OUTSTANDING ISSUES WITH ROBERT RUSSELL'S NIODA CONCERNING QUANTUM BIOLOGY AND THEISTIC EVOLUTION

by Emily Qureshi-Hurst and Christopher T. Bennett

Abstract. Non-Interventionist Objective Divine Action (NIODA), introduced by Robert John Russell, is a model of divine action drawing upon insights from quantum mechanics. It presents an intriguing and significant challenge to classical conceptions of divine action with far-reaching consequences. When applying NIODA to theistic evolution, however, significant questions emerge that require attention. We identify and assess two sets of concerns. The first relates to quantum physics, particularly whether and how quantum occurrences influence mutations and evolution. We argue that the current empirical evidence is ambiguous in its support of the kinds of quantum action that Russell proposes, though emerging data from quantum biology look promising. The second set of concerns is metaphysical, especially concerning the problem of evil. NIODA gives Godextensive agency over evolution and genetics, which has adverse consequences for theodicy. We propose potential solutions to the problems highlighted in our article, both metaphysical and physical, to improve the viability of NIODA's application to theistic evolution.

Keywords: divine action; non-interventionist objective divine action; quantum biology; quantum mechanics; theistic evolution; theodicy

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The Bible depicts an immanent, interactive God who performs "mighty acts" (Ps. 145:4), "wondrous deeds" (Ps. 40:5), and "wonderful works" (Ps. 107:21). Yet, since David Hume's powerful critique of miracles, and *mutatis mutandis* divine action more generally, the theist has faced a problem. Hume claimed that miracles are violations of laws of nature—that class of divine action, *interventionism*, involves God breaking or suspending laws of nature to bring about a desired outcome. Interventionism faces a serious

Emily Qureshi-Hurst is a D.Phil. Candidate in Theology (Science and Religion) at Pembroke College, University of Oxford, Oxford, UK; e-mail: emily.qureshihurst@gmail.com.

Christopher T. Bennett is a D.Phil. Candidate in Theology (Science and Religion) at St Hilda's College, University of Oxford, Oxford, UK; e-mail: christopher.bennett@theology.ox.ac.uk.

philosophical challenge: we have overwhelming empirical evidence in favor of the claim that the laws of nature are never broken, and *ipso facto* that miracles do not occur. Thus, miracle claims can never have good enough evidence to be considered credible. Moreover, interventionist miracles are theologically problematic in that they involve "the theological absurdity of God acting against God, since theologically the laws of nature are to be understood as expressing the faithful will of the Creator who ordains them" (Polkinghorne 2001, 188). Thus, there are good philosophical and theological reasons to avoid an interventionist model of divine action.

In response to Hume, the theist has recourse to a range of tactics: (1) challenging Hume's definition of laws of nature along with Montgomery (1978, 145–53); (2) denying the existence of laws of nature altogether in line with scientific antirealists like van Fraassen (1989); (3) challenging Hume's use of background evidence to exclude the possibility of miracles, as in Swinburne (2004, chapter 12). In this article, we consider one further option that has received a great deal of scholarly attention in recent years, namely, challenging the idea that a miracle must violate a law of nature. If God can act in and through the laws of nature to enact valuable and significant change, particularly in the context of guiding the evolutionary process, then the theist is able to maintain miraculous, providential action on the part of God without the philosophical or theological problems contained in interventionism. Robert Russell has developed a form of divine action that aims to circumvent Hume's challenge: Non-Interventionist Objective Divine Action (NIODA), which is the subject of this article.

NIODA describes the effects of God's direct action in nature, specifically in the realm of quantum mechanics, and has several key features that are expressed by each component of the acronym. By using the term *non-interventionist*, Russell explicitly distances himself from interventionist divine action, the doctrine that God acts by breaching laws of nature, circumventing the philosophical and theological problems contained therein. Non-interventionism, Russell maintains, involves God acting with the grain of nature, realizing God's specific will in harmony with the more general divine providence composed of the laws and process by which the natural world unfolds. Objective divine action is action that brings about consequences that would not have occurred if God had not acted to bring them about. It contrasts with subjective divine action, in which individuals may see religious significance in the world's everyday beauty or splendor (i.e., a particularly magnificent sunset), objective divine action occurs when God brings about material change in the world in a particular instance (Russell 2006, 581). NIODA is therefore an example of special divine action. By this, we mean that NIODA refers to specific acts of God that cause desired outcomes, as opposed to general divine action (or

general providence) whereby God creates and sustains the universe and its contents.

