20. Consciousness and Quantum Information[1]

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§1. Minding Our Business

We have a lot of business to attend to in this essay. Our subject is the nature of reality, the nature of mind, and the nature of the relationship between mind and reality as mediated by the mind-brain connection. Exploration of these themes will take us through quantum physics and quantum cosmology and their implications for the ultimate nature of the universe, to a deeper understanding of consciousness and its relationship to the brain, and finally to some concluding observations about the nature of death and the adventure of a scientific and philosophical life. A map of our journey is in order. We'll begin by limning the consequences of the irreducibly probabilistic nature of quantum descriptions, nonlocal quantum phenomena, the separability of microphysical properties from anything like a substrate, and the measurement problem (**§2**), then briefly canvass supervenience and emergence accounts of how the macroscopic world of our experience depends on the microworld of quantum phenomena, showing how material substance disappears with the quantum-theoretic dissolution of material identity and individuation (**§3**). What fundamental physics leaves us with is a world of phenomena conforming to certain mathematico-structural constraints minus an origin or grounding in any substantial *material* reality. Material substances do not exist.

What, then, *is* the natural world and what accounts for its regularity? Nature is regular despite the absence of material substances and sufficient reasons for observing one outcome rather than any other in fundamental physics. Can we accept this as a *brute* fact or is an explanation required? I'll argue that the *principle of sufficient reason* (PSR)—understood as the requirement that every contingent state of affairs has an explanation—is epistemically, logically, and metaphysically necessary. It points to the necessary existence of something that is the terminus for all contingent explanations. Since nature's regularities are themselves contingent and cannot proceed from *nonexistent* material substances (which would also be contingent, if they existed), they must be grounded in an immaterial, transcendent, necessarily existent cause (**§4**). Our experiential reality must be *merely phenomenological* and regulated by *transcendent mental action*. God

must therefore exist as the ground of all being, and divine mental causation must be the foundation of the natural order. The foundational metaphysical picture is provided by theistic quantum idealism.

This gives the picture from the bottom up. What do things look like from the top down? How is our local experience integrated into the universe as a whole? This is the province of quantum cosmology, ruled heuristically by the Wheeler-DeWitt equation, the solution of which is the "wavefunction of the universe" (universal wavefunction). In its reconciliation of general relativity with quantum physics, this equation describes the world as a static four-dimensional entity. Nonetheless, local observers *within* the universe experience dynamical systems with probabilistic time-dependent measurement outcomes. These seemingly incompatible pictures can be reconciled in quantum cosmology, and there is experimental evidence for this reconciliation (**§5**). While reality from the bottom up is the mental result of occasionalist divine action,[2] reality from the top down is a singular timeless mental act in which God thought of the universe—and created the mental substances in it—as a static four-dimensional spatiotemporal entity. God transcends created reality as an incorporeal, timeless, necessarily existent being whose essence does not change with the creation of the universe. Furthermore, much as the occasionalistic divine action in the immanent frame *removes* any distinction between creation and providence in the natural order, so too does bringing all of spacetime (which includes all moments of time—past, present, and future) transcendently into being in a singular, timeless divine act.

These immanent and transcendent pictures are integral to the nature of reality as a quantum-informational construct (**§6**). Information, being neither self-explanatory nor metaphysically autonomous, requires a substrate which, in the absence of anything physical, requires immaterial mental substances as a medium. The timeless quantum-informational construct of our universe is transcendently grounded in the divine mind and experienced immanently and dynamically by created minds. Correspondingly, the universal wavefunction is an expression of divine omniscience—it represents the quantum information constitutive not only of everything that *has happened* and *will happen*, but of everything that *could have happened* and *might have resulted* as a consequence. God transcendently orchestrates the decoherence of quantum information in the universal wavefunction to achieve his purposes in created reality and in concert with the decisions of finite created agents. But the universal wavefunction as a representation of the ramified possibilities in created reality is a timeless book-keeping device that—apart from the consciousnesses of created beings who collectively share one (and only one) *phenomenological* path through its interwoven superposition of experiential possibilities—has its existence *solely* in the divine mind.

Individual human beings perspectivally experience divinely caused phenomenological structures and properties as part of a shared perceptual reality. The phenomenology of our brain states, which are divinely-given information-processing channels for the quantum information generative of perceptually embodied experience, are subject to empirical study just like every other aspect of experiential reality. Quantum-informational neuroscience analyzes the phenomenology of the neuroanatomical and neurophysiological correlates of our phenomenological experience (**§7**). For the perceptually embodied individual in the quantum-informational construct constitutive of our universe, this analysis requires an examination of the role of coherent and decoherent

quantum states in the neurophenomenology of brain mechanisms (*§7.1*) as well as a broader analysis of how experiential consciousness is neurophenomenologically correlated with structures and processes in the brain (*§7.2*). We will sketch how investigations of this nature can be pursued programmatically through adaptations of Matthew Fisher's research in quantum cognition and Giulio Tononi's integrated information theory of consciousness.

It must then be asked how conscious interaction with the world and other minds should be modeled. We have seen how immaterial consciousness constitutes fundamental reality and therefore is *not* what needs to be explained, but rather is what makes explanation possible. *Theistic conscious realism* thus provides the metaphysical foundation for research into the dynamics of consciousness (**§8**). An adaptation of Donald Hoffman's conscious realism—extracting it from the context of evolutionary naturalism and its resultant antirealism and grounding it in theistic quantum-informational idealism—provides just what is needed. Specific conscious experiences are conditionalized on specific states of the world, decisions are conditionalized on experiences, and changes in the world are conditionalized on actions taken, so these conditional probabilities, which characterize the flow of individual consciousness, can be modeled using Markov kernels (*§8.1*). Interestingly, this *formal* model for individual conscious experience allows us to *combine* different subjects of such experiences into an *interpersonal* or *transpersonal* description that has the same mathematical properties as the individual conscious agent. On the hypothesis that the world consists entirely of conscious agents defined *solely* in terms of this mathematical formalism—which, of course, they cannot be—the *formal* combination of any two conscious agents makes *another* conscious agent, which then can be combined with *another* conscious agent, and so on, until *all* finite conscious agents are conjoined in one *ultimate* conscious agent (*§8.2*).[3] Interactive conscious agency, so modeled, asymptotically exhibits quantum dynamics: the harmonic functions of the spacetime chain associated with the dynamics of a system of conscious agents have the same mathematical form as the non-relativistic quantum wavefunction of a free particle. Extended to a relativistic context, the corresponding wavefunction could be interpreted as the universal wavefunction, so reality again would have the character of a quantum-informational construct in the mind of God, who would then be understood as the universal conscious agent. Such a proposal obviously needs careful formulation and analysis, for God is *not* the combinatorial sum of finite conscious agents, nor do we, as finite conscious agents, lose our individuality to a combinatorial corporate mind. We do, however, share a *corporate reality* that is the *product* of God's mind, so our discussion of conscious dynamics will conclude by showing how a *relational metaphysic* provides an abstract model for corporate reality that conjoins *theistic quantum-informational idealism* with *theistic conscious realism*.

We'll wrap up this essay by tying together two loose ends. First, we'll move from the neurophenomenology of brain-linked consciousness to a brief evaluation of phenomenological descriptions of consciousness *decoupled* from brain states. This will involve consideration of salient phenomena from out-of-body near-death experiences (NDEs), discussion of possible connections to quantum nonlocality, and connection to Christian-theistic metaphysics and issues of individual and corporate eschatology (**§9**). Lastly, we'll consider how science should be conceptualized and practiced in the context of theistic quantum-informational

idealism and theistic conscious realism. Notably, we'll highlight how a uniformitarianism recognizing intelligent causes and permitting design-theoretic inferences has a proper place in scientific investigation, since God's mind defines past, present, and future reality, and we're privileged endlessly to explore God's inexhaustible imagination (**§10**).

§2. Quantum Reality

Quantum mechanics sets aside classical conceptions of motion and the interaction of bodies and introduces acts of measurement and probabilities for observational outcomes in an irreducible way, that is, in a way that cannot be resolved by an appeal to our inability to observe what is actually happening (in fact, quantum physics shows this peculiarity is a real part of the world rather than an artifact of our limited knowledge). In classical mechanics, the state of a physical system at a particular time is completely specified by giving the precise position and momentum of all its constituent particles, after which the equations of motion determine the state of the system at all later times. In this sense, classical mechanics is deterministic. But quantum mechanics does not describe systems by states in which particle position and momentum, for example, have simultaneously defined values. Instead, the state of the system is described by an abstract mathematical object called a *wavefunction*. The wavefunction of a quantum-mechanical system is governed by the Schrödinger equation, which evolves deterministically in time as a linear superposition of different states. This deterministic evolution is altered by the measurement process, which, when the measurement has an actual result, always finds the system in a definite state with a particular value in accordance with a probability specified by the Born Rule. After such a measurement, the future development of the quantum system is based on the state the system was measured to be in, so measurements restrict the future development of the system in an irreducibly probabilistic way not determinable from the Schrödinger evolution. Furthermore, the Born-rule probabilities, given by the square of the amplitude of the wavefunction, are such that they cannot *all* equal zero or one (be representative of impossibility or necessity). This fact is expressed in Heisenberg's indeterminacy (uncertainty) principle: no mathematical description of the state of a quantum system assigns probability one (determinateness) to the simultaneous existence of exact values for certain complementary pairs of observables. The particular value resulting from the measurement of a quantum observable thus can be *irreducibly* probabilistic in that *no sufficient condition* is provided for one value being observed rather than another permitted by the wavefunction. Quantum physics is indeterministic in this sense. Also, since all the information about a quantum system is contained in its wavefunction, no measurement of the current state of a system suffices to determine the value that a *later* measurement of an observable will reveal. This is another (related) sense in which quantum physics is indeterministic.

That our reality is described at its most fundamental level by such mathematics has a variety of experimentally confirmed consequences that preclude the view that we live in a world of mind-independent material substances governed by material efficient causation. The most rudimentary of these consequences is that quantum reality does not exist (is not defined) until it is measured (observed, experienced). A straightforward demonstration of this fact is provided by the delayed-choice quantum eraser experiment proposed in 1982 and later successfully performed.[4] This experiment is an analogue of the two-slit experiment

demonstrating wave-particle duality, with the added wrinkle that a which-path particle measurement is made *after* quantum wavefunction interference phenomena have been created. The interference can be turned off or on by choosing whether or not to look at the which-path information *after* the interference already exists. Choosing to look erases the wavefunction interference as if it had never happened and gives the system a particle history. It would be a mistake to think that this is an example of backward causation, however. Rather, the wavefunction entanglement responsible for interference is fundamentally *nonlocal* and which-path measurement catalyzes instantaneous localization. More recently, a quantum erasure experiment has been performed under Einstein locality conditions.[5] In this experiment, the erasure event procuring which-path information is relativistically space-like separated from the registered passage of the interfering system through the interferometer, meaning that *no physical signal* could connect the choice to look with the interference. The fact that we can choose—at space-like separation *after* the relevant measurement interaction has taken place—whether wave or particle phenomena manifest in a quantum system demonstrates that no causally-connected substantial material reality exists at the microphysical level.[6] This also shows that wave-particle complementarity and quantum nonlocality are directly related.

Nonlocality is straightforwardly demonstrated by the Einstein-Podolsky-Rosen (EPR) paradox and Bell's Theorems. In 1935, Albert Einstein, Boris Podolsky, and Nathan Rosen argued that the quantum description of physical systems must be *incomplete* because there are elements of reality that quantum theory does not recognize. To make this case, they considered a situation in which two quantum particles interact so as to *entangle* their spatial coordinates with each other and their linear momenta with each other.[7] As a result of this wavefunction entanglement, measuring either the position or the momentum for one particle instantaneously fixes the value for that same observable for the other particle, no matter how far apart they are. If one then assumes, as the 1935 paper did, that what counts as an element of reality for the second particle is independent of which measurement is performed on the first particle, then reality can be attributed to both the position *and* the momentum of the second particle, since measuring the position or the momentum of the first fixes the position or the momentum of the second without disturbing it and without any signal (subject to the limiting velocity of light) having passed between them. As rendered in the EPR paper: "If, without in any way disturbing a system, we can predict with certainty (i.e., with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity."[8] Since quantum theory does not allow the second particle to have both position and momentum simultaneously, it is incomplete.

By way of response, Bohr argued that EPR missed the point of quantum-mechanical descriptions by ignoring the *different contexts of measurement*.[9] He agreed that measuring *either* the position *or* the momentum of one particle would render *either* the position *or* the momentum of the other particle an element of reality but *denied* that the results from these different experimental contexts could be *combined*. In other words, if we try to make context-independent claims about what is real in a distant system, we will violate quantum-mechanical predictions and run afoul of experiment. This amounts to the claim that *measurement* of the first particle *can constitute what is real* about the second particle, even when

they are separated by a distance that would prohibit any signal (subject to the limiting velocity of light) from passing between them.

While Bohr's attempt to justify these claims generated much confusion,[10] John Bell's work on the EPR argument and missing elements of reality,[11] along with subsequent experimental tests,[12] has shown that Bohr was essentially correct and Einstein wrong about the completeness of quantum mechanics. As we've noted, the wavefunctions of interacting quantum systems can become entangled in such a way that what happens to one of them instantaneously affects the other, no matter how far apart they have separated. What Bell showed is that, if quantum theory is correct, no hidden variables (empirically undetectable elements of reality) can be added to the description of quantum systems exhibiting such *nonlocal* behavior that would explain these instantaneous correlations on the basis of *local* considerations. As mentioned, subsequent experiment showed that quantum theory is correct and complete as it stands. Since all *physical* cause-and-effect relations are local, however, the completeness of quantum theory implies the *physical incompleteness* of reality: the universe is shot through with mathematically predictable nonlocal correlations that, on pain of experimental contradiction, have *no* physical cause.[13]

The radicalness of nonlocality is actually deeper than this because it extends to isolated quanta as well. Stated roughly, it has been shown that if one makes the reasonable assumptions that an individual quantum can neither serve as an infinite source of energy nor be in two places at once, then that particle has *zero* probability of being found in any bounded spatial region, no matter *how* large.[14] In short, unobserved quanta do not exist *anywhere* in space, and so, realistically, have no existence at all apart from measurement.[15] Hans Halvorson and Robert Clifton closed some minor loopholes and extended this result by showing it holds under more general conditions—including when the standard relativistic assumption that there is *no* privileged reference frame is dropped.[16] The proper conclusion seems to be that there is no intelligible notion of microscopic material objects: particle talk has pragmatic utility in relation to measurement results and macroscopic appearances, but *no* basis in an unobserved mind-independent microphysical reality. There are no mind-independent micro-*physical* substances.

This is further evidenced in that microphysical properties can be seen to be separable from anything like a substrate. The Cheshire Cat in *Alice in Wonderland* famously disappeared leaving only its grin, prompting Alice to remark that she had often seen "a cat without a grin, but never a grin without a cat." Quantum physics has its own version of a Cheshire Cat in which a quantum system behaves as if quantal position is spatially separated from another property like polarization or spin.[17] For example, an experiment was performed using a neutron interferometer that sent neutrons along one path while their spins traveled along another.[18] Translated into macroscopic terms, this would be like performing measurements on red balls that sent their sphericity along one path and their redness along another. Under appropriate measurement conditions, quantum systems are decomposable into disembodied immaterial mathematical properties, in short, a collection of Cheshire Cat grins.[19] Since an abstract collection of properties cannot cohere except in a substance, in the absence of a physical substrate, they must be mentally caused to cohere in a mind.

But what about the macroscopic world of our experience? How should we understand the transition between the microscopic realm and the macroscopic world? This question leads

to the second famous paradox of quantum theory, *the measurement problem*, first described in Erwin Schrödinger's famous "cat paradox" paper.[20] In Schrödinger's iconic example, a radioactive atom with an even chance of decaying in the next hour is enclosed in a chamber containing a cat and a glass vial of poison. If a Geiger-counter detects the radioactive decay of the atom in that hour, it triggers a relay that causes a hammer to smash the vial and release the poison, thus killing the cat; otherwise, the cat survives. After an hour, the quantum wavefunction for the whole system (atom + counter + relay + hammer + vial + cat) is in an unresolved superposition that involves the cat being neither dead nor alive. The question of *where* and *how* the superpositions in the wavefunction produce a determinate result is the essence of the measurement problem. Is the determinate result a consequence of some special random process? Is it due to the quantum system's interaction with a macroscopic measurement device? Is it somehow connected to the *act* of observation itself? Is determinateness perhaps not manifested until the result is recognized by a *conscious* observer? This issue arises because every quantum wavefunction is expressible as a superposition of different states in which the thing it describes, say an alpha particle that could be ejected from an atomic nucleus, fails to *possess* the properties specified by those states. At any given time, then, some features of a quantum object occupy an ethereal realm between existence and non-existence. Nothing subject to a quantum description *ever* has simultaneously determinate values for *all* its associated properties.[21] And these ethereal superpositions percolate upward into the macroscopic realm because anything composed of quanta is always in a superposition of states, even though destructive interference (what physicists call *environmental decoherence*) may give the *appearance* that the wavefunction has "collapsed" into the determinate reality we observe.[22]

That macroscopic reality has no more material substantiality than microscopic reality is furthermore evident in that, under special conditions in the laboratory, we can create *macroscopic* superpositions, that is, macroscopic coherent states. Not only have large organic molecules been put into quantum superposition,[23] but Superconducting Quantum Interference Devices (SQUIDs) have been put in combined states involving over a billion electrons moving in a clockwise direction around a superconducting ring, while another billion or more electrons simultaneously move around it in an anti-clockwise direction, placing two *incompatible macroscopic currents* in superposition.[24] With respect to this macroscopic superposition of incompatible states, one might think the pressing question is: in what direction are the electrons *supposed* to be moving*?* Which of the incompatible macroscopic states is *supposed* to be real? But this question has no answer and is not the right one to ask. The correct question is: What do macroscopic superpositions demonstrate about the *nature of reality*? And the ineluctable answer is they show us that *none of the superposed states are materially substantial*—they are *mere* phenomena, multimodal percepts superimposed on conscious awareness.[25]

Neither the phenomena of quantum physics nor their mathematical descriptions are consistent with the view that the world of our experience has its causal ground in material substances. Our world is a world of *mere* phenomena. Moreover, given the irreducibly probabilistic nature of quantum outcomes and nonlocal correlations, and given relativistic constraints on causality, we must ask how the causal structure of our world is grounded and whence

sufficient causality derives. Why does the world of our experience cohere at all, let alone in a regular way that makes science possible?[26]

§3. From Microscopic to Macroscopic[27]

How does the macroscopic depend on the microscopic, and how does the transition between microphysics and the classical world of macroscopic appearances happen? Consideration of *supervenience* and *emergence* in quantum physics is needed, for these concepts are invoked to advocate various reductive and non-reductive physicalist pictures of nature that prove untenable on close examination.

3.1 Sisyphean Supervenience

The physicalist account of the dependency relation of the macroscopic on the microscopic, understood as a supervenience thesis, requires a mereological supervenience in which the macro-properties of material things supervene on their micro-properties. This mereological supervenience relation could be articulated in a variety of ways. To differ from a nomological or even broadly logical (metaphysical) reducibility, however, the relationship needs to be anomalous in the same way that Davidson's anomalous monism[28] tries to account for the supervenience of the mental on the physical. Using Jaegwon Kim's distinction, this requires *weak* as opposed to *strong* supervenience,[29] but weak mereological supervenience is insufficient to ground the objecthood of macroscopic substances in relevant micro-properties. Strong mereological supervenience is what the physicalist requires, and this commits him to the nomological *reducibility* of the macro-world to the micro-world.[30] Non-reductive physicalism is not an option here. The physicalist needs a nomological specification of how macroscopic material objecthood is produced from intrinsic facts about the parts composing it, together with the spatial relationships among those parts.

But now the nature of quantum reality comes to bear. The fundamental quantum "parts" of macroscopic objects don't have well-defined spatiotemporal locations and are not subject to this kind of metaphysical analysis. They are not autonomous material objects, they do not possess a complete set of determinate properties, they have no intrinsic identities, they are not individuals, and they have no substantial material existence. Furthermore, where nonlocal phenomena are concerned, no supervenience of nonlocal quantum systems on the properties of various subsystems taken separately or in other combinations is possible—the relevant joint probabilities are not factorizable. Nor, for this very reason, are there objective properties of the system immediately prior to measurement that can provide the nomologically necessary connection to measurement results required by any viable supervenience explanation of the macroscopic on the microscopic realm. The postulation of such objective properties leads to empirically false consequences for both local deterministic and local stochastic models.[31]

Whence, then, the supervenience explanation of macroscopic material objecthood? Nowhere at all, it would seem. Supervenience explanations for the material identity of macroscopic substances based on subvenient quantum systems are a complete nonstarter. In an ironic turn, fundamental *physical* theory renders impossible any *physicalist* account of macroscopic supervenience on microphysical entities and laws.

3.2 Empty Emergentism

The essence of emergentism is a layered view of nature. The world is divided into ontological strata beginning with fundamental physics and

ascending through chemistry, biology, neuropsychology, and sociology. The levels correspond to successive organizational complexities of matter, and at each successive level there is a special science dealing with the complex structures possessing the distinguishing causal characteristics of that level. Higher-level causal patterns necessarily supervene on (are dependent upon) lower-level causal interactions, but are not reducible to them. The resultant picture is of emergent nomological structures irreducible to lower-level laws, with emergent features not only affecting the level at which they appear, but also exercising "downward causation" on lower-level phenomena.

In this regard, it is true that classical (Maxwell-Boltzmann) statistical behavior can be understood to *emerge* from quantum (bosonic and fermionic) statistics in both the classical-mechanical and classical-statistical limits. While these limits are useful in understanding how quantum descriptions give rise to classical *appearances*, they are unenlightening as an explanation of how macroscopic material *substances* emerge, and irrelevant in cases involving nonlocality.[32] Classical appearances result from environmental decoherence (essentially, statistical damping through wavefunction orthogonalization) that gives quantum-mechanical ephemera a cloak of macroscopic stability, but decoherence does not solve the measurement problem to produce a substantial material reality. The seeming solidity of the world is a mere *epiphenomenon* of quantum statistics; the underlying phenomena retain their quantum-theoretic essence while sustaining classical *appearances*.

Trying to explicate macroscopic emergence with the analytical tools of supervenience fails for reasons already discussed. In particular, nonlocal quantum phenomena do *not* supervene on the properties of their subsystems taken separately or in other combinations, and any viable account of nomological necessity in the quantum realm must connect objective properties of the system immediately *prior to* measurement with the results obtained. Imposing such restrictions generates empirically false consequences in both local deterministic and local stochastic models.

If we move to *non-supervenient* descriptions and consider contemporaneous parts of nonlocal wholes, however, we must relativize contemporaneity to reference frames. This creates a new difficulty: the properties of nonlocal quantum systems can differ depending on which frame is in view. In some frames, for example, the quantum wavefunction may have collapsed, while in others this won't have happened yet. There are an infinite number of reference frames, however, some of which intersect, and ontologically inconsistent properties may be attributable to the quantum system at some intersections, for example, that it's *both* collapsed and not collapsed. If we resolve the contradiction by embracing the *nonlocalizability* of quantum particles, then they don't exist anywhere and can't be real. Since the particles are still nonlocalizable even if we postulate a privileged reference frame,[33] the same conclusion follows. In short, particle ontologies are untenable and cannot provide a metaphysical basis for the emergence of macroscopic substances from the quantum realm.[34]

This situation is *not* ameliorated by switching to a quantum field ontology. The same ontological contradictions arise involving states of the field, and the fields themselves exhibit states of superposition of contradictory numbers of quanta that not only render the intrinsic substantiality of the quanta impossible, but also that of the field itself.[35] *Non-supervenient* descriptions of quantum emergence are therefore explanatorily vacuous too, and emergentism

fails as naturalistic science at the most basic level of physical theory. We have mathematical *descriptions*, but we don't have *explanations*.

§4. The Principle of Sufficient Reason and the Nullification of Natural Necessity

The mathematical *descriptions* of quantum physics tell us how nature behaves, but they do not tell us *why* nature behaves that way. Insofar as these descriptions give us a picture of the development of a physical system, they require initial and boundary conditions to do so, conditions that also need explanation. But the more fundamental question is *why is nature regular at all*? And what about probabilistic regularities—like those of quantum physics—that give distributions over a range of possibilities for observable outcomes, but provide *no sufficient reason* for the observational result? Could we just say *no* explanation exists, maintaining that laws of nature are *mere* regularities, as David Hume did? Perhaps, like David Lewis, we could advocate a sophisticated regularist theory of physical laws.[36] But this still leaves us asking *why is nature regular at all*, and *what keeps it so*? A stable universe of *mere* regularities is a perpetual miracle.

Saying that no explanation is required entails denying the principle of sufficient reason (PSR) that *every contingent state of affairs has an explanation*. Indeed, where the regularities of nature are concerned, the PSR must be denied on a universal scale. But this would be a mistake of disastrous proportions. If there were no sufficient reason why one thing happens rather than another, if the regularities of nature were metaphysically ungrounded, our current perception of reality and its accompanying memories could be happening for no reason at all, so the world of our experience might be totally adventitious. How could we know? As far as science is concerned, if a physical state of affairs *can* lack an explanation, then the possibility of *no explanation* becomes a competing "explanation" for anything that occurs. Since no objective probability and hence no likelihood is assignable to something for which there is no explanation, the possibility of no explanation becomes an inscrutable competitor to every other proposed explanation, undermining our ability to decide whether a scientific explanation exists for *anything* that happens. So denying that every contingent event has an explanation not only destroys the possibility of science, it engenders irremediable skepticism and undermines *all* knowledge. So we must conclude that the PSR is a broad logical truth that we know *a priori*; it is a *precondition* for all knowledge and for the intelligibility of the world.[37]

Consider now the contingent facts of cosmology. Whether our universe—or multiverse, if you grant credence to fashionable speculation—had an absolute beginning or is postulated to emerge from some timeless quantum state, the fact that something exists that *did not have to exist* is a contingent state of affairs requiring explanation. This explanation cannot be provided by another contingent thing, for it too would require an explanation. Even a beginningless series of contingent universes, each one causing the next in succession—if such were possible—would be something that didn't have to exist and thus begged explanation. Explaining why there is something rather than *absolutely* nothing must terminate with an entity that exists *necessarily* and is capable of acting as a cause. It's a necessary truth, therefore, that a necessary being is the *ultimate* explanation for contingent states of affairs, including our universe's existence. This brings us to the cusp of recognizing that the existence of a being like God is required both to ground

knowledge and to explain why anything exists to be known.[38]

So, what explains the "laws" of nature and their accompanying initial and boundary conditions? Even more, what explains the outcome of probabilistic regularities that *lack sufficient conditions* for any given result? A metaphysical account of what we mean by *laws of nature* that involves the PSR is needed. To this end, some philosophical naturalists argue that natural laws are *metaphysical necessities* similar to statements like *No mammals are mathematical propositions*. But this cannot be right. Take Coulomb's law, for example: the fact that two like (or different) charges repel (or attract) each other with a force proportional to the magnitude of the charges and inversely proportional to the square of the distance between them gives *no* hint of being metaphysically necessary. The world could have been different. Other philosophers have suggested that laws of nature are *contingently necessary relationships* among universals mirrored among the corresponding particulars. Oxymoronic appearances aside, no coherent account of this claim has been produced. Merely calling something "necessary" doesn't make it so. Finally, other would-be necessitarians propose that physical laws derive from innate causal powers grounded in the essential natures of things and inherent in their material substance. These laws are supposedly manifested through forces or fields that, by natural necessity, emanate from associated material substances, mediating physical interactions in a necessary way. But why should *this* causal power necessarily flow from *that* material substance? Things could have worked differently.[39]

Even if naturalistic accounts of physical law weren't *metaphysically* inadequate, however, quantum physics manifests their untenability. There is no sufficient physical explanation for one value being observed rather than another permitted by the wavefunction—or, if you prefer, there is no sufficient condition for finding oneself in one reality rather than another included in the wavefunction. The natural reality behind our experience is causally incomplete in a way that shows it *cannot* be autonomous. Causal closure is achieved by a transcendent immaterial cause that is always active, not by contingent postulations introduced in a futile effort to make nature autonomous. The best explanation for constantly active transcendent immaterial causality is, of course, divine providence. Quantum physics provides a *ceteris paribus* description of divine action and divine freedom in creation and the created order. All causal appearances in inanimate nature simply *are* the result of divine action. This point needs further elucidation.

A crucial question is whether God's providential action could be realized by creating natural kinds with causal powers intrinsic to their substantial natures, so that nature is ordered by way of a primitive metaphysical necessity. This suggestion is irremediably problematic. Its theistic defenders generally maintain that to disallow such a primitive metaphysical necessity is to confuse metaphysics with epistemology or, more specifically, the necessary with the analytic or *a priori*. They say that it is not required for us to see why *this* causal power flows essentially from *that* essential nature as long as it is clear from God's point of view. No. Since the causal powers in view are not conceptually manifest in the essential natures of the corresponding natural kinds, they only coincide with that kind because God *freely made it so*. If there is no conceptual reason why a *different* causal power might not be manifested, it remains a metaphysical possibility that it *could have been*, had God so decided. Rejecting conceivability as a reasonable guide to metaphysical possibility constrains God's

power unjustifiably and strips us of the only analytical tool we have, leaving us defenseless against ungrounded assertions. This doesn't make these divine decisions arbitrary, however, for God undoubtedly has a reason for ensuring that certain causal behaviors and not others attach to the natural kinds that exemplify them.

This means that Thomistic secondary causation isn't an adequate account of God's governance of nature. For secondary causation to operate in inanimate nature, essential states of material substances must exist to generate the lawlike behaviors we observe. But we have just seen that there's *no necessary metaphysical connection* between any material substance and its supposed causal power. God could have associated a different causal power with that material substance. Material substances are observed to function in the way they do, therefore, because God chose to manifest the associated causal powers through those substances, which means they *cannot* be functioning in a secondary causal capacity. Rather, God is *continuously acting* to produce those behaviors in those substances. When we realize that material substances possess no intrinsic causal powers, however, we move from secondary causation to *occasionalism* as the better account of divine providence: God is the sole efficient cause of everything happening in that portion of nature not subject to the influence of creatures with libertarian freedom.

Beyond this, of course, the whole picture is moot because quantum physics shows *there are no material substances* to bear intrinsic causal powers in the first place, even if it had made sense to say that they could do so. What's left, then? Without material substances, divine causality becomes *mental causation* generating an intersubjective perceptual reality for the finite minds God has created. The physical world of our perception is therefore a world of *mere* phenomena produced by the mental causation constitutive of divine action. In this context, irreducible quantum probabilities for *observables* show that occasionalist quantum idealism is the proper model for divine action.[40] So-called "physical laws" therefore become *regularities of divine action*. A general form for the physical regularities of our experience is thus:

> If collective conditions C were observed, all other things being equal, with quantum-mechanical probability p, God would cause state of affairs S to be observable.

For example, if the temperature of fresh water at sea level were observed to be raised to 100 degrees Celsius, all other things being equal, with high quantum-mechanical probability, God would cause the boiling of that water to be observable. The mathematically describable regularities of nature are thus *active* expressions of God's perpetual faithfulness (Ps. 33:4; Ps. 119:90; 2 Tim. 2:13). God is the one in whom we live and move and have our being (Acts 17:28), the one who is before all things, and in whom all things hold together (Colossians 1:17). Furthermore, when the mode of divine providence is occasionalistic, there's no practical distinction to be made between creation and providence since reality, *in toto*, is realized through divine action (mental causation) in the form of *creatio continua*.

§5. The Significance of Quantum Cosmology

We examined "physical reality" from the bottom up, inquiring after the nature of macroscopic reality when quantum physics describes the microworld. We arrived at theistic quantum idealism as the best explanation for our perceptual world. What results if we focus on the whole universe instead, and examine reality from the top down? Modern physics fuses space and time together universally into *spacetime*.

This is how Einstein's theories of special and general relativity are standardly interpreted. Within spacetime, the measurement of time's passage is relativized to the reference frame (inertial frame) of the observer and affected by that frame's state of motion and the intensity of the gravitational field containing it. Observers in *different* reference frames may experience the *same* spacetime event *differently* as present, past, or future since, in relativistic physics, the passage of time is an *artifact* of one's inertial frame *within* spacetime. Nonetheless, all past, present, and future instants of time *co-exist* in universal spacetime, which timelessly contains their respective realities. Thus, in standard interpretation, the universe is timeless and static in global perspective, but from the perspective of any local observer's reference frame, it is dynamic—time flows, and there is a past, a present, and a future.

How is static global spacetime reconciled with local measurements of time's passage and the human experience of temporal flow and our decision-making freedom within it? The broad reconciliation of general relativity with quantum physics in the Wheeler-DeWitt equation, solutions of which are the quantum-gravitational wavefunction of the universe (the so-called *universal wavefunction*),[41] enables an answer. In global quantum-cosmological perspective, the Wheeler-DeWitt equation describes the universe as a static four-dimensional entity. How does the time we experience arise, then? Donald Page and William Wootters have argued that our experiential time is actually internal proper (clock) time rather than external coordinate time, so the universe can exist in a static quantum-entangled state while subsystems within it evolve by an appropriate internal measure.[42] The idea is to treat time as a quantum degree of freedom that is assigned a Hilbert space, H_T, so the flow of time consists in the correlation (entanglement) of this degree of freedom with the rest of the system. This correlation is present in the global, time-independent state, $|\Psi\rangle\rangle$. Normal time-evolution with the system state $|\psi(t)\rangle$ at time t for internal observers results from projecting $|\Psi\rangle\rangle$ to time t (conditioning the state to the time in question). Criticisms of this approach have argued it succumbs to the standard "problem of time" in quantum gravity and that the Page-Wootters mechanism gets "stuck" after the first time measurement and cannot subsequently provide the needed global-local time correlations.[43] Both these problems, as well as some additional objections, have been resolved by Giovannetti, Lloyd, and Maccone.[44] The first problem, the solution of which was incipient in Page and Wootters, is removed by using a global state that is time-independent and noting that internal observers will use conditioned states, and the second is addressed using generalized observables with von Neumann's approach to measurement, which, by appropriately conditioning the global state to a particular time, produces the correct evolution and time correlations. Interestingly, Moreva et al. have performed an experiment that illustrates the principle involved: an entangled state of the polarization of two photons was created, one of which was then used internally as a "clock" to measure the evolution of the other, while an external observer observing the global properties of the two-photon system could show it was static.[45]

The Page-Wootters-Giovannetti-Lloyd-Maccone resolution thus produces two points of view: (1) that of a creator-observer external to the universe (God, as the necessarily existent being who grounds the existence of everything else); and (2) that of internal actor-observers (us).[46] If we consider the creation of the universe from God's point of view, then, we realize

that as an act of mental causation, he brings all of spacetime and its contents into existence in a singular timeless act. From this perspective, as from the standpoint of occasionalism, there also is no practical distinction to be made between creation and providence.[47]

§6. Reality as a Quantum-Informational Construct

The universal wavefunction of quantum cosmology is frequently understood as representing possible histories of the universe in superposition and used to support the Everettian "many worlds" interpretation of quantum physics.[48] Contrary to this, and in accordance with our earlier treatment of macroscopic superposition, what such superpositions and their decoherence reveal instead is that none of the superposed states are materially substantial. The Everettian is *mistaken* when he interprets macroscopic coherent states and environmental decoherence as evidence for the dynamical interaction of parallel realities containing parallel versions of ourselves, each experiencing a different outcome across the full spectrum of quantum-mechanical possibilities. None of the mathematical-structural components of a quantum state are *materially* real. In the case of laboratory-created macroscopic superpositions, our conscious self is not *in* the superposition but rather *observing* it. In the broad context of quantum cosmology, it would be metaphysically misguided, therefore, to regard the universal wavefunction as describing the dynamical evolution of countless interweaving and substantially real histories of the universe existing in parallel superposition. Rather, the unitary Schrödinger (Wheeler-DeWitt) dynamics describes the structural evolution of the *quantum information* undergirding every possible experience of the universe that might be perceived—each with an associated quantum-mechanical probability—but only *one* of these possibilities will, in fact, be experienced as real.

In this regard, we can think of the universe as a *quantum-informational construct*,[49] but one that is not and cannot be metaphysically autonomous, and certainly is not self-explanatory.[50] Information in nature, quantum or otherwise, is not a new kind of substance; it is an immaterial principle of organization. Natural information is a quantitative measure of phenomenological complexity and, in some cases, also serves a specified functional purpose. Created conscious beings can perceive and, to some extent, process this information. As a *phenomenological informational structure*, then, the universe is the immaterial organizational product of a Mind contextually communicated to other minds in a perceptually coordinated construct.

It is therefore possible, if one wishes, to think of unitary quantum dynamics as being maintained without collapse as in the Everett interpretation, but without Everett's branching universe being understood as materially substantial. Instead, the universal wavefunction becomes a divine book-keeping device that—apart from the consciousnesses of created beings who collectively share one (and only one) *phenomenological* path through its interwoven superposition of phenomenological possibilities—has its existence solely in the divine mind.[51] Furthermore, by the decisions they make, created consciousnesses participate in the divine making of phenomenological reality, with divine permission synergistically forging a unique path through the superposition of phenomenological possibilities represented by the universal wavefunction. Divine omniscience—whether ultimately given an open theist, Molinist, simple foreknowledge, or Calvinist explication—might therefore be understood in terms of the full (ramified) universal wavefunction that provides a complete

conceptual map of the possibilities inherent in created reality. God not only knows everything that has happened and can or will happen, he knows everything that might have happened and what could have resulted. Returning to the issue of coherent states involving macroscopic superpositions created in the laboratory, then, we can regard such phenomena as God-given glimpses into the *conceptual possibility structure* by which the world of our experience is divinely governed—there is no need to join the Everettians in a fantasy of genuine parallel realities with real parallel versions of ourselves.

§7. Quantum-Informational Neuroscience

Is it even possible to do neuroscience in the metaphysical context we have established? Yes. Given that human consciousness experiences the divinely caused phenomenological structures and properties of perceptual reality, the phenomenology of our brain-states as the information-processing channels for the quantum information generative of bodily experience is subject to empirical study just like every other aspect of experiential reality. God is the *vera causa* for phenomenological reality, though created conscious agents influence divine action in the phenomenological world through their choices, but the neuroanatomical and neurophysiological correlates of our phenomenological experience are subject to proximate causal analyses.

When consciousness is tied to bodily experience, therefore, it is not surprising from the idealist point of view that first-person consciousness is altered, rendered deficient, or shuts down when the brain's information-processing channels are observed (from a third-person perspective) to be damaged or occluded. In respect of the correlation of conscious function with the phenomenology of information-processing in brain states, a helpful simile is that immaterial consciousness extracts information from neurophenomenological states as a DVD-player and screen extract and display information from a DVD, the difference being that consciousness actively interprets the extracted information in the service of understanding, whereas the DVD player and screen just integrate and display digital representations of sight and sound without comprehension or the disposition and ability to act. Neuronal configurations and synaptic traffic in the phenomenological brain provide the information storage and syntactical processing that holistically infuse brain-linked conscious thought with bodily data, but the semantic and pragmatic interpretation associated with the neurochemical content and neurophysiological syntax is external to the neural phenomena and located in immaterial consciousness itself, much as the meaning of natural language is not intrinsic to the aural and visual symbols and syntax used to represent it—the same meaning is, after all, expressible in multiple languages—but resides irreducibly in the immaterial mind of the language user. In the brain-coupled state, memory is phenomenologically stored in neuronal configurations and subject to often less-than-perfect information-retrieval channels, but quantum information is never ultimately lost or destroyed and there are indications from NDEs that it is completely retrievable when consciousness is decoupled at death from the information-processing channels of brain-state phenomenology.[52]

7.1 Coherence and Decoherence in Brain State Phenomenology

Does brain function involve coherent quantum information processing? Some researchers think the decoherence times for quantum states in the brain are too fast for entanglement to play a role. My view is that coherent quantum

processing *does* play a role in brain-linked conscious states. The most often cited computation contradicting this judgment is a technical paper by Max Tegmark[53] critiquing the Hameroff-Penrose "Orch-OR" proposal.[54] In this proposal, brain-linked consciousness is dependent on biologically "orchestrated" coherent qubit processing across collections of microtubules in brain neurons. These processes correlate and regulate neuronal synaptic and membrane activity and terminate with the objective reduction (decoherence) of the quantum-informational state in accordance with the Diósi-Penrose scheme for gravitationally-induced wavefunction collapse.[55] Nonetheless, as Hameroff and Penrose point out,[56] Tegmark's calculation of 10^{-13} seconds before decoherence in microtubules at biological temperature, which is far too short to have physiological effects, was performed on the wrong microtubule distance scale. It gives a decoherence time seven orders of magnitude too small. Once the proper scale is recognized, the Orch-OR proposal remains physiologically viable.

Longer times for coherent states seem desirable, however, especially if the binding problem for brain-linked conscious states is to be resolved physiologically by quantum information processing in the phenomenological brain. In this regard, nuclear-spin mediated theories of consciousness,[57] which allow for coherence times of five minutes or longer, seem better suited to the task. Matthew Fisher's research focuses on quantum-entangled phosphates produced by phosphorus atoms that are in a quantum-entangled singlet state as a result of the enzymatic hydrolysis of extracellular pyrophosphates in the brain. These entangled phosphates are found in Posner molecules $[Ca_9(PO_4)_6]$ and lead to entangled calcium phosphates, two pairs of which can undergo binding reactions to form quantum-entangled Posner dimers. Entangled Posner molecules are then transported—through endocytosis into presynaptic vesicles and by the action of a vesicular glutamate transporter—into glutamatergic neurons. Further binding reactions and hydrolysis of entangled Posner molecules in different neurons generate calcium-mediated glutamate release in presynaptic neurons, enabling nonlocal quantum correlations in postsynaptic firing that might provide or contribute to a physiological basis for the unity of consciousness in the phenomenological brain. How this research will play out is anyone's guess, but the existence of coherent quantum states and nonlocal effects for the processing of neural qubits in brain phenomenology clearly has a reasonable and empirically investigable basis.

7.2 Integrated Information Theory and Consciousness: Prospects and Limitations

By whatever means the structure of the phenomenological brain constrains and channels the brain-linked unity of consciousness, quantum physics shows that immaterial consciousness is the bedrock of reality, and we know first-hand that its integrated unity is a fundamental datum. It therefore makes sense to *begin* with the experiential phenomenology of consciousness, do our best to model it rigorously, and work backward to ascertain how neural phenomena might be correlated with these models. This is essentially the approach taken by Giulio Tononi's integrated information theory of consciousness,[58] though Tononi maintains, mistakenly, that consciousness is *generated*, either in whole or in part, by the corticothalamic system[59] rather than merely *correlated* in whole or in part with its function in the brain-linked state. In fact, he *identifies* consciousness with integrated information by equating the phenomenological properties of experience with the causal properties of

physical systems, but this *ignores* rather than solves the hard problem of consciousness. As Cerullo points out,[60] Tononi's approach actually *separates* experience from cognition (understanding, intentionality, the recognition of what the integrated phenomena are *about*) and thus does not really offer us a theory of *consciousness* so much as a theory of how the phenomena of third-person neurobiology might be correlated with a proximate causal-mathematical analysis of the components of first-person experience. As Scott Aaronson argues,[61] Tononi's theory would make many things conscious that we know, in fact, are *not* conscious. And this is not surprising, for the *equation* of consciousness with integrated information in a substantial material system would make that material system conscious and, as we have seen, it is not just that no *material* thing can be conscious, but even if (*per impossibile*) it were, the fact remains that there are no material *things* (substances) that exist to be conscious. Matter is *merely* phenomenal, and as such, it is part of what consciousness *experiences*, not its basis.

From an idealist perspective, however, what Tononi's theory attempts is all that should ever be expected, since consciousness is the *irreducible origin and explanation* of everything else.[62] An idealist approach to neuroscience thus undoes and reverses the misconceived and intractable orientation of physicalist explanation. All that is needed is a theory of how the raw phenomena of the world are experientially united and ordered in the brain-linked state by the neural architecture and information-processing channels of the phenomenological brain so as to constrain the possible foci (intentionality and activity) of immaterial consciousness. As the fundamental reality and starting point for explanations, contingent consciousness only needs an explanation of its *existence*, an explanation that is found in the necessary existence and chosen activity of God as the source of all consciousness. The "hard problem" thus disappears to be replaced by a more tractable research problem, namely, that of correlating the phenomenological structure of our internal (emotional) and external (sensory) perceptions, as well as our processes of thought and decisions, with the phenomenological structures and activity of the brain. Placing Tononi's integrated information theory (IIT) into this metaphysical context, *mutatis mutandis*, gives us a theory that attempts to address this problem. Whether IIT or some modified version of it will lead to a genuinely workable theory of the phenomenological brain remains to be seen, but a theistic idealist research program in neuroscience clearly should include programmatic research of this kind.[63]

§8. Mind and World

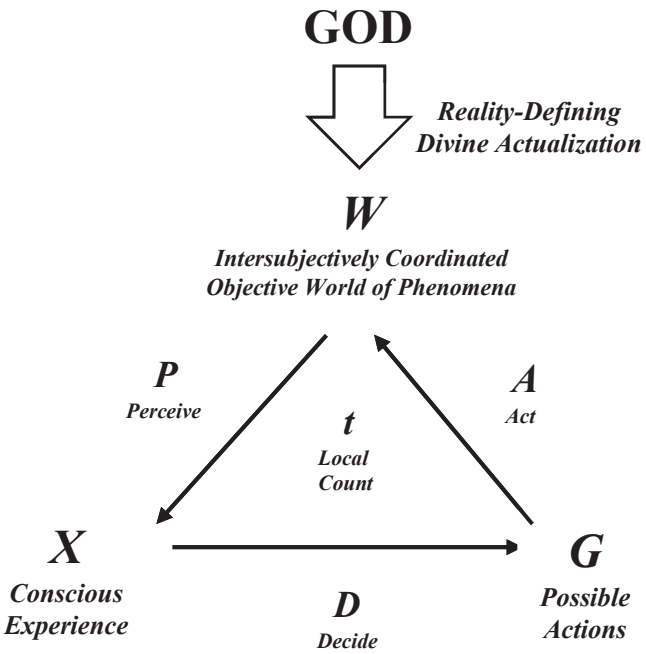
Consciousness is basic to reality, in fact, it is what is *most* real. Consciousness isn't what needs explaining; it is what *does* the explaining. Mind, not matter, is fundamental. Our consciousness transcends and makes possible the experience of what we call physical reality in and through our bodies, and divine consciousness is what creates and sustains physical reality as a whole, inclusive of our bodies. The presence of consciousness in the universe and the existence of physical reality itself do *not* have explanations that arise from *within* nature. Both have their explanation in that which grounds all of reality: God. Divine consciousness transcends nature and is fundamental while created consciousness transcends nature and is derivative of divine consciousness. Both function as *explanans*, not *explananda*. As noted, however, this does not mean that consciousness cannot be scientifically investigated. There are neural correlates of consciousness, and the neurophenomenology of brains and nervous systems is empirically

investigable within a metaphysics that reverses the polarity of explanation from what is commonly supposed. The mental is primary and causative, and the physical is derivative and passive, not the reverse. With this in mind, an explicit model for individual conscious agency and its interaction with the world, along with a model for our corporate phenomenological reality as divinely-provided and objective, can be constructed. All finite conscious beings are a part of this corporate reality that conscious beings in the same reference frame share from their individual perspectives.

8.1 Modeling Conscious Agency with Markov Kernels: The Central Model for Individual Conscious Agency

The theistic idealist quantum-informational metaphysic at which we have arrived safeguards both the objectivity and veridicality of human perception and the validity of human reason, because proper human cognitive function is conceived within, and grounded and justified by, a theistic metaphysic. In this context, we can appropriate Donald Hoffman's model of conscious agency—dissociated from his self-defeating evolutionary naturalism—and adapt it as illustrated in Figure 20.1 below.

A conscious agent *C* lives in a world *W* that is the interactive experiential environment for every contingent conscious agent. This world *W* exists immaterially in the mind of God, who as the necessarily existent universal conscious agent, transcends *W* and actualizes it as an objective perceptual environment intersubjectively experienced by contingent immaterial substantial consciousnesses. Dependent on the internal history of the world up to time *t* in the local



A Conscious Agent

Figure 20.1

reference frame of C, God transcendently defines at t in W a space X of possible conscious experiences for every individual agent C that in turn specifies a space G of possible actions that C can take. Agent C perceives W via a perceptual map P, decides how to act among the possible actions open to him using a decision map D, and acts in a way that affects the intersubjective dynamic development of the world W through an action map A. Within the divine economy, the maps P, D, and A can be thought of as discrete communication channels for the divinely managed flow of quantum information, and a non-negative integer t (the local count) keeps track of the number of discrete messages transmitted to C through channel P by God's actualization of W. The local count number t is correlated with sequential experiences that are the basis for the subjective sense of temporal flow.[64, 65]

Since specific conscious experiences are conditionalized on specific states of the world, decisions are conditionalized on experiences, and changes in the world are conditionalized on actions taken, these conditional probabilities can be modeled using Markov kernels. For instance, a Markov kernel might specify that if w_1 is the state of the world, then the probabilities for the various conscious experiences that might result are $p_1, p_2, \ldots, p_n$, whereas a different state would yield different probabilities for a different set of conscious experiences, and so on for all the possible states of the world. We thus can *model* a conscious agent C in the divinely managed immaterial world W with the *six lower components* of the graph in Figure 20.1, and write this as $C = \langle X, G, P, D, A, t \rangle$.[66]

The world W is required to define the perceptual map P and the action map A for contingent conscious agents. W can and should be taken to include the phenomenological spacetime world of physics. It is objective in that: (1) it is not generated by finite consciousness; (2) it is intersubjectively shared from different perspectives by finite consciousnesses inhabiting the same inertial frames; and (3) it has a well-defined actual history and nonlocal totality in the mind of God. Unlike Hoffman's model, however, including W in the formalism does not make it dualistic in a substantial sense, for it is *not* the case that some components (X and G, for example) refer to consciousness and others (W) refer to a mind-independent physical world. Rather, W is nothing more than the immaterial quantum information generated by God and communicated to conscious agent C through informational channel P as the locally perceivable spacetime and its contents available from the perspective of that agent. As such, for each contingent conscious agent C, perceiving the world W is receiving communication from the necessarily existent universal conscious agent, God, who is in turn aware of the conscious experiences (intentional states) of C grounding the possible decisions and actions available in W, which when made and willed by C, are actualized in W by God as the quantum information in W is appropriately updated for all affected consciousnesses. Interacting with the world is thus interacting with God as the universal conscious agent whose mind objectively defines W.[67]

8.2 The Combination Theorem and God as the Universal Conscious Agent: The Central Model for Corporate Reality

Though there remains an absolute dichotomy between the necessarily existent, uncreated, self-sufficient, substantial Being (God) and all created, dependent, personal beings, immaterialist monism is the ultimate metaphysical context of conscious agent interactions. Within this framework, we can sketch how to appropriate Hoffman's model for interacting finite conscious agents and explore its implications. The first thing to note, in case it has not already been

appreciated, is that this model is *not* a theory of conscious awareness (which is taken as the primitive that explains everything else) but rather a minimal *formal* model of conscious perception and action. Addressing how conscious awareness is correlated with third-person neurophenomenology would take us back to Tononi's integrated information theory. Since we're not dealing with a theory of conscious awareness, but rather a formal model of conscious perception and action, we do not face a combination problem involving the way that phenomenal experiences (*qualia*) are unified in individual conscious experience. The subjective unity of experience is grounded in the *irreducible* immaterial subject in our model. The formal model does, however, present a combination problem of a different sort, namely that of combining the *subjects* of experiences, for on the hypothesis that the world consists entirely of conscious agents, the combination of any two conscious agents in the formalism makes another conscious agent, which then can be combined with another conscious agent, and so on until *all* finite conscious agents are joined into one.[68] But how could all these different points of view be combined to yield a new *single* point of view? What would this even mean? Does the formalism degenerate into metaphysical nonsense at this point?

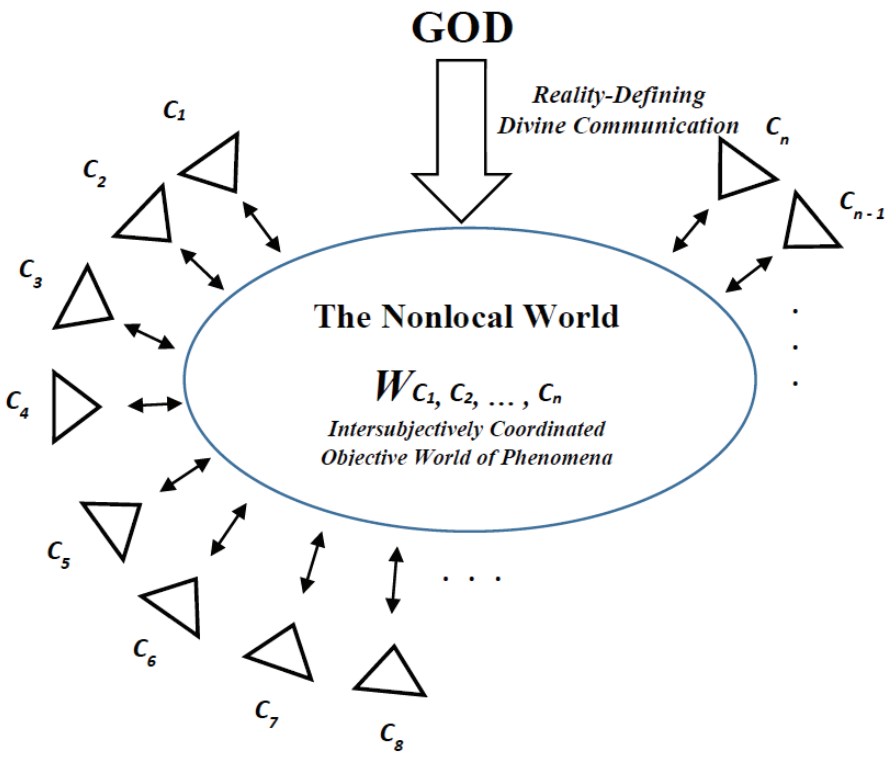
Clearly, if the formalism is to make sense, the combining of subjects cannot represent a loss of identity and absorption into a new conscious entity, because this does *not* happen. The concatenation of agents must therefore be understood *relationally*. The original agents retain their identities but are influenced in the combinatorial process through their *interactions* with each other. The new relational consciousness, while defined mathematically by the distinctive contributions of the original agents, has properties not possessed by the component agents, but which are intelligible on the basis of the structural and interactive contributions of the original agents. In particular, the meta-agent can possess periodic asymptotic properties not possessed by the constituent agents.[69] The relational properties of the combined conscious entity are extrinsic to the identities and consciousnesses of the constituent agents,[70] but intrinsic to the combined agent, and iterated up the combinatorial hierarchy of meta-conscious agents. Meta-consciousness is thus *relational* and comes in degrees: the constituent agents, through communication, become increasingly aware of the mental states of other agents in the combinatorial construct. In the brain-linked state, this communication is overwhelmingly through the perceptual channels of the five sensory modalities and the medium of natural language, and it is very limited in its completeness.

None of this is particularly surprising given a foundational role for quantum information and entanglement in consciousness. Notably, it is supported by the fact that interactive conscious agency in Hoffman's model asymptotically exhibits quantum dynamics. More specifically, Hoffman and Prakash show that the harmonic functions of the spacetime chain associated with the dynamics of a system of conscious agents have the same mathematical form as the non-relativistic quantum wavefunction of a free particle.[71] They then sketch some ideas for the extension of this mathematical consonance to macroscopic reality and relativistic spacetime. Their suggestion that all of physics might be derived from the dynamics of conscious agents is strained, however, and the prospects for it seem dim. In particular, the leap from the fact (a) that the mathematical expression for the dynamics of conscious agents in Hoffman's formalism is isomorphic to the wavefunction of a free particle, to the assertion (b) that "particles are vibrations not of strings but of interacting conscious agents,"[72]

is unwarranted. Rather, this similarity of mathematical form arises from three potential sources: (1) the mathematical description of the dynamics of conscious agency and individual reasoned decision-making is fundamentally and irreducibly stochastic; (2) quantum entanglement plays a role in consciousness and the conscious states of interacting agents are relationally entangled; and (3) the intersubjective world experienced by immaterial conscious agents is a quantum-informational phenomenological construct.

Hoffman's formalism needs to be placed in the context of theistic quantum idealism, where the it-from-qubit construction of the phenomenological world of our experience can be understood as an artifact of our interaction with God as the universal conscious agent. More particularly, individual perceptions of reality are the explicit result of *interaction* with God as the fundamental Consciousness from whom *all* finite conscious agents derive their being, with whom (knowingly or unknowingly) they all interact, and in whose *Gedankenwelt* they all live. Theistic informational idealism and theistic conscious realism thereby seamlessly unite as corollaries of theistic quantum idealism.

The resultant model is rendered in Figure 20.2. Each individual conscious agent (modeled as in Figure 20.1), interacts with the perceptual world provided by God in a feedback loop that updates perceptual reality in accordance with the chosen actions of the finite agent. God, *timelessly* perceiving each individual conscious choice, has built these choices into the very fabric of creation.



Phenomenological Corporate Reality

Figure 20.2

§9. Theistic Conscious Realism and NDEs

We might also wonder what happens when consciousness is set free from the constraints of brain-state information-processing channels—as it is in near-death experiences (NDEs), where individuals documented to be brain-dead for a significant period of time have revived to offer first-person accounts of out-of-body experiences containing early-stage perceptual details that have been independently corroborated. In such cases, it is common for first-person reports to detail heightened conscious awareness, lucidity, and even new cognitive capacities as consciousness is decoupled from the constraints imposed in brain phenomenology.[73, 74] For instance, as noted earlier, in the brain-coupled state memory is phenomenologically stored in neuronal configurations and subject to often less-than-perfect information-retrieval channels, but quantum information is never ultimately lost or destroyed and there are indications from NDEs that it is *completely retrievable* when consciousness is decoupled from the information-processing channels of brain-state phenomenology.[75] In the decoupled state, furthermore, there are many independently reported accounts of awareness of the mental states of *other* conscious agents, both brain-linked and decoupled, in which the standard sensory and linguistic communication channels are bypassed and apprehension is direct and nonlocal/unmediated.[76] Rendered metaphysically coherent by a relational metaphysic, the subjective combinatorics of Hoffman's descriptive formalism is consistent with, and perhaps even suggestive of, such properties of consciousness.

As a final observation, from a Christian idealist perspective, the transition from the embodied state to the intermediate state to the final resurrected state does not involve substantial changes at any point, but rather *perceptual* changes. We remain our same substantial immaterial selves throughout all three stages of perceptual development. If we take a relatively standard NDE account of the intermediate state seriously, it is *not* a disembodied state but rather one in which we perceive ourselves as being in a *body* with different qualities and capacities than our first embodiment. Communication in this state takes place by unmediated thought-content, not linguistic mediation, and is incapable of ambiguity. With respect to embodiment, it may be entirely *impossible* for finite conscious agents to experience and interact with a perceptual reality apart from perceived embodiment. We might *speculate* that this correlates with the Apostle Paul's distinction between the natural body and the spiritual body (I Corinthians 15:44). In the final resurrected state, there is another change in perception whereby we experience a bodily phenomenology like Christ's glorified body. In essence, we could speak of perceptual phenomenological environments and embodiments 1.0, 2.0, and 3.0.

§10. Science in the Divine *Gedankenwelt*

We've discussed how neuroscience can be done under the aegis of theistic quantum-informational idealism, but what about the *whole* of science and human history? How should we think about cosmology, astronomy, physics, geology, paleontology, biology, and anthropology, and how should we understand the 13.7-billion-year history of the universe, as theistic idealists? The mind of God globally defines universal history by a singular, timeless act of creation, and we are exploring—from our time-bound, reference-frame relative perspective—God's reality-defining thought.

While idealist and non-idealist science have much in common, the theistic idealist understanding of *the nature of nature* is distinctly non-naturalistic, and this does produce some differences. Most notably, since all of reality is the product of a Mind, when we seek to understand past events on the basis of presently operative causes in accordance with uniformitarian principle, we include intelligence as a foundational cause of nature, one that has been operative throughout universal history and is operative in nature now. Indeed, the fact that the universe and we ourselves are ultimately the product of an Intelligence explains the order and intelligibility of nature, its amenability to the human mind, and the very possibility of science as a truth-conducive enterprise.

If we were to suppose otherwise, then, as Alvin Plantinga has lucidly argued,[77] the resultant naturalistic and undirected evolutionary account of our origin provides no ground for supposing our cognition is veridical. This would have the self-defeating effect of negating any epistemic support for belief in naturalism, evolution, or anything else, for that matter. The substance of this argument is confirmed by computational experiments using evolutionary game theory. These computational experiments show that organisms acting in accordance with arbitrarily-imposed species-specific fitness functions will out-compete and drive to extinction organisms that act in accordance with the true causal structure of their environment.[78] One of the ironies of this situation, of course, is that we can only trust these computational experiments and the conclusions we draw from them if we ourselves are *not* organisms with non-veridical fitness functions arising through undirected evolutionary processes. If our cognitive apparatus were, in fact, the byproduct of an undirected process, we'd have no reason to think that conclusions drawn on the basis of experiments we have devised bear any relationship to the way the world actually is. In short, without cognitive faculties whose proper function, broadly speaking, is the production of true beliefs, all human knowledge—including any of the claims of science—is just a fitness-driven coping mechanism that has no essential connection to the way things are. Theism gives us access to the world and a basis for thinking that science has something to do with reality-in-itself; naturalism takes this away.

This also affects scientific methodology. Since a uniformitarianism that recognizes intelligent causation as part of the cause-and-effect structure of the world becomes *central* to scientific methodology, any pretense that methodological naturalism is essential to science is rightly dismissed as utter nonsense.[79] It follows that some developments in the history of the universe might require extraordinary providence for their complete explanation, while others may be explained by its ordinary course. Another way of saying this is that certain features of the universe and of biological systems might best be explained as the result of particular intelligent design rather than the regular course of divine activity that maintains the law-like phenomenology of the universe. Which case is relevant can, in general, be discerned from the quantum-informational character of the phenomenon in question. Information is always generated from a reference class of possibilities. In the regular course of nature, quantum Shannon theory[80] can be used to describe the ordinary divine activity constitutive of the it-from-qubit information that, in accordance with the relevant quantum probabilities, decoheres for finite conscious perception in a divinely directed way. We can think of this type of information as resulting in a singular reduction of the possibilities constitutive of *mere* physical phenomena. But there can be another level of possibility reduction in physical

phenomena, one that is associated with agent-induced conceptual information and indicative of design, viz., specified complexity.[81] Complex specified information represents a dual reduction of possibilities: a conceptual reduction in accordance with an independent pattern *combined with* a physical-phenomenological reduction. Information structures exhibiting specified complexity must be both highly unlikely under the relevant probability distribution (complex) and conform to an independently recognizable pattern (specification). Recently, different models of specified complexity involving semiotic,[82] algorithmic,[83] functional,[84] and irreducible[85] complex specified information have been shown to have a common underlying mathematical form that, with additional constraints, allows the construction of canonical specified complexity models demonstrating that large specified complexity values are exceedingly improbable under any given discrete or continuous probability distribution.[86] These canonical models can then be used to create statistical hypothesis tests by bounding the tails for arbitrary distributions. Inferring design from a specified-complexity test that gives large values only to features of designed structures gives it the form of a likelihood-ratio test in which the alternative hypothesis is that the structure is most likely to have been produced by intentional design. Under these conditions, rejecting the null hypothesis in favor of the alternative provides good, but defeasible, evidence of particular design (extraordinary providence), and the more evidence of this nature that is gathered, the more certain this conclusion becomes, just as one would expect for any scientific procedure.[87]

Einstein famously remarked that "I want to know how God created this world. I am not interested in this or that phenomenon, in the spectrum of this or that element. I want to know His thoughts; the rest are details."[88] As we have seen, however, apart from the finite immaterial beings that have their substantial origin in God and such thoughts as originate with them, *every phenomenon* of this world, including the details in which Einstein had little interest, is a divine thought. Our task, therefore, is to seek the proximate causal structure of reality and the cooperative role that other created conscious agents have played and are playing, wittingly or unwittingly, in the phenomenological history of the world for which God is the ultimate *vera causa*. The mind of God defines past, present, and future reality. We have the privilege of exploring the endless variety, beauty, and subtlety of God's thought, an adventure that is made all the more meaningful when His authorship of reality is recognized and the personal and relational character of reality is embraced.

Notes

1. This essay synthesizes and extends aspects of research I've published in a variety of articles: Bruce L. Gordon, "Maxwell-Boltzmann Statistics and the Metaphysics of Modality," *Synthese* 133, no. 3 (2002): 393–417; Bruce L. Gordon, "Ontology *Schmontology*? Identity, Individuation, and Fock Space," *Philosophy of Science* 70 (2003): 1343–1356; Bruce L. Gordon, "A Quantum-Theoretic Argument against Naturalism," in *The Nature of Nature: Examining the Role of Naturalism in Science*, eds. Bruce L. Gordon and William A. Dembski (Wilmington: ISI Books, 2011), 179–214; Bruce L. Gordon, "Divine Action and the World of Science: What Cosmology and Quantum Physics Teach Us about the Role of Providence in Nature," *Journal of Biblical and Theological Studies* 2, no. 2 (2017): 247–298; Bruce L. Gordon, "The Incompatibility of Physicalism with Physics," in *Christian Physicalism? Philosophical Theological Criticisms*, eds. J. R. Farris and R. K. Loftin (New York: Lexington Books, 2018), 371–402; Bruce L. Gordon, "The Necessity of Sufficiency: The Argument from the Incompleteness

of Nature," in *Two Dozen (or so) Arguments for God: The Plantinga Project*, eds. Jerry L. Walls and Trent Dougherty (Oxford: Oxford University Press, 2018), 417–445; Bruce L. Gordon, "Constrained Integration: Optimizing Coherence and Seeking Truth in the Interaction between Science and Christianity," "Response to Michael Ruse," "Response to Alister McGrath," and "Rejoinder," in *Three Views on Christianity and Science*, eds. Paul Copan and Christopher L. Reese (Grand Rapids: Zondervan, 2021), 133–163, 58–69, 115–126, and 187–195; and Bruce L. Gordon, "Idealism and Science: The Quantum-Theoretic and Neuroscientific Foundations of Reality," in *The Routledge Handbook of Idealism and Immaterialism*, eds. Joshua R. Farris and Benedikt-Paul Göcke (London: Routledge, 2021), 536–575.

2. For those unfamiliar with occasionalism, it is a theory about the mode of divine action in the natural realm. It has both strong and weak forms. In its *strongest* form, occasionalism maintains that all created entities, whether inanimate, merely sentient, or both sentient and rational, are devoid of the power to cause anything, so God is the *only* genuine causal agent (*vera causa*, i.e., true cause). This leads to a picture in which "rational" created agents are reduced to puppets, for none of the thoughts in their minds are self-generated—God causes the succession of each and every thought—and none of their supposed acts of "will" proceed from themselves, but rather God is the sole cause of *everything* that comes to pass. *Weak* occasionalism, which is what is in view here, rejects the idea that God causes the succession of ideas in our minds that *interpret* reality, especially those that form the basis of acts of will based in rational deliberation. Rather, for the weak occasionalist, God is the sole cause of everything in that segment of nature *not* subject to the influence of rational creatures with *libertarian* free will, that is, creatures with the rational ability to make deliberative choices among alternative courses of action, and whose rational will controls which choice is made. While God is the sole cause of regularity in inanimate nature, he allows rational creatures to affect the course the development of reality takes as a result of their morally significant choices, actualizing the effects of those choices, and holding them accountable for the character condition that gave rise to them and the consequences that issue from them. Examples of strong occasionalists would be the French philosopher Nicolas Malebranche (1638–1735) and American idealist and hyper-Calvinist philosopher-theologian, Jonathan Edwards (1703–1758). An historical representative of weak occasionalism in the idealist vein advocated here would be the philosopher and Anglican bishop George Berkeley (1685–1753). The position developed here, while driven by considerations from quantum physics, is accurately characterized as neo-Berkeleyan. For a broad, albeit brief, historical introduction to occasionalism and a guide to further reading on the subject, see Bruce L. Gordon, "Occasionalism," in *Dictionary of Christianity and Science*, eds. Paul Copan, Tremper Longman III, Christopher L. Reese, and Michael G. Strauss (Grand Rapids: Zondervan, 2017), 491–493.
3. Of course, Hoffman interprets this formalism as indicating that at each successive level, the meta-agent is a conscious agent in the same sense as all lower levels, a picture that lends itself, ultimately, to a cosmic panpsychist interpretation of what the formalism represents. The significance of the formalism is understood in a markedly different way here; indeed, considerations highlighting the untenability of Hoffman's straightforward reading of the formalism and various cosmopsychist interpretations of it will be discussed in later sections of this essay, and are also a feature in §5 of my companion essay in this volume, "Mind Over Matter: Idealism Ascendant."
4. M. O. Scully and K. Drühl, "Quantum Eraser: A Proposed Photon Correlation Experiment Concerning Observation and 'Delayed Choice' in Quantum Mechanics," *Physical Review A* 25 (1982): 2208–2213.; Y.-H. Kim et al., "Delayed 'Choice' Quantum Eraser," *Physical Review Letters* 84, no. 1 (2000): 1–5.
5. X.-S. Ma et al., "Quantum Erasure with Causally Disconnected Choice," *Proceedings of the National Academy of Sciences (USA)*, 110, no. 4 (2013): 1221–1226.
6. V. Jacques et al., "Experimental Realization of Wheeler's Delayed Choice *Gedanken* Experiment," *Science* 315 (2007): 966–968; A. G. Manning et al., "Wheeler's Delayed-Choice *Gedanken* Experiment with a Single Atom," *Nature Physics* 11 (2015): 539–542; G. Rubino et al., "Experimental verification of an indefinite causal order," *Science Advances* 3, no. 3 (2017): e1602589.
7. A. Einstein, B. Podolsky, and N. Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" *Physical Review* 47 (1935): 777–780; and A. Fine, "The Einstein-Podolsky-Rosen Argument in Quantum Theory," *Stanford Encyclopedia of Philosophy*, ed. E. N. Zalta (2017), https://plato.stanford.edu/entries/qt-epr/.
8. Einstein, Podolsky, and Rosen (1935): 777.
9. N. Bohr, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" *Physical Review* 48 (1935): 696–702.

10. For a helpful clarification, see H. Halvorson and R. Clifton, "Reconsidering Bohr's Reply to EPR," in *Nonlocality and Modality*, eds. J. Butterfield and T. Placek (Dordrecht: Kluwer Academic, 2002), 3–18.
11. J. S. Bell, "On the Einstein-Podolsky-Rosen Paradox" [1964], and "On the Problem of Hidden Variables in Quantum Mechanics" [1966], in *Speakable and Unspeakable in Quantum Mechanics*, ed. J. S. Bell (Cambridge: Cambridge University Press, 1987), 14–21 and 1–13.
12. A. Aspect, P. Grangier, and G. Roger, "Experimental Tests of Realistic Theories via Bell's Theorem," *Physical Review Letters* 47 (1981): 460–467; A. Aspect, J. Dalibard, and G. Roger, "Experimental Tests of Bell's Inequalities Using Time-Varying Analyzers," *Physical Review Letters* 49 (1982): 1804–1807; A. Aspect, P. Grangier, and G. Roger, "Experimental Realization of Einstein-Podolsky-Rosen-Bohm *Gedanken-Experiment*: A New Violation of Bell's Inequalities," *Physical Review Letters* 48 (1982): 91–94; M. A. Rowe et al., "Experimental Violation of a Bell's Inequality with Efficient Detection," *Nature* 409 (2001): 791–794; M. Giustina et al., "Significant-Loophole-Free Test of Bell's Theorem with Entangled Photons," *Physical Review Letters* 115, no. 25 (2015): 250401; B. Hensen et al., "Loophole-Free Bell Inequality Violation Using Electron Spins Separated by 1.3 Kilometres," *Nature* 526 (2015): 682–686; and L. K. Shalm et al., "Strong Loophole-Free Test of Local Realism," *Physical Review Letters* 115 (2015): 250402.
13. As should be clear, the locality of all physical interactions is a consequence of special relativity. Nonlocal quantum correlations exist without the transfer of energy, i.e., without any signal passing between the components of the quantum system that would explain their correlation. See J. S. Bell, "Bertlmann's Socks and the Nature of Reality" [1981], in *Speakable and Unspeakable in Quantum Mechanics*, ed. J. S. Bell (Cambridge: Cambridge University Press, 1987), 139–158; J. A. Wheeler, "Law without Law," in *Quantum Theory and Measurement*, eds. J. A. Wheeler and W. H. Zurek (Princeton: Princeton University Press, 1983), 182–213; M. Redhead, *Incompleteness, Nonlocality and Realism: A Prolegomenon to the Philosophy of Quantum Mechanics* (Oxford: Clarendon Press, 1987); J. Cushing and E. McMullin, eds., *Philosophical Consequences of Quantum Theory: Reflections on Bell's Theorem* (Notre Dame: University of Notre Dame Press, 1989); R. Clifton, ed. *Perspectives on Quantum Reality: Non-Relativistic, Relativistic, and Field-Theoretic* (Dordrecht: Kluwer Academic Publishers, 1996); J. Bub, *Interpreting the Quantum World* (Cambridge: Cambridge University Press, 1997); H. Halvorson, "Reeh-Schlieder Defeats Newton-Wigner: On Alternative Localization Schemes in Relativistic Quantum Field Theory," *Philosophy of Science* 68 (2001): 111–133; T. Maudlin, *Quantum Non-Locality and Relativity*, 2nd edition (Oxford: Blackwell, 2002); A. Rae, *Quantum Physics: Illusion or Reality?*, 2nd edition (Cambridge: Cambridge University Press, 2004); and Bruce L. Gordon, "A Quantum-Theoretic Argument against Naturalism." At a deeper level, this might be elucidated by the ER = EPR conjecture in which all entangled quanta are connected by a wormhole (an Einstein-Rosen bridge). The most extensive version of this conjecture seeks to understand the emergence of spacetime from quantum entanglement, that is, the emergence of physical phenomena from a more fundamental mathematical and non-spatiotemporal reality that does not occupy spacetime and thus cannot itself be physical, let alone material. See B. Swingle and M. van Raamsdonk, "Universality of Gravity from Entanglement" (2014), https://arxiv.org/pdf/1405.2933.pdf; C. Cao, S. Carroll, and S. Michalakis, "Space from Hilbert Space: Recovering Geometry from Bulk Entanglement," *Physical Review D* 95 (2017): 024031' and N. McMahon, S. Singh, and G. Brennen, "A holographic duality from lifted tensor networks," *npj Quantum Information*, vol. 6, no. 36 (2020), https://doi.org/10.1038/s41534-020-0255-7. For those with the eyes to see it, this is a clear harbinger of an idealist metaphysic. As for would-be cosmic monist physicalists, who would seek to eschew local interactions altogether [e.g., J. Schaffer, "Monism: The Priority of the Whole," *Philosophical Review* 119 (2010): 31–76; J. Schaffer, "Why the World has Parts: Reply to Horgan and Potrč," in *Spinoza on Monism*, ed. P. Goff (Basingstoke: Palgrave Macmillan, 2012), 77–91; and J. Schaffer, "The Action of the Whole," *Proceedings of the Aristotelian Society*, *Supp.* 87 (2013): 67–87], it is fair to ask how various parts of the universe can be causally isolated from each other but still metaphysically grounded in the nature of the whole. The only recourse is to appeal to brute factuality in the form of Humean supervenience, but this violates the principle of sufficient reason on a universal scale, undermining a precondition for all knowledge and the intelligibility of the world (see the discussion in §4).
14. G. C. Hegerfeldt, "Remark on Causality and Particle Localization," *Physical Review D* 10 (1974): 3320–3321;

G. C. Hegerfeldt, "Difficulties with Causality in Particle Localization," *Nuclear Physics B* 6 (1989): 231–237; G. C. Hegerfeldt, "Instantaneous Spreading and Einstein Causality in Quantum Theory," *Annalen der Physik* 7 (1998): 716–725; D. Malament, "In Defense of Dogma: Why There Cannot Be a Relativistic Quantum Mechanics of (Localizable) Particles," in *Perspectives on Quantum Reality: Non-Relativistic, Relativistic, and Field-Theoretic*, ed. R. Clifton (Dordrecht: Kluwer Academic Publishers, 1996), 1–9.

15. M. Fuwa et al., "Experimental Proof of Nonlocal Wavefunction Collapse for a Single Particle Using Homodyne Measurement," *Nature Communications* 6 (2015): 6665.
16. H. Halvorson and R. Clifton, "No Place for Particles in Relativistic Quantum Theories?" *Philosophy of Science* 69 (2002): 1–28.
17. Y. Aharonov et al., "Quantum Cheshire Cats," *New Journal of Physics* 15 (2013): 113018; A. Matzkin and A. K. Pan, "Three-Box Paradox and 'Cheshire Cat Grin': The Case of Spin-1 Atoms," *Journal of Physics A: Mathematical and Theoretical* 46, no. 31 (2013): 315307.
18. T. Denkmayr et al., "Observation of a Quantum Cheshire Cat in a Matter-Wave Interferometer Experiment," *Nature Communications* 5 (2014): article 4492.
19. This experimental result might seem to lend credence to the trope-theoretic interpretation of quantum field theory, but see the discussion and argument in note 35 for an explanation of the ontological incompleteness of trope theory in a naturalistic context.
20. See E. Schrödinger, "Die Gegenwärtige Situation in der Quantenmechanik," *Naturwissenschaften* 23 (1935): 807–812, 823–828, and 844–849.
21. R. Lapkiewicz et al., "Experimental Non-classicality of an Indivisible Quantum System," *Nature* 474 (2011): 490–493.
22. W. Zurek, "Decoherence, Einselection, and the Quantum Origins of the Classical," *Reviews of Modern Physics* 75 (2003): 715–775; E. Joos et al., eds., *Decoherence and the Appearance of a Classical World in Quantum Theory*, 2nd edition, (Berlin: Springer, 2003); N. P. Landsman, "Between Classical and Quantum," in *Handbook of the Philosophy of Physics*, *Part A*, eds. J. Butterfield and J. Earman (Amsterdam: Elsevier, 2007), 417–553; M. Schlosshauer, *Decoherence and the Quantum-to-Classical Transition* (Berlin: Springer-Verlag, 2007); and G. Bacciagaluppi, "The Role of Decoherence in Quantum Mechanics," in *Stanford Encyclopedia of Philosophy*, ed. E. N. Zalta (2012), http://plato.stanford.edu/entries/qm-decoherence/.
23. S. Eibenberger et al., "Matter-Wave Interference of Particles Selected from a Molecular Library with Masses Exceeding 10,000 Amu," *Physical Chemistry and Chemical Physics* 15 (2013): 14696–14700.
24. J. R. Friedman et al., "Quantum Superposition of Distinct Macroscopic States," *Letters to Nature* 406 (2000): 43–46; A. J. Leggett, "Testing the Limits of Quantum Mechanics: Motivation, State of Play, Prospects," *Journal of Physics: Condensed Matter* 14 (2002): R415; J. Baggott, *Beyond Measure: Modern Physics, Philosophy, and the Meaning of Quantum Theory* (Oxford: Oxford University Press, 2004); and J. Lambert, "The Physics of Superconducting Quantum Interference Devices" (2008), http://www.physics.drexel.edu/~bob/Term_Reports/Joe_Lambert_3.pdf.
25. While some would try to salvage material substance in the face of macroscopic superpositions, that such superpositions rule out the existence of macroscopic physical substances is evident in the nature of the thermodynamic continuum limit (the classical statistical limit). Statistical mechanics mathematically relates the thermodynamic properties of macroscopic objects to their microscopic constituents. Since these microscopic constituents obey quantum dynamics, the correct description continues to lie within the domain of quantum statistical mechanics. Nonetheless, under thermodynamic conditions of high temperature and low density, classical statistical mechanics can serve as a useful approximation. In respect of quantum statistical behavior, however, the classical statistical limit is continuous and the quantum indistinguishability arising from permutation symmetry is *not* removed despite being dampened in the limit—quantal non-individuality persists even as aggregate behavior approximates a Maxwell-Boltzmann distribution. Thus, while the macroscopic world emerges from and supervenes upon microphysical reality, it does not acquire substantiality in this emergence, for it is environmental decoherence (essentially, statistical dampening through wavefunction orthogonalization) that gives quantum-mechanical ephemera the cloak of macroscopic stability. Decoherence does not resolve the measurement problem. The apparent stability of the macroscopic world of our experience is a mere epiphenomenon of quantum statistics; the underlying reality retains its quantum-theoretic insubstantiality as *mere* phenomenon even while sustaining classical appearances. I have argued this in more detail elsewhere: Bruce L. Gordon, "Maxwell-Boltzmann Statistics and the Metaphysics of Modality"; Bruce L. Gordon "A Quantum-Theoretic

Argument against Naturalism"; and Bruce L. Gordon, "The Incompatibility of Physicalism with Physics."

26. Efforts abound to interpret quantum phenomena in a way that preserves a naturalistic metaphysics, but a complete consideration of the primary strategies and their inadequacies is beyond the scope of this essay. In §6 we will discuss how theistic idealism absorbs and reinterprets the many worlds (Everettian) interpretation (setting aside the quantum probability and preferred basis problems otherwise besetting the approach), but let me add some brief critical remarks about the de Broglie-Bohm nonlocal hidden variable theory. Bohmian Mechanics, as it is often called, tries to restore material causality to quantum phenomena by privileging position as an observable and introducing either a "guidance equation" or a "quantum potential field" that gives determinate trajectories to all of the constituents of a quantum system. There are intractable problems with this proposal. First of all, even though it solves the measurement problem in ordinary (non-relativistic) quantum mechanics, neither the quantum potential field nor the guidance equation carry energy-momentum, so they act in a way that is both *undetectable* and *non-mechanical* and hence cannot, in principle, provide a *causal* explanation of interactions among particle locations. Nonlocal correlations among unobserved spatiotemporally located particles are *described*, but not *explained*. Furthermore, when the necessary attempt is made to extend Bohmian mechanics to relativistic quantum field theory, fatal theoretical inadequacies arise: (1) the quanta associated with relativistic pilot waves can travel faster than light and backwards in time; (2) the numbers of quanta do not vary in field interactions as experiment demands and standard quantum field theory describes; (3) unlike standard quantum field theory, Bohmian field theory does not predict or explain the existence of antimatter; and (4) relativistic Bohmian field theory reintroduces the measurement problem and makes it unsolvable [see S. Saunders, "The 'Beables' of Relativistic Pilot-Wave Theory," in *From Physics to Philosophy*, eds. J. Butterfield and C. Pagonis (Cambridge: Cambridge University Press, 1999), 71–89]. These are some of the main reasons for thinking the Bohmian research program is a metaphysical and technical dead-end.
27. We can only offer a cursory discussion of this subject and the associated concepts of supervenience and emergence here. I deal with these matters thoroughly in a variety of publications. See especially: Bruce L. Gordon, "A Quantum-Theoretic Argument against Naturalism"; Bruce L. Gordon, "The Incompatibility of Physicalism with Physics"; Bruce L. Gordon, "The Necessity of Sufficiency: The Argument from the Incompleteness of Nature"; and Bruce L. Gordon, "Idealism and Science: The Quantum-Theoretic and Neuroscientific Foundations of Reality."
28. Donald Davidson, "Mental Events" [1970], in *Essays on Action and Events*, ed. D. Davidson (Oxford: Oxford University Press, 1980), 207–224.
29. Jaegwon Kim, "Concepts of Supervenience," *Philosophy and Phenomenological Research* 45 (1984): 153–176; reprinted in J. Kim, *Supervenience and Mind: Selected Philosophical Essays* (Cambridge: Cambridge University Press, 1993), 53–78.
30. I demonstrate this in my essay "The Incompatibility of Physicalism with Physics" on pages 378–383.
31. See Arthur Fine, "Hidden Variables, Joint Probability, and the Bell Inequalities," *Physical Review Letters* 48 (1982): 291–295, and Arthur Fine, "Joint Distributions, Quantum Correlations, and Commuting Observables," *Journal of Mathematical Physics* 23 (1982): 1306–1310.
32. See Bruce L. Gordon, "Maxwell-Boltzmann Statistics and the Metaphysics of Modality," especially pages 402–407, for a more extensive discussion of related issues.
33. Halvorson and Clifton, "No Place for Particles in Relativistic Quantum Theories?"
34. See my essays, "A Quantum-Theoretic Argument against Naturalism" and "The Incompatibility of Physicalism with Physics," for an extended treatment of these topics.
35. The reasons that quantum field theory (QFT) cannot support a materialist/physicalist ontology are discussed at much greater length in §4 of my essay "Idealism and Science: The Quantum-Theoretic and Neuroscientific Foundations of Reality," in *The Routledge Handbook of Idealism and Immaterialism*, eds. Joshua Farris and Benedikt-Paul Göcke (New York: Routledge, 2022). Let me make a few comments here.

    The move from classical field theory to quantum field theory (QFT) is achieved by constructing operator-valued quantum fields and associated conjugates that obey the canonical commutation relations. In the case of quantum fields as opposed to classical fields, however, the field values attaching to space-time points are *operators* rather than real numbers, so no real physical properties are ascribed to space-time points in the quantum field formalism. This should be obvious in that the operators represent mere probabilities for

possible measurement outcomes. The association of operators with *observables* is particularly apropos here, since it emphasizes the phenomenological (as opposed to substantial) character of the reality described. (It should also be noted that the space-time points to which the operators attach similarly disappear in quantum gravity, because there are those who might seek to salvage an epiphenomenal materialism on the basis of space-time substantivalism.) What the quantum field operators represent is a spectrum of possible values that only have determinate values upon measurement and not all of which can have simultaneous values, that is to say, they have the mathematical structure of a C^*-algebra of *observables*. Since neither particle nor field ontologies are viable, it makes sense to take the operators (observables) themselves as basic and acknowledge that the nature of the reality revealed by QFT is not and cannot be substantial; it is *merely* phenomenological. There simply is no substantial *physical* reality.

Coming to terms with the phenomenological structure and properties of quantum reality in the absence of material substances and causes has led in the directions of *ontic structural realism*, *trope ontologies*, or *process ontologies*. But ontic structural realism, trope ontologies, and process ontologies face a different difficulty because, absent immaterial agency, they are simply reificational fallacies. Ontic structural realism, which hypostatizes the structural invariants of gauge symmetry groups, confronts the fact that there can be no structures in the absence of something that bears that structure—we cannot build castles in the air—and that mere mathematical structures are inert, lacking efficient causality, and inherently qualitatively incomplete, as all abstract formal structures must be. Trope theorists, on the other hand, contend that objects are reducible to bundles of localized properties (conceived as individual accidents) but there is no underlying substance that *has* these properties—in other words, the tropes composing an object inexplicably maintain themselves as bundles of abstract particulars without any underlying substance that unites them. Like the ontic structural realist, the trope theorist is trying to build concrete entities out of abstract ones and committing a reificational fallacy by attributing active dispositions and capacities to abstracta. The process theorist fares no better, for every process is a sequence of events, and every event ultimately requires *participants* that are not themselves mere events. In other words, process ontologies rely on event ontologies that are parasitic on substance ontologies. In the absence of any material substances and the ineluctable demand of sufficient reason, formal structures, tropes, and processes require *immaterial* substances with causal powers. Needless to say, Platonic entities like mathematical symmetries—even if one implausibly granted them an existence independent of mind—are causally inert and cannot play this role; what is needed are immaterial minds, and ultimately, a necessarily existent Mind that explains the existence of all contingent minds. The phenomenological character of the informational structure and properties of a Hilbert-space-based quantum reality, with its emergent spacetime, drives us to a *theistic quantum idealism* in which contingent immaterial mental substances have their spatiotemporal perceptions of the world and each other mediated and coordinated by an uncreated and necessarily existent immaterial Mind (God). In short, a critical scientific realism regarding fundamental physical theory reveals the *impossibility* of taking matter to be fundamental and the basis for an explanation of mind; rather, one must take *mind* as fundamental and seek an explanation of material phenomena. This leads us to a form of *conscious realism*: consciousness (immaterial agency) is the foundational reality and starting point for everything else, immaterial substances are the fundamental constituents of reality, and the phenomenological reality of our experience (the universe) is ultimately *personal and relational*, not impersonal.

36. See David Lewis, "New Work for a Theory of Universals," *Australasian Journal of Philosophy* 61 (1983): 343–377; and David Lewis, "Humean Supervenience Debugged," *Mind* 103 (1994): 473–490.
37. For extended defenses of the principle of sufficient reason (PSR) along these lines, see Robert Koons, "A New Look at the Cosmological Argument," *American Philosophical Quarterly*, 34, no. 2, (1997): 193–211; Richard M. Gale and Alexander R. Pruss, "A New Cosmological Argument," *Religious Studies* 35, no. 4 (1999): 461–476; Alexander R. Pruss, *The Principle of Sufficient Reason: A Reassessment* (Cambridge: Cambridge University Press, 2006); Alexander R. Pruss and Joshua L. Rasmussen, *Necessary Existence* (Oxford: Oxford University Press, 2018); and the philosophical-mathematical defense of causal finitism in Alexander R. Pruss, *Infinity, Causation, and Paradox* (Oxford: Oxford University Press, 2018). Aside from the disastrous epistemic consequences of denying the PSR, we can give a logico-metaphysical proof of it as well. Let S be any contingent state of affairs—for instance, the existence of our universe—and let p be a proposition

representing this state of affairs. Every state of affairs is representable by a (suitably complex) proposition and every contingent proposition represents a contingent state of affairs. We now argue:

(1) For all *p*, if *p* is a contingently true proposition, it's *possible* there's a proposition *q* such that *q* completely explains *p*.
(2) Point (1) is uncontroversial: given any contingently true proposition, it's merely *possible* there exists an explanation for its being true.
(3) The fact that *q* explains *p* entails both *p* and *q*, since *q* cannot explain *p* if *q* isn't true, and *p* must be true if it's explained.
(4) For a contradiction, assume that *p* has no explanation.
(5) Let *p** be the following proposition: *p* is true and there's no explanation for *p*.
(6) Since *p* is contingently true, so is *p**.
(7) By (1), there's a possible world *W* at which *p** has a complete explanation, *q*.
(8) If a conjunction has been completely explained, so has each conjunct.
(9) Since *p* is a conjunct of *p** and *q* completely explains *p** at *W*, *q* explains *p* at *W*.
(10) But *q* also explains *p** at *W*, so *p** is true at *W*, thus there's *no* explanation for *p* at *W*.
(11) Hence, *p* both has and lacks an explanation at *W*, a contradiction.
(12) The supposition that *p* has no explanation leads to a contradiction and therefore is false.
(13) Thus, for any contingently true proposition *p*, *p* has an explanation.

Since every contingently true proposition represents a contingent state of affairs that's actual, and every contingently true proposition has an explanation, every contingent state of affairs has an explanation. The principle of sufficient reason is thus *necessarily true*.

38. See Pruss and Rasmussen's *Necessary Existence* for an extended examination of these themes. The logical consequences of intuitions (positive or negative) regarding necessary being are interactively explorable at https://www.necessarybeing.com.
39. Examples of these necessitarian approaches are: (1) Laws as broad logical necessities: A. Bird, "The Dispositional Conception of Law," *Foundations of Science* 10, no. 4 (2005): 353–370; (2) Laws as relationships among universals: D. Armstrong, *What Is a Law of Nature?* (Cambridge: Cambridge University Press, 1983); and (3) Laws as causal powers: R. Harré and E. Madden, *Causal Powers: A Theory of Natural Necessity* (Oxford: Blackwell, 1975); J. Bigelow and R. Pargetter, *Science and Necessity* (Cambridge: Cambridge University Press, 1990).
40. If time permitted, we could also examine how ongoing research in quantum gravity furthers the case for theistic quantum idealism. In particular, just as we have discussed how matter is rendered insubstantial and merely phenomenological in regular quantum physics, so too the very fabric of space-time is rendered merely phenomenological in the context of quantum gravity. More specifically, the general quantum-gravitational picture forming sees space-time as emerging from immaterial information that cannot, in principle, reside within space-time itself. See J. Hartle and S. Hawking, "Wavefunction of the Universe," *Physical Review D* 28 (1983): 2260–75; J. Feldbrugge, J-L Lehners, and N. Turok, "No Smooth Beginning for Spacetime," *Physical Review Letters* 119 (2017): 171301; B. Swingle and M. van Raamsdonk, "Universality of Gravity from Entanglement"; C. Cao, S. Carroll, and S. Michalakis, "Space from Hilbert Space: Recovering Geometry from Bulk Entanglement"; and N. McMahon, S. Singh, and G. Brennen, "A holographic duality from lifted tensor networks." We will take up the subject of global versus local time in §5 and also consider how our psychological experience of the flow of time and rational libertarian freedom works in this context in the final note of §5, note 47.
41. The Wheeler-DeWitt equation is the general-relativistic analogue of the Schrödinger equation in ordinary quantum mechanics. In principle, its solutions represent all the information about the geometry and matter content of the universe. See Carlo Rovelli, "The Strange Equation of Quantum Gravity" (2015), https://arxiv.org/pdf/1506.00927.pdf.
42. Don N. Page and William K. Wootters, "Evolution without Evolution: Dynamics Described by Stationary Observables," *Physical Review D* 27 (1983): 2885.
43. More technically, the criticisms are that: (1) the total energy constraint in canonical general relativity requires all observables to commute with the Hamiltonian, which, contrary to observation, translates into static physical states and eliminates time-dependence entirely (this is the essence of the "problem of time" in quantum gravity); and (2) the Page-Wootters mechanism gets "stuck" after the first time measurement and is not able to provide the correct propagators or the correct two-time correlations.

44. Vittorio Giovannetti, Seth Lloyd, and Lorenzo Maccone, "Quantum Time," *Physical Review D* 92 (2015): 045033.
45. E. Moreva et al., "Time from Quantum Entanglement: An Experimental Illustration," *Physical Review A* 89 (2014): 052122; and E. Moreva et al., "The Time as an Emergent Property of Quantum Mechanics: A Synthetic Description of a First Experimental Approach," *Journal of Physics: Conference Series* 626 (2105): 012019.
46. More technically again, the Hamiltonian constraint is associated with the transcendent observer who perceives the whole universe as a static system in an eigenstate of its global Hamiltonian, but internal observers witness evolving systems and time-dependent measurement outcomes with wavefunction decoherence ("collapse") in accordance with the Born rule.
47. One of the key questions about this view, which presumes a mathematical reconciliation of global eternalism with phenomenological becoming in local inertial frames, is how divine timelessness and eternalist metaphysics are reconciled with the libertarian free will requisite to moral agency. The answer begins with God being timelessly present to every local experience of becoming in the (nonlocal) *spatiotemporal* totality of *W*, and thus having foreknowledge of libertarian conscious agency on an ontic perceptual rather than epistemic conceptual basis. Drawing on his knowledge of the universal wavefunction, God even knows everything that might have happened had different choices been made, and what could have resulted in such cases. The background picture in physical theory sees local temporal evolution as an emergent artifact of quantum entanglement. But the nonlocal divine action is metaphysically perspicuous, for all perceived distances are merely phenomenological and part of the perceptual map *P* that is the communication channel for the quantum information through which God provides our respective orientations to the objective world in which we interact with others (see *§8.1*).The question remains how this plays out with respect to human libertarian freedom. Here we can take a cue from Augustine's profound reflections on the human experience of time in relation to divine timelessness in Book XI of the *Confessions*. The passages relevant for our reflection, as found in *The Confessions of St. Augustine* [397 A.D.], trans. John K. Ryan (New York: Doubleday, 1960), are from Book XI.14 (p. 253), Book XI.15 (pp. 254–255), Book XI.16 (pp. 255–256), Book XI.17 (p. 256), Book XI.18 (p. 258), Book XI.26 (p. 264), and Book XI.28 (p. 268):

> What, then, is time? If no one asks me, I know; if I want to explain it to someone who does ask me, I do not know… If nothing were passing away, there would be no past time, and if nothing were coming, there would be no future time, and if nothing existed, there would be no present time. How, then, can these two kinds of time, the past and the future, be, when the past no longer is and the future as yet [is not]? But if the present were always present, and would not pass into the past, it would no longer be time, but eternity. Therefore, if the present, so as to be time, must be so constituted that it passes into the past, how can we say that it is, since the cause of its being is the fact that it will cease to be? Does it not follow that we can truly say that it is time, only because it tends toward non-being?... [But] in what sense is something *non-existent* either long or short? *The past no longer exists, and the future is not yet in being*… [and the present has no length, for] if it is extended, it is divided into past and future. The present has no space… [and yet] O Lord, *we perceive intervals of time*… It is passing times that we measure, and we make these measurements in perceiving them… as long as time is passing by, it can be perceived and measured, but when it has passed by, it cannot be measured *since it does not exist*…. [But] a thing that does not exist cannot be seen. If those who narrate past events did not perceive them by their minds, they would not give true accounts. If such things were nothing at all, they could not be perceived in any way. Therefore, *both future and past times have being*… There are three times, past, present, and future. But perhaps it might properly be said that there are three times, the present of things past, the present of things present, and the present of things future. These three *are in the soul*, but elsewhere I do not see them: the present of things past is *memory*; the present of things present is in *intuition*; the present of things future is in *expectation*… Time [therefore] is nothing more than *distention*: but of what thing I know not, and the marvel is, if it is not *of the mind itself*… The same thing holds for a man's entire life, the parts of which are all the man's actions. The same thing holds throughout the whole age of the sons of men, the parts of which are the lives of all men.

The picture Augustine gives us is one in which *time is an activity of the mind* whereby the mind is not only extended into the past by way of memory, or into

the future by way of anticipation, but *distended*, so as *to hold these memories and anticipations as present*. Psychologically speaking, the past and the future thus exist *in the mind alone*, as a *mental synthesis*. An illustration of this is provided by the activity of speaking. In speech, my perception is distended into the past by reason of what has been spoken and into forethought by reason of what is about to be spoken. We can connect these ideas to Fisher's neurological hypothesis for quantum cognition. In the case of brain-linked consciousness, coherent brain states allow non-local binding of different areas of the brain, but they may also serve as the neurological means by which memories of the past, perceptions of the present, and anticipations of the future are retained in superposition until the immaterial mind, through the libertarian exercise of rational will, makes a decision. At this point, from a temporal perspective, God occasionalistically brings about decoherence so the effects of that decision are manifested in the brain, influence bodily behavior, and the consequences lead to decoherence of the wavefunction in the intersubjective perceptual space that produces an objective reduction in communal reality, thereby influencing the responses of other finite conscious agents in our immediate local inertial frame. In the present moment of consciousness, therefore, the distention of the mind that Augustine observed provides the ontological ground for the libertarian exercise of the rational will and the making of a decision, on the basis of reason, that could have been otherwise, and over which the moral agent exercised control.

But how does this play out in the timeless (eternal) and static divine perspective? Augustine observes that when God made the heavens and the earth, he did not create them within space and time, for space and time were brought into being by his creation of them. Indeed, God did not create *in* time, but rather *with* time, that is, with all the time that created reality will ever possess. Augustine remarks (*Confessions*, XI.30 (p. 269); XI.31 (p. 270): "There can be no time without creation… and you [i.e., God] are before all times, the eternal creator of all times, and [those] times are not coeternal with you… Therefore, just as in the beginning you have known heaven and earth without change in your knowledge, so too 'in the beginning you made heaven and earth' without any difference in your activity."

However, if the future already exists objectively and contains all the actions that we will ever perform, then how could we do otherwise? How could we have control of our choices? It's all right there for God to see and it was he who created it, so what room is there for creaturely responsibility? And the answer to these questions is that there is room for creaturely responsibility *in each present moment of distended consciousness* contained within this overarching whole. In that moment, we possess the libertarian freedom of rational choice and God eternally perceives what that choice is. If we would have chosen differently, God would have actualized for conscious perception a different decoherence of the universal wavefunction. So, from the point in universal history that finite rational choice first appears, it is the composition of the chosen actions of all finite agents that God uses as the basis for creating the decoherence that defines the objective path perceived and traveled by all finite consciousnesses through the superposed possibilities in the universal wavefunction. And as already noted, it is the universal wavefunction that models divine omniscience, for it encapsulates divine knowledge not only of everything that has happened, is happening, and will happen, but also of all the possibilities of things that could have happened and all of the things that could have resulted.

48. See Hugh Everett, "'Relative State' Formulation of Quantum Mechanics," *Reviews of Modern Physics* 29 (1957): 454–462; Bryce S. DeWitt and Neil Graham, eds. *The Many Worlds Interpretation of Quantum Mechanics* (Princeton: Princeton University Press, 1973); David Wallace, "Everett and Structure," *Studies in History and Philosophy of Modern Physics* 34 (2003): 87–105; David Wallace, "Quantum Probability from Subjective Likelihood: Improving on Deutsch's Proof of the Probability Rule," *Studies in History and Philosophy of Modern Physics* 38 (2007): 311–332; David Wallace, *The Emergent Multiverse: Quantum Theory according to the Everett Interpretation* (Oxford: Oxford University Press, 2012). A good critical discussion can be found in S. Saunders et al., eds. *Many Worlds? Everett, Quantum Theory, and Reality* (Oxford: Oxford University Press, 2010).
49. For discussions and variants of this viewpoint see, for example: J. A. Wheeler, "Information, Physics, Quantum: The Search for Links," in *Proceedings of the 3rd International Symposium on Foundations of Quantum Mechanics in the Light of New Technology*, eds. S. Kobayashi *et al.* (Tokyo, Physical Society of Japan, 1989), 354–368; R. Clifton, J. Bub, and H. Halvorson, "Characterizing Quantum Theory in Terms of Information-Theoretic Constraints," *Foundations of Physics* 33 (2003): 1561–1591; C. Fuchs, "Quantum

Mechanics as Quantum Information, Mostly," *Journal of Modern Optics* 50, no. 6–7 (2003): 987–1023; A. Bokulich and G. Jaeger, eds. *Philosophy of Quantum Information and Entanglement* (Cambridge: Cambridge University Press, 2010); J. Bub, *Bananaworld: Quantum Mechanics for Primates* (Oxford: Oxford University Press, 2016); O. Lombardi, F. Holik, and L. Vanni, "What Is Quantum Information?," *Studies in History and Philosophy of Modern Physics* 56 (2016): 17–26; C. Timpson, *Quantum Information Theory and the Foundations of Quantum Mechanics* (Oxford: Oxford University Press, 2016); L. Felline, "Quantum Theory Is Not Only about Information," *Studies in History and Philosophy of Modern Physics* (2018), https://doi.org/10.1016/j.shpsb.2018.03.003; L. Henderson, "Quantum Reaxiomatisations and Information-Theoretic Interpretations of Quantum Theory," *Studies in History and Philosophy of Modern Physics (2018),* https://doi.org/10.1016/j.shpsb.2018.06.003.

50. The reasons why information is neither metaphysically autonomous nor self-explanatory are twofold. First, aside from the fact that abstract information is causally inert, the very existence of information *requires a substrate*, so it *cannot* serve as the foundation of reality. Information is given by state differences discernible in a system and, as such, constitutes a property of that system that is associated with its possible configurations; it is not an entity unto itself. In a physicalist context, the system the arrangements of which constitute information is a physical configuration. In an idealist context, it is the mind that is configured, for mental experience requires different phenomenal states that are quantitatively and qualitatively different from each other. Thus, for information to be conceptualized coherently presupposes either a material or a mental substrate. To maintain that information is metaphysically autonomous is to speak of "spin without the top, of ripples without water, of a dance without the dancer, or of the Cheshire cat's grin without the cat" [Bernardo Kastrup, *The Idea of the World: A Multi-disciplinary Argument for the Mental Nature of Reality* (Winchester, UK: *iff* Books, 2019), 26]. In short, information without a substrate *is metaphysically impossible*.
51. This picture has a superficial similarity to the neo-Aristotelian/Thomistic "traveling forms" interpretation of quantum mechanics proposed by Alexander Pruss ["A Traveling Forms Interpretation of Quantum Mechanics," in *Neo-Aristotelian Perspectives on Contemporary Science*, eds. W. M. Simpson, R. C. Koons, and N. J. Teh (New York: Routledge, 2018), 105–122], and also Robert C. Koons ["The Many Worlds Interpretation of QM: A Hylomorphic Critique and Alternative," in *Neo-Aristotelian Perspectives on Contemporary Science*, eds. W. M. Simpson, R. C. Koons, and N. J. Teh (New York: Routledge, 2018), 61–104], which draws on the "traveling minds" view first proposed by Euan Squires [E. Squires, *Conscious Mind in the Physical World* (Bristol: Hilger, 1990)] and Justin Barrett [J. A. Barrett, "The Single-Mind and Many-Minds Versions of Quantum Mechanics," *Erkenntnis* 42 (1995): 89–105]. The similarity is merely superficial, however, since all these approaches require the existence of material substances and, as has been and is being argued, *material substances do not exist*. A residue of hylomorphism remains, however, in that immaterial consciousnesses exemplify the universal forms distinctive of their kind—human consciousness intrinsically differs from canine consciousness, for example—and are differentiated by their haecceities: each immaterial consciousness possesses a primitive substantial *this*ness that individuates it as a member of its kind (renders it a unique particular). A hylomorphic residue pervades the *perceptions* of immaterial consciousness as well, in that the ontic form/matter distinction is replaced with a phenomenological quantitative/qualitative or structure/content distinction. Beyond this, as *simple* immaterial substances, finite consciousnesses experience the divinely provided reality (inclusive of their phenomenological bodies) holenmerically.
52. The indestructibility of quantum information is secured by the resolution of the black hole information paradox using the holographic principle [for a popular account, see Leonard Susskind, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics* (New York: Back Bay Books, 2008)]. Evidence for memory recovery and retention in the decoupled state is provided by the life reviews reported, for example, in 22.2% of NDEs in a study involving 613 people from a variety of backgrounds and cultures [J. Long and P. Perry, *Evidence of the Afterlife: The Science of Near-Death Experiences* (New York: HarperOne, 2010), 65–69, 107–120, 199–202]. Some of these involved incidents that had been forgotten or suppressed until recognized in the review [see also P. van Lommel, *Consciousness Beyond Life: The Science of the Near-Death Experience* (New York: HarperOne, 2010), 7–43 et passim, especially 35–38].
53. Max Tegmark, "The Importance of Decoherence in Brain Processes," *Physical Review E* 61 (2000): 4194–4206.

54. S. Hameroff and R. Penrose, "Conscious Events as Orchestrated Space-Time Selections," *Journal of Consciousness Studies* 3, no 1, (1996): 36–53.
55. L. Diósi, "A Universal Master Equation for the Gravitational Violation of Quantum Mechanics," *Physics Letters A* 120, no. 8 (1987): 377–381; L. Diósi, "Models for Universal Reduction of Macroscopic Quantum Fluctuations," *Physical Review A* 40 (1989): 1165–1174; R. Penrose, "On Gravity's Role in Quantum State Reduction," *General Relativity and Gravitation* 28 (1996): 581–600; and R. Penrose, "On the Gravitization of Quantum Mechanics 1: Quantum State Reduction," *Foundations of Physics* 44 (2014): 557–575.
56. S. Hameroff and R. Penrose, "Consciousness in the Universe: A Review of the 'Orch OR' Theory," *Physics of Life Reviews* 11 (2014): 39–78; the correction to Tegmark is on p. 67.
57. H. Hu and M. Wu, "Spin-Mediated Consciousness Theory: Possible Roles of Neural Membrane Nuclear Spin Ensembles and Paramagnetic Oxygen," *Medical Hypotheses* 63, no. 4 (2004): 633–646; M. Fisher, "Quantum Cognition: The Possibility of Processing with Nuclear Spins in the Brain," *Annals of Physics* 362 (2015): 593–602; C. Weingarten, P. Doraiswamy, and M. Fisher, "A New Spin on Neural Processing: Quantum Cognition," *Frontiers in Human Neuroscience* 10 (2016): article 541.
58. G. Tononi, "Consciousness as Integrated Information: A Provisional Manifesto," *Biological Bulletin* 215 (2008): 216–242; G. Tononi and C. Koch, "The Neural Correlates of Consciousness: An Update," *Annals of the New York Academy of Sciences* 1124 (2008): 239–261; D. Balduzzi and G. Tononi, "Qualia: The Geometry of Integrated Information," *PLoS Computational Biology* 5, no. 8 (2009): e1000462; D. Toker, "Informational Idealism and the Integrated Information Theory of Consciousness" (2013), https://danieltoker.files.wordpress.com/ 2013/10/toker-informational-idealism.pdf; M. Oizumi, L. Albantakis, and G. Tononi, "From the Phenomenology to the Mechanisms of Consciousness: Integrated Information Theory 3.0," *PLoS Computational Biology* 10, no. 5 (2014): e1003588; W. Marshall, J. Gomez-Ramirez, and G. Tononi, "Integrated Information and State Differentiation," *Frontiers in Psychology* 7 (2016): article 926; C. Koch et al., "Neural Correlates of Consciousness: Progress and Problems," *Nature Reviews Neuroscience* 17 no. 5 (2016): 307–321; M. Oizumi et al., "Measuring Integrated Information from the Decoding Perspective," *PLoS Computational Biology* 12, no. 1 (2016): e1004654; M. Tegmark, "Improved Measures of Integrated Information," *PLoS Computational Biology* 12, no. 11 (2016): e1005123; D. Toker and F. Sommer, "Moving Past the Minimum Information Partition: How to Quickly and Accurately Calculate Integrated Information" (2016), https://arxiv.org/pdf/1605.01096.pdf; S. Krohn and D. Ostwald, "Computing Integrated Information," *Neuroscience of Consciousness* 3, no. 1 (2017): nix017; X. C. Arsiwalla and P. Verschure, "Measuring the Complexity of Consciousness," *Frontiers in Neuroscience* 12 (2018): article 424; H. Kim et al., "Estimating the Integrated Information Measure Phi from High-Density Electroencephalography during States of Consciousness in Humans," *Frontiers in Human Neuroscience* 12 (2018): article 42; D. Toker and F. Sommer, "Information Integration in Large Brain Networks," *PLoS Computational Biology* 15 no. 2 (2019): e1006807.
59. The corticothalamic system is the integrated connection of the cerebral cortex and the thalamus in the brain. Corticothalamic and thalamocortical fibers project from the cerebral cortex to the thalamus and from the thalamus back to the cortex, forming circuits consisting of looped neural pathways that some researchers think may allow the brain to monitor its own activity.
60. M. A. Cerullo, "The Problem with Phi: A Critique of Integrated Information Theory," *PLoS Computational Biology* 11, no 9 (2015): e1004286.
61. S. Aaronson, "Why I Am Not An Integrated Information Theorist (or, The Unconscious Expander)" (2014), https:// www.scottaaronson.com/blog/?p=1799.
62. Quite frankly, this is all that should be expected on substance dualist grounds as well, a point that has been made forcefully in terms of the "autonomy thesis" defended by J. P. Moreland. See his *Consciousness and the Existence of God: A Theistic Argument* (New York: Routledge, 2008); and J. P. Moreland, "The Physical Sciences, Neuroscience, and Dualism," in *The Nature of Nature: Examining the Role of Naturalism in Science*, eds. Bruce L. Gordon and William A. Dembski (Wilmington, DE: ISI Books, 2011), 835–849].
63. I develop some of the technical details of an idealist appropriation of Tononi's research program in my essay "Idealism and Science: The Quantum-Theoretic and Neuroscientific Foundations of Reality" (London: Routledge, 2021), 536–575.
64. D. D. Hoffman, "The Origin of Time in Conscious Agents," *Cosmology* 18 (2014): 494–520; C. Fields et al., "Conscious Agent Networks: Formal Analysis and Application to Cognition," *Cognitive Systems Research* 47 (January 2018): 186–213.

65. For a discussion of the relationship between the global state of the universe in the mind of God and the local subjective experience of temporal flow on the part of finite conscious agents, see §5, especially note 47.
66. A more formal model is possible and instructive. See D. D. Hoffman and C. Prakash, "Objects of Consciousness," *Frontiers in Psychology* 5 (2014): article 577, and (especially) the above-cited C. Fields et al., "Conscious Agent Networks," which provide much more detail. We will focus on the earlier and simpler model in Hoffman and Prakash. Markov kernels on finite sets of states can be expressed as matrices in which the entries in each row sum to 1. A Markov kernel can also be regarded as a discrete information channel with an input alphabet X and an output alphabet Y and a probability transition matrix that expresses the probability of observing output y given input x. We also need the following concepts: a set X with a collection of subsets X, called events, is a *measurable space* (X, X) just in case three conditions are satisfied: (1) X is in X; (2) X is closed under set-complementation; and (3) X is closed under countable union. A probability measure over the measure space assigns a probability to each event in X. The collection of events X is a σ-algebra. We can now model a conscious agent formally as follows:

    A conscious agent C in a world W is a 6-tuple $C = \langle (X,\mathbf{X}),(G,\mathbf{G}),P,D,A,t\rangle$ where:

    (1) $(X, \mathbf{X})$, $(G, \mathbf{G})$, and $(W, \mathbf{W})$ are measurable spaces;

    (2) P: $W \times \mathbf{X} \rightarrow [0, 1]$, D: $X \times \mathbf{G} \rightarrow [0, 1]$, and A: $G \times \mathbf{W} \rightarrow [0, 1]$ are Markov kernels; and

    (3) t is a non-negative integer.

    If we omit the σ-algebras, we can more conveniently write $C = \langle X,G,P,D,A,t\rangle$.
67. A concern here is whether appropriating aspects of Hoffman's model excludes libertarian free will as an exercise of *reason*, reducing it to a mere set of Markovian transition probabilities. I would argue that it does not. The irreducibly probabilistic nature of Markov kernels rather reflects two things: (1) the brain processes correlated with consciousness are not and could not be metaphysically deterministic insofar as an individual is able to have chosen otherwise and is in control of the choice made, and (2) while rational action is based on reasoned choice, reason gives *differential weight* to different choices, and rational choices are not themselves usually things that could not be otherwise. So individual rational weighting for the Markovian transition probabilities skews the probability distribution *because* the exercise of reason is included, not compromised. Not unrelated to these considerations, and matters for further research and reflection, are the relationship among interactive conscious agency in Hoffman's model asymptotically manifesting quantum dynamics and (a) possible adaptations and appropriations of David Wallace's treatment of decision theory in quantum physics and his decision-theoretic derivation of the Born Rule in Everettian quantum theory (Wallace, *The Emergent Multiverse*), as well as (b) quantum Bayesianism (QBism) and its dependence on the tools of quantum information theory. See the above-cited C. Fuchs, "Quantum Mechanics as Quantum Information, Mostly," and again C. Fuchs, "QBism, the Perimeter of Quantum Bayesianism" (2010), https://arxiv.org/pdf/1003.5209.pdf.
68. Hoffman and Prakash, "Objects of Consciousness," 11–13.
69. Hoffman and Prakash, "Objects of Consciousness," 10.
70. This is reflective of what Giulio Tononi calls the "exclusion axiom." See the above-cited Oizumi et al., "From the Phenomenology to the Mechanisms of Consciousness."
71. Hoffman and Prakash, "Objects of Consciousness," 10, 13–14.
72. Hoffman and Prakash, "Objects of Consciousness," 13.
73. Preliminary analyses and discussions of possible connections between quantum nonlocality and consciousness that has been decoupled from brain-states are discussed by both Pim van Lommel and Liang Shan. See the above-cited P. van Lommel, *Consciousness Beyond Life*, 205–238 et passim; P. van Lommel, "Near-Death Experiences: The Experience of the Self as Real and Not as an Illusion," *Annals of the New York Academy of Sciences* 1234, no. 1 (2011): 19–28; P. van Lommel, "Non-local Consciousness: A Concept Based on Scientific Research on Near-Death Experiences During Cardiac Arrest," *Journal of Consciousness Studies* 20, nos. 1-2 (2013): 7–48; and Liang Shan, "Consciousness Is an Entity with Entangled States: Correlating the Measurement Problem with Non-Local Consciousness," *NeuroQuantology* 16, no. 7 (2018): 70–78. See also: K. Ring and S. Cooper, *Mindsight: Near-Death and Out-of-Body Experiences in the Blind*, 2nd edition (Bloomington, IN: iUniverse, Inc., 2008); J. M. Holden et al., eds., *The Handbook of Near-Death Experiences: Thirty Years of Investigation* (Santa Barbara: Praeger, 2009); Long and Perry, *Evidence of the Afterlife* (2010); C. Fracasso and H. Friedman, "Near-Death Experiences and the Possibility of Disembodied Consciousness," *NeuroQuantology* 9, no. 1 (2011): 41–53; and J. C. Hagan,

ed. *The Science of Near-Death Experiences* (Columbia: University of Missouri Press, 2017). The literature on near-death experiences (NDEs) is voluminous and fascinating to explore. The Near-Death Experience Research Foundation (NDERF) also maintains a website (https://www.nderf.org/site_index.htm) that provides a guide to the literature, with over 4600 accounts of NDEs (so far), and other resources. The *Journal of Near-Death Studies* is a well-established periodical that publishes research in this field. Articles on the evidential value of these experiences, both pro and con, are scattered liberally in a variety of medical journals and the well-established *Journal of Consciousness Studies*. The only semi-rigorous book-length attempt to challenge the veridicality (though not the sincerity) of first-person reports of out-of-body NDEs is John Martin Fischer and Benjamin Mitchell-Yellin, *Near-Death Experiences: Understanding Visions of the Afterlife* (Oxford: Oxford University Press, 2016), but it is marred by a presumptive materialism as the supposed "worldview supported by the physical sciences" (p. 179)—a worldview, as we have seen, that is incompatible with quantum physics. In short, Fischer and Mitchell-Yellin seek to explain away the evidence, however implausibly, rather than deal with its obvious implications. Naturalists, after all, have their own tribal religious commitments, and are no less subject to flights from reason and confirmation biases than other human beings.

74. Robert Koons, defending hylomorphic dualism to me in private correspondence, queried the value of tying mental operations to brain processes in substance dualist and idealist anthropologies if, as NDEs seem to indicate, the mind can actually function better when disentangled from the body/brain. From the standpoint of NDE research and a broadly Christian theological anthropology, there are two responses to be made. The first is that the degradation of mental function associated with consciousness in our current brain-linked state is understandable as one of the noetic effects of sin, manifested here as a functional hindrance in addition to moral and epistemic distortion. The second relevant observation is that there is considerable anecdotal evidence in the NDE literature that our decoupled minds/souls are not so much disembodied as *differently* bodied. There are many NDE descriptions of the decoupled individual possessing a translucent body transparent to perception so the surrounding environment is perceivable through it. Secondly, there is a metaphysical argument to be made that finite consciousness requires both perceived location and perceived embodiment to be able to act, which is to say, ontologically speaking, that there is no such thing as a "view from nowhere" for finite epistemic agents. All of this makes perfect sense from the standpoint of an idealist Christian metaphysics in which embodiment, the intermediate state, and eschatological resurrection are *not* substantial changes, but rather changes in our divinely mediated perceptual environment and cognitive capacities.
75. See footnote 73 and the references therein.
76. Ring and Cooper, *Mindsight* (2008); P. Fenwick, "Nonlocal Effects in the Process of Dying: Can Quantum Mechanics Help?," *NeuroQuantology* 8, no. 2 (2010): 155–163; P. van Lommel, *Consciousness Beyond Life* (2010); P. van Lommel, "Non-local Consciousness"; Shan, "Consciousness as an Entity with Entangled States."
77. Alvin C. Plantinga, *Warrant and Proper Function* (Oxford: Oxford University Press, 1993), Chapter 12; and Alvin C. Plantinga, *Where the Conflict Really Lies: Science, Religion, and Naturalism* (Oxford: Oxford University Press, 2011), Chapter 10. See also J. Beilby, ed., *Naturalism Defeated? Essays on Plantinga's Evolutionary Argument against Naturalism* (Ithaca: Cornell University Press, 2002).
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