psychology? At best, these fields will be restricted to discovering postemergent empirical truths. “After becoming a gene,” one might say, “such-and-such natural laws about the gene obtain with and such-and-such observable regularities.” While conceivable, such an approach to explanation hardly seems satisfying. If Kim and other emergentists deny explanations that connect a system’s causal powers to that system’s underlying properties, then they place a fatal limitation on the explanations that science can uncover.³²

So we find here also that NE fails to satisfy another philosophical presupposition—the emergentist’s worldview denies the natural regularity necessary for practicing science. Despite emergentists’ superficial acknowledgement of recurring phenomena, their insistence on the potential for unpredictable metaphysical novelty flatly contradicts the regularity on which scientists rely.

29. *Ibid.*, 226; cf. Mark Solms, “A Neuropsychanalytical Approach to the Hard Problem of Consciousness,” *Journal Of Integrative Neuroscience* 13, no. 2 (2014): 173–85.

30. Eleanor Taylor, “An Explication of Emergence,” *Philosophical Studies* 172 (2015): 657.

31. Kim, “Making Sense of Emergence,” 8.

32. To call it a “fatal limitation” is strong, but intentionally so. On this Hong Yu Wong, “The Secret Lives of Emergents,” in *Emergence in Science and Philosophy* (New York: Routledge, 2010) writes “it is unclear how supervenience emergentism allows for novel, downward causal powers for emergent properties whilst still guaranteeing the covariation of emergent properties with basal properties in a way consistent with the fundamental emergent laws which ensure the supervenience of emergent properties on basal properties.” For the naturalistic emergentist, is the physical world causally closed? If not, is it really naturalism? If so, is it really emergentism? And either way, can naturalistic emergentists appeal to emergence as a causal explanation?

Emergence and Natural Law

Naturalistic emergentists univocally affirm the veracity of natural laws discovered by reductionistic science. “Newton’s laws are wonderfully successful,” Kauffman writes. “We send rockets on complex voyages through the solar system guided by nothing else.”³³ Moreover, some of the recent work on NE seems to allow the charitable interpretation that emergentists see their project as building on rather than abolishing the productive framework of NR.³⁴

However, many of Kauffman’s specific descriptions of NE explicitly disavow law-like behavior in emergent phenomena. As Kauffman puts it, “If by a natural law we mean a compact prior description of the regularities of the phenomena in question, the evolution of the biosphere via preadaptations is not describable by law.”³⁵ And he does not limit nature’s lawlessness to biological evolution, but instead widens the aperture to include social phenomena as well. He writes, “We will soon find its analogues in economic and cultural evolution, which, like the biosphere, are self-consistently self-constructing but evolving wholes whose constituents are partially lawless.” But is “partially lawless” different from lawless *simpliciter*?

Many partisans of NE agree with Kauffman. When explaining the dichotomy of a system’s properties under emergentism, Kim writes, “Resultant properties are those that are predictable from a system’s total microstructural property [that is, a full knowledge of its constituent parts], but emergent properties are those that are not so predictable.”³⁶ Others lament reductionists’ “fruitless attempt[s] to save a law-based model of reduction.”³⁷ Still others favor law-like replacements called “mechanisms” citing a distaste for laws as “sloppy, gappy generalizations.”³⁸

This all seems rather antithetical to science. Upon encountering a mystery in the human brain, for example, would not the paradigmatic scientist test hypotheses methodically and tirelessly for some as-yet-unknown law at work in the system’s constituent parts? The resulting law might look something like, *human neurons instantiate their latent property of consciousness-support when combined with one hundred billion other neurons and other necessary conditions*. And thereafter the inquiry would move down a level: what is it about the human neuron that gives it the property *supportive of consciousness*? But emergentists reject this.

33. Kauffman, *Reinventing the Sacred*, 13.

34. Scot D. Yoder, “Emergence and Religious Naturalism: The Promise and Peril,” *American Journal of Theology and Philosophy* 35, no. 2 (2014): 154.

35. Kauffman, *Reinventing the Sacred*, 149.

36. Kim, “Making Sense of Emergence,” 8.

37. Kari L. Theurer, “Seventeenth-Century Mechanism: An Alternative Framework for Reductionism,” *Philosophy of Science* 80 (2013): 917; see also Nagel, *Mind and Cosmos*, 16–17.

38. Wimsatt, *Re-Engineering Philosophy for Limited Beings*, 357.

So what shall we conclude of NE and natural law? Despite NE's retrospective support for reductive laws already "on the books," its broad-based pessimism at the prospect of discovering laws governing ontological emergence cuts against an essential presupposition necessary for practicing science. Here too NE fails.

Emergence and Mathematics

By and large, NE adheres to the presuppositions of mathematical efficacy necessary for scientific endeavor. I can find no examples in which emergentists express unalloyed skepticism about mathematics as a reliable and efficacious means for describing and predicting the world's regularities.

There is, however, a concerning aspect of Kauffman's NE that seems to sidestep mathematical rationality. Kauffman points out that there are twenty types of amino acids that chain together to form biological proteins, the basis of all known life. It takes roughly 100,000 different combinations to build a human being. That may seem like a considerable number of protein variants, but Kauffman urges us to consider how many kinds of proteins are possible. Assuming a conservative chain-length of two hundred amino acids (many proteins contain thousands of linked amino acids), Kauffman makes the straightforward calculation that this number implies a range of at least 10^{260} possible protein permutations. With this example Kauffman is simply demonstrating that the universe has instantiated but a tiny fraction of all possible states of affairs. Kauffman's universe is making never-before-born proteins all the time, and will continue to break new ground even when it is many times older than it is now.³⁹

But Kauffman's math cuts another direction also: if all extant proteins comprise less than $1/10^{255}$ of the full set of protein permutations, how do we explain such a young universe so quickly producing the fraction of proteins we now have, a fraction that just so happens to be capable of supporting human life? The emergentist exercises tremendous faith if she believes that the miniscule set of proteins that happened to emerge in these early days were just the sort necessary for constructing humans capable of understanding proteins. Is such a faith any more "scientific" than that of the intelligent design proponent?⁴⁰

Moreover, there are problems with conjoining any form of naturalism—whether NR or NE—with reliable human access to mathematics. Mathemati-

39. Kauffman, *Reinventing the Sacred*, 122–3. "As the biosphere advances into its chemically adjacent possible, it is persistently making new molecules. Thus as mutations occur so novel proteins are made, or new organic molecules are synthesized in evolution, the biosphere is persistently advancing into its adjacent possible."

40. See Elliott Sober, "What Is Wrong with Intelligent Design?," *Quarterly Review of Biology* 82 (2007): 3–8.

cal concepts are extrasensory: it is possible to conceive of the number three (for example, the only member of the set of positive integers greater than two and less than four, the square root of nine, the first prime number greater than two, and so on) absent concrete objects (for example, three apples, three houses, three root beer floats). Naturalistic accounts of unguided evolution can account for the latter, but not the former. It is certainly conceivable that evolved beings with sufficiently sophisticated cognitive and linguistic abilities would have decided to commission the word *three* as an adjectival modifier of groups-of-several-things. But it is another thing entirely to suggest that unguided evolutionary processes would have given humans access to extrasensory concepts such as mathematical numbers, functions, and sets.⁴¹

Despite these misgivings, I am willing to concede that NE more or less satisfies the philosophical presupposition that mathematics is efficacious for practicing science. Kauffman's statistical miracle of protein formation and naturalism's broader flaws notwithstanding, there is little inherent in NE suggesting that the principles of mathematics are somehow up for grabs as a result of purportedly emergent properties.

Emergence and Experiential Explanation

NE encounters some of its severest incompatibilities with science in the presumption of experiential explanation. This is most clearly on display in Kauffman's discussion of abiogenesis, the emergence of life from nonlife. "If life is natural, as I firmly believe," he writes, "then part of the immense call for a transcendent Creator God loses its force."⁴² He goes on: "If we seek a reinvented sacred based on this universe and its miraculous creativity, then a natural explanation for the origin of life in the universe is of paramount importance." Kauffman unpacks this view with a chapter-long anthology of scientists' fascinating efforts to generate self-replicating molecules or symbiotically self-replicating sets of molecules. These include chemist Stanley Miller's famous demonstration of amino acids forming under conditions simulating early Earth; organic biologist Leslie Orgel's brilliant but unsuccessful attempts to induce RNA template replication; Nobel laureate Walter Gilbert's theory of an "RNA world" in which certain strands of early earth RNA acted as catalysts inducing other RNA strands to replicate; chemist Gunter von Kiedrowski's achievement of molecular self-replication through *catalytic closure*, a sort of symbiosis between molecules that enables coreplication; and chemist Reza Ghadiri's extension of von Kiedrowski's principle to create a very simple collectively autocatalytic self-replicating protein. De-

41. Plantinga, *Where the Conflict Really Lies*, 290–1.

42. Kauffman, *Reinventing the Sacred*, 45.

spite his emergentist commitments, Kauffman believes a reductive explanation for life's natural emergence from the abiotic world may be possible.⁴³

But the chapter also exposes the mind-beggingly small statistical probability of abiotic self-replication beginning at all. In fact, each of the conclusions about abiogenesis described above relies on a host of *ad hoc* auxiliary hypotheses. Miller's early Earth simulations yield some amino acids, but not all required for protein formation. On this Kauffman speculates that the others "may have come from space."⁴⁴ Concerning Orgel's work, "after forty years of effort, applying all sorts of tricks, [RNA template replication] proponents have not yet succeeded. They may yet, but hope is dwindling."⁴⁵ Are we to believe that at no point in forty years did someone raise their hand to contend that "applying all sorts of tricks" does not qualify as simulating chance? Commenting on the RNA world hypothesis, Kauffman concedes "the probability of such an RNA polymerase appearing [that self-replicates] seems to be less than 1 in 10^{15} ."⁴⁶ Molecular biologist David Bartel is undaunted—at this very moment he is in the laboratory painstakingly seeking that one polymerase from a library of 10^{15} sequences. Von Kiedrowski and Ghadiri both achieved their results of catalytic closure using fragments of carefully crafted compounds, namely "by holding these fragments next to one another."⁴⁷ So we see in all of the above examples of "successes" in this field a proliferation of *ad hoc* assumptions and the not-so-subtle nudge of human agency to overcome the improbability of abiogenesis.

Emergent explanation is another such *ad hoc* assumption. But on what grounds may one invoke emergence as a legitimate form of scientific explanation? One would necessarily have to presume naturalism, and thereafter infer that some natural processes give rise to irreducible entities. But what might these processes be? Biologists Sherman and Deacon take as given that "evolution itself must have emerged" and proceed to speculate how molecular autocatalytic sets were the foundations of life arising from nonlife.⁴⁸ This approach stands in stark contrast with NR. Where NR (very successfully) infers that the future will be like the past, NE instead postulates a universe in which the future is always creatively moving beyond the past into the "adjacent possible."

For these reasons, I conclude that NE fatally undermines the kinds of experiential explanation necessary for the scientific enterprise. And we may note in passing that the foregoing analysis shows that emergentists make the same error when explaining the gaps in NR that they accuse intelligent

43. *Ibid.*, 44–71.

44. *Ibid.*, 48.

45. *Ibid.*, 50.

46. *Ibid.*, 52.

47. *Ibid.*, 57.

48. Sherman and Deacon, "Teleology for the Perplexed," 880.

design proponents of making to explain the origin of life.⁴⁹ Philosopher Elliott Sober joins Kauffman and many others in criticizing intelligent design proponents of inventing auxiliary propositions for which there is no independent evidence,⁵⁰ the very thing emergentists do with auxiliary propositions concerning emergence. And a worldview rife with auxiliary appeals to unpredictable emergence is ultimately incompatible with practicing science.

Emergence and Preference for Simplicity

Many aspects of NE seem to emit an air of simplicity. Most of Kauffman's allusions to simplicity frame NE as a tidier option compared to theistic alternatives: "Life has emerged in the universe without requiring special intervention from a Creator God."⁵¹ For Kauffman and other emergentists, the God hypothesis is exotic and unnecessary. Far more preferable, far more *simple*, is the default hypothesis that the natural world exhausts reality and emergent processes explain the otherwise inexplicable.

But what sort of simplicity is this? Although I do not wish to be drawn into evergreen debates on the nature of parsimony in science, a few brief comments are in order. When philosophers test explanations for parsimony, they often look for qualitative parsimony (or uniformity), quantitative parsimony, and explanatory sufficiency. Qualitative parsimony refers to judgments of uniform likeness, such as comparisons of things within a group (for example, a basket of apples is simpler than a basket of mixed fruit) or events occurring over time (for example, arriving to work at the same time every day is simpler than haphazard arrival times). Quantitative parsimony concerns comparisons of numerical plenitude (for example, a life with one spouse is simpler than one with ten spouses). And finally, explanatory sufficiency locates simplicity in qualitatively and quantitatively parsimonious causal explanations (for example, the homicide detective's default preference for postulating one murderer rather than one hundred). We humans by and large display an innate preference for beliefs featuring these kinds of parsimony and widely advocate its liberal application to scientific and other endeavors.⁵²

Now consider NE—how does it fare in each of these tests of parsimony? As a member of the broader family of naturalistic worldviews, it does seem to enjoy a form of qualitative parsimony: the natural is one kind of thing, the supernatural is another. Reality is all the simpler for conceiving it as contain-

49. See Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution*, 2nd ed. (New York: Free Press, 2006).

50. Sober, "What Is Wrong with Intelligent Design?," 6.

51. Kauffman, *Reinventing the Sacred*, 71.

52. Alan Baker, "Simplicity," in *Stanford Encyclopedia of Philosophy*, ed. Edward Zalta, 2013.

ing just nature rather than nature and “supernature.” I grant this. But we also find in NE a kind of qualitative complexity that militates against the practice of science. All ordered things with which I am familiar in my day-to-day life have been so ordered by an orderer. However, when emergentists explain order in nature, they cite unguided, unpredictable, irreducible instantiations of emergence. Does it not offend principles of qualitative parsimony to posit orderer-less emergent explanations for ordered behavior?

Perhaps NE fares better in quantitative parsimony. But do we have anything to count? I suppose in NE there are the alleged mechanisms of emergence. One set of mechanisms may concern emergent processes by which chemistry emerges from physics, another concerns biology’s emergence from chemistry, and still another concerns the emergence of economics from biology, psychology, and a host of other disciplines. The superset of emergent this-to-that mechanisms is presumably quite large and quite heterogeneous. If quantitative parsimony favors one over many, NE fails this test.

Finally we come to explanatory sufficiency. Here the goal is to offer a sufficient explanation for some observed phenomena by adding the least number of (1) kinds of causal factors and (2) causal factors within those kinds. As we’ve seen in previous sections, NE explains phenomena by way of two high-level kinds of causal factors: reductive laws (for example, Newton’s laws) and emergent causal factors (for example, agents valuing things). Two is not very many. Moreover, the emergentist may argue that these fall within a highest-level kind of causal factor, namely natural causes—so we may be down to a single causal factor. But do emergent causal factors have any explanatory power whatsoever to deserve the label *causal*? Kim writes, “The supervenience condition on emergence simply amounts to the assertion that there is an in-principle *unexplainable* covariation between the putatively emergent properties and their base properties. This cannot be considered a substantive positive characterization of the emergence relation.”⁵³ So we have it from an emergentist himself that NE is a theory about what *cannot* be causally explained, not a theory about what can.

In summary, I conclude that NE precludes the parsimony necessary for practicing science. While it is beyond the scope of this paper to discern whether theism fares better, we might note that theism traces all causal factors to an uncaused intelligent agent’s first cause. If by divine act God created space, time, matter, energy, and their causally interrelated properties, then theists are at liberty to affirm the principles of parsimony in scientific endeavor because they are compatible with the ordered thought of a divine mind. Theists might be forgiven for wondering why Kauffman prefers a plurality of indefinable, unpredictable, natural emergent mechanisms to a single theistic explanation.

53. Kim, “Emergence: Core Ideas and Issues,” 556.

Emergence and Empirical Observation

Despite these shortcomings, Kauffman displays nothing short of brilliance as an observer of the physical world. He is fully conversant in recent developments in advanced physics such as Philip Anderson's thinking on computation,⁵⁴ Robert Laughlin's work to understand the emergent phenomenon of temperature,⁵⁵ and Leonard Susskind's efforts to explicate string theory.⁵⁶ But as a medical doctor and theoretical biologist, Kauffman's native language is biology. With tremendous rhetorical flair he discusses the intricacies of RNA, DNA, protein chains, reaction graphs, and collectively autocatalytic molecule sets. Empirical observation is the lifeblood of Kauffman's writing.

Other leading thinkers of the emergentist school evince the same qualities. Philosopher and emergentist Philip Clayton makes a point of coauthoring and editing books about emergence together with physicists, chemists, and biologists who have built towering reputations in their fields.⁵⁷ Celebrated physicist and emergentist Paul Davies has won two Eureka prizes, the Kelvin Medal, the Faraday Prize, and the Templeton Prize for his work in theoretical physics, cosmology, and astrobiology. Religious naturalist Loyal Rue supports her argument by painstakingly detailing a dizzying array of examples of nature's overwhelming beauty.⁵⁸ The theme is incontrovertible—emergentists share an allegiance to empirical observation that transcends mere commitment; it approaches something closer to reverence.

If NE shows any weaknesses in empirical observation they reside in emergentists' theories about the origin and development of life.⁵⁹ Despite the recurring failure of experiments designed to vindicate abiogenesis, emergentists insist that undirected natural causes gave rise to life. Similarly recurrent encounters with long odds for this or that link obtaining in the evolutionary series also fail to dissuade emergentists. Would not a more open-minded empiricism leave open the possibility that life is the handiwork of an intelligent agent?

However, despite these clear shortcomings in emergentists' approach to biology, I conclude that NE's presuppositional commitment to empirical observation does cohere with our scientific compatibility principle. In fact, it might be said that emergentists take this presupposition too far—that is, they cleave so tightly to this one presupposition that they loosen their grip on the

54. Philip Anderson, "More Is Different," *Science* 177 (1972): 393–6.

55. Robert Laughlin, "Fractional Quantization in High-Temperature Superconductivity," *Mechanisms of High Temperature Superconductivity* (1989): 76–88.

56. Leonard Susskind, *The Cosmic Landscape: String Theory and the Illusion of Intelligent Design* (New York: Little, Brown, and Company, 2006).

57. See, e.g., Clayton and Davies, *The Re-Emergence of Emergence*.

58. Loyal Rue, *Nature Is Enough*, 121.

59. I am grateful to an anonymous reviewer for highlighting this insight.

other six. They look at the world and see value; therefore value must be real. Then they look closer and it seems that value seems to emerge inexplicably from valueless matter; therefore, it must be so. Observation is both the beginning and the end of the emergentist program.

Summary of Emergentism's Compatibility with Science

What shall we say in summary? On a positive note, emergentism does hold to two presuppositions compatible with practicing science. Despite some dubious appeals to probability, emergentists generally hold the view that mathematics provide a reliable method for describing and predicting the world's regularities. They also have shown a commitment to fastidious empirical observation of the natural world.

However, in the final analysis, NE's philosophical foundation is incompatible with the scientific enterprise. Naturalist philosopher and artificial life theorist Mark Bedau agrees:

All the evidence today suggests that strong [that is, ontological] emergence is irrelevant. There is no evidence that strong emergence plays any role in contemporary science. The scientific irrelevance of strong emergence is easy to understand, given that strong emergent causal powers must be brute natural phenomena. Even if there were such causal powers, they could at best play a primitive role in science. Strong emergence starts where scientific explanation ends.⁶⁰

Emergentists' claims to the existence of inscrutable emergent forces are incompatible with science's grounding in reliable human knowledge. Their insistence on nature's unpredictability cuts against science's reliance on natural regularity. Their belief in lawless emergent behavior is antithetical to science's search for natural law. Their preference for an unending multiplicity of emergent forces to explain observed phenomena is a direct affront to science's preference for parsimony. And their rejection of a future that resembles the past makes science's efforts at experiential explanation impossible. NE fails as a scientifically compatible worldview.

Potential Objections

Emergentists could respond to my analysis in various ways. First, some may argue that the list of requisite philosophical presuppositions may work

60. Bedau, "Downward Causation and Autonomy in Weak Emergence," in *Emergence: Contemporary Readings in Philosophy and Science*, ed. Mark A. Bedau and Paul Humphreys (Cambridge, MA: Bradford, 2008), 159.

just fine for the “old science” but are woefully inadequate for evaluating the “new science” represented by NE. “However, a problem seems to face the emergentist here,” says Mikael Leidenhag.

Given the epistemological position of emergence, the idea that emergent properties/phenomena are ultimately unexplainable and unpredictable (something they mean should invite a sense of wonder), it is not possible to give a case for the causal effectiveness of emergent properties or to offer a positive account of emergence relations. If you maintain that emergent properties are ultimately a mystery, that they transcend human knowing (that we are facing a genuine epistemological problem), then you have no way of determining if these properties can exert causal effectiveness and hence be considered ontologically real.⁶¹

In other words, on what firm foundation are we building our “new science”? None at all. Under the most charitable interpretation, NE is carving out certain nonreductive territories (for example, consciousness, value, ethics) in which brute naturalistic emergent forces are presumed to be at work.⁶² But surely this arbitrary assertion of primitive fact does not resemble anything like the scientific spirit that doggedly follows the empirical evidence to discern regularities in the observable universe. Others may cite recent attempts underway to develop relational ontologies that would describe ontological emergence in terms of laws relating entities within systems.⁶³ But even if we assume these attempts will be successful, in what meaningful sense does relational ontology differ from reductionism if in both cases we are reducing systems into laws and properties? For these reasons, the “new science” argument is unconvincing.

Second, some emergentists may argue that in many disciplines, reductionistic science may proceed much as before, now only within a broader emergentist worldview. This objection also fails for reasons stated at the outset of this paper: science can only be practiced in the context of a set of metaphysical assumptions compatible with it. Although many of the emergentist scientists and philosophers cited herein live out their professional lives in the murky area between methodological reductionism and metaphysical emergentism, they do so at great injury to their philosophical coherence. As

61. Leidenhag, “The Relevance of Emergence Theory in the Science-Religion Dialogue,” 980.

62. Here also I am grateful to an anonymous reviewer for pointing out that proponents of NE seem to offer no evidence for the existence of these naturalistic emergent forces. Such novelties play the role of God, but on pain of removing a guiding intelligence from the picture. This sort of explanation is, in a sense, “bruter” than theism insofar as it credits undirected novelties with the origin of order.

63. See, e.g., Gil C. Santos, “Ontological Emergence: How Is That Possible? Towards a New Relational Ontology,” *Foundations of Science* 20, no. 4 (2015): 429.

emergentists are coming to realize,⁶⁴ the coherent emergentist must reject the methods of reductionistic science.

Third, other emergentists may seek to shore up their philosophical foundation by moderating Kauffmanian claims of lawless phenomena and nonergotic emergence. This “weak emergence” strategy holds more promise for the emergentist than most others, but it too runs into serious problems. The emergentist’s most common and paradigmatic example of emergence is the conscious mind. Every thought is an emergent entity. But if all scientific praxis is contingent on the mind, then science itself (by virtue of being an intellectual pursuit) is by extension the product of lawless emergence. No matter how much one moderates Kauffman’s claims about the rest of the universe, the emergentist’s central claim about the human mind—an emergent thing—renders it incompatible with the philosophical presuppositions necessary for science to flourish.

Fourth and finally, emergentists may accept the ramifications of scientific incompatibility in an unqualified way. While this too is a live option, its claimant bites many bullets. True, those emergentists who are able to keep their science-offending commitments in the shadows may enjoy long and happy scientific careers as reductionistic pretenders. But those who are more vocal may find themselves pushed to the fringes of the research community or perhaps instead gather to advance NE in small cohorts.

To these and other objections we may respond more generally with an argument from NE’s existential viability. Does NE meaningfully preserve value, meaning, and purpose in the same sense as theists understand these terms? It seems not. In the final analysis, reductionists may be forgiven for wondering what emergentists’ “hope in the creativity of the natural world” had earned them? Neither NE nor NR give humans the final word on meaning—that verdict rests with that which will outlast the emergentist and the reductionist alike, the universe itself, and in that verdict neither worldview forecasts a meaningful outcome.

Conclusion

In this paper I have argued that naturalistic theories of ontological emergence are incompatible with the philosophical preconditions necessary for practicing science. I defended this thesis by first repurposing Plantinga’s list of philosophical presuppositions into a rubric by which to assess any worldview’s compatibility with science. I then surveyed emergentist literature with a focus on Kauffman’s *Reinventing the Sacred* to understand the primary claims of emergentism. With these foundations in place, I assessed emergentism’s compatibility with science according to the seven philosophi-

64. See, e.g., Wimsatt, *Re-Engineering Philosophy for Limited Beings*, 347.

cal preconditions and found it successfully upholds two, but precludes five. For these reasons I found emergentism wholly incompatible with practicing science. This finding will no doubt encounter dissenting objections from the emergentist community, a few of which I try to anticipate and address as similarly flawed. Fruitful areas for further research include applying the rubric used herein to a wider range of worldviews—I suspect we may be surprised to learn how few enjoy deep coherence with the philosophical mores of the scientific enterprise.⁶⁵

65. Another potentially fruitful area for further research is the area of supervenience. I suspect the theist has the most cogent explanation for the existence of supervenient properties, namely the intent of an intelligent designer. NE allows for supervenience also, but there supervenience *is* the explanation. So which is preferable: no supervenient properties (NR), brute supervenient properties (NE), or created supervenient properties (theism)?