NIDOA is developed in conversation with Quantum Mechanics, and the open ontological structure implied by at least one of its philosophical interpretations. In many ways, NIODA has revolutionized theological conceptions of divine action through dialog with modern science, and Russell's proposal should be recognized for the creative step forward that it is. Nevertheless, it is vulnerable to the extent that there are outstanding concerns from both physics and metaphysics. In what follows we assess whether and to what extent these concerns present significant problems for the viability of NIODA and theistic evolution.

NIODA: Context and Content

The Humean Challenge

Against the backdrop of Newtonian physics, Hume mounted a challenge to miracles, which extends to all forms of divine action. Newtonian mechanics describes forces governing the behavior of bodies in motion, and it appears to entail causal determinism (Butterfield 1998). Causal determinism can be defined counterfactually: given the state of the world immediately prior to some event e + the laws of nature, no event other than e could have occurred. Importantly, on this view, the universe proceeds like clockwork and does not require (nay, cannot accommodate) any external causal influence.

In *An Enquiry Concerning Human Understanding*, Hume argues: (1) a miracle is a violation of a law of nature[1] and (2) there can never be grounds for believing in such a thing. The argument runs as follows: we have overwhelming empirical evidence that laws of nature are infallible. Each moment we experience regularity in nature from the trivial to the significant—letting go of a pen will always cause it to fall; dead men stay dead. Our sensory experience repeatedly confirms the uniformity of nature, and this provides strong evidence that natural laws are never broken. In order for a miracle to be believed, one must provide evidence that proves it beyond possible doubt; however, Hume claimed that empirical evidence of the infallibility of the laws of nature will always provide stronger evidence *against* the miracle than a believer could ever provide *for* it. Hume argues therefore that this establishes an unattainably high threshold of epistemic verification, and thus, we never have good grounds for believing a miracle has occurred. (Hume [1748] 2007, Section X)

Hume's challenge was primarily epistemic, in that it questioned one's ability ever to have justification for belief in a miracle. Therefore, it has left a powerful legacy against the credibility of miracles altogether. There are several criticisms that the believer in miracles can mount against Hume,

most of which are outside the scope of this article.[2] For the present discussion, we need acknowledge only one: whether a miracle must violate a law of nature.

Non-Interventionist Objective Divine Action

NIODA emerged from an extended project that brought science and theology into conversation on the subject of divine action. The Divine Action Project (DAP), conceived of and led by Robert Russell, encompasses a series of conferences and publications on theology and science (specifically "Scientific Perspectives on Divine Action") jointly sponsored by the Vatican Observatory and the Centre for Theology and the Natural Sciences. DAP spanned 20 years and was motivated by the belief that contemporary science could generate theologically fruitful discourse concerning divine action, insofar as the structure of the natural world and the means by which God could act in that world must be fundamentally related (Russell et al. 2008). As Wesley Wildman writes: "the major points of consensus among DAP participants were that there are significant theoretical grounds for confidence in the intelligibility of the concept of providential divine action, and that there are several technically and theologically feasible theories of it" (Wildman 2010, 32). The particular focus was divine action in conformity with the laws of nature, and hence, its output can be read as a response to Hume's challenge.

Russell's NIODA is intended to establish divine causal efficacy in the realm of genetic mutations, thus affecting the course of evolution. Hence, it is a theological interpretation of evolution, generally termed theistic evolution. By identifying an ontological openness at the quantum level in which God can act *in* and *through*, as opposed to *against*, laws of nature, divine causality works with natural causality to actualize outcomes that would not have occurred otherwise. NIODA stands upon the Copenhagen Interpretation of quantum mechanics. An in-depth explanation of quantum mechanics' formal structure is inessential here—its salient features can be expressed through the example of wave-particle duality. Prior to the quantum revolution at the turn of the twentieth century, subatomic particles were understood approximately like billiard balls, behaving in relevantly similar ways to objects at the macroscopic level of human experience. Similarly, light was believed to be similar to sound, insofar as it was composed of continuous oscillating waves. The quantum revolution turned these ideas on their head, introducing the notions of wave-particle duality and Heisenberg's uncertainty principle. The uncertainty principle claims that pairs of properties exist in uncertainty relations, namely, the more precisely one measures one property, the less certain one can be about the other. One such pair is position and momentum, which results from wave-particle duality.

Before measurement quantum objects exist in a superposition, that is, in all physically possible states spread out over all possible locations. The behavior of such a quantum object through time is described by the Schrödinger equation, a deterministic equation mapping the movement of the wave function of the object. To measure the momentum of an object, one must measure its wavelength; but as a wave is spread out, the precision by which its position can be known decreases. Ascertaining the position of the object requires a specific spatial measurement, and thus, it cannot be measured as a wave and its momentum is uncertain. The act of measurement fundamentally alters the system, causing the wave function to collapse into a particular state and actualize one of a range of possible outcomes. Essentially, unobserved quantum objects exhibit both wave-like and particle-like behavior, and the position and momentum of such an object has no precise value until measurement takes place. Measurement necessarily collapses the wave function, which constitutes a quantum event. The outcome of a quantum event can only be predicted within a probability range that is spread out over the superposition, with various states being more likely than others but none being certain. The Copenhagen Interpretation claims that this indeterminacy is ontological, namely, it reflects some mind-independent feature of reality, and not an epistemic gap that will be filled with future scientific development.[3]

The central metaphysical difference between classical and quantum worldviews is that while the former is deterministic, the latter appears indeterministic at least at the microlevel. In a quantum event, a range of possible outcomes can occur, and on the Copenhagen Interpretation, there is necessary but not sufficient causal explanation for which possible outcome will be actualized.[4] On the Copenhagen Interpretation, "the future is ontologically open, influenced, of course, but *under*determined by the factors of nature acting in the present" (Russell 1997, 54). This ontologically open structure leaves scope for non-interventionist divine action: God acts in and through quantum processes to actualize particular outcomes at quantum events, thus enacting material changes in the physical world. Thus, Russell argues: "to the scientist, quantum processes are entirely random; to the Christian, God can be seen as choosing the outcome from among the quantum mechanically allowed options" (1998, 208). The NIODA hypothesis then interprets quantum mechanics theologically and claims that God participates in the process that realizes particular outcomes. These quantum effects are the means by which God may, through mutations, shape the course of evolution.

A key question for NIODA is whether quantum processes have perceptible effects at the level relevant to life. Russell argues that "the classical world is not an irreducible given but a result of the quantum world" (Russell 1997, 59). Through bottom-up causality, in which "lower" level causes filter up the causal chain to have knock-on effects at "higher"

levels, quantum mechanics can become biologically relevant. To establish this, one requires a stratified ontology mirrored in the supervening sciences—quantum mechanics affects chemical reactions, which, in turn, affect life and therefore biology (Cartwright 1983). The way Russell establishes quantum causation as effective at the macrolevel of evolution is through genetic mutations. In particular, he argues that God guides the evolutionary process providentially by acting in the quantum mechanical processes that underlie genetic mutations. Specifically, God actualizes genetic mutations whose presence in the germ line, amplification by replication, and expression in the phenotype confers adaptive advantage and ultimately lead to speciation and evolutionary change. Thus, according to Russell, quantum causes have biological effects through bottom-up causality.

Russell argues that there are both classical and quantum causal explanations for mutations, but that the most likely candidates for having quantum causes are: "point mutations, including base-pair substitutions, insertions, deletions; spontaneous mutations, including errors in DNA replication, repair, recombination; radiative physical mutagens (including X-rays and ultraviolet light; and crossing over)" (Russell 1998, 207). Mutations in the DNA of an organism are one of the ways phenotypic variation is introduced. In sexual reproduction, organisms pass on their genetic material to their offspring through combination with another organism's genetic material, and the offspring's genotype will be an exact blend of their parents," including any mutations. Likewise, asexual reproduction (such as cell division) creates genetically identical copies unless mutations take place. Mutations are alterations of an organism's genotype that occur at random, and they can be maladaptive, adaptive, or adaptively irrelevant, depending on which effects they confer upon an organism's phenotype and how that organism then fares in the environment (Pigliucci and Muller 2010). Organisms with more adaptive traits have a greater chance of surviving to a stage where they can pass on their DNA. If the mutation does result in adaptive phenotypical consequences, the mutated DNA will spread throughout the species through *biological amplification* (Russell 2018a). Thus, the microworld of genetic mutations can have significant macroeffects.

In summary, Russell's argument for theistic evolution is composed of three core claims: "(1) a theological commitment to extend special divine action to include evolutionary biology, (2) a philosophical view in which we interpret quantum physics in terms of metaphysical indeterminism, and (3) a scientific claim regarding the role of quantum mechanics in genetic mutation and thus in evolution" (1997, 60). Claim (2) is relatively unproblematic, given our working assumption that the Copenhagen Interpretation is an accurate depiction of subatomic reality. The success of NIODA then hangs on the success of (1) and (3). We identify physical

concerns with (3) and metaphysical concerns with (1). While concerns raised in relation to (3) could be assuaged by further scientific developments, (1) raises problems that are not so easily resolved.

Physical Concerns

The first set of concerns is physical; they relate to the strength of empirical evidence upon which NIODA depends. In order for NIODA to work as a form of theistic evolution, two requirements must be satisfied. First, there must be areas where biology clearly leaves space for the indeterminacy that would allow non-interventionist divine action. Second, compelling evidence must be available to substantiate Russell's claims that "quantum processes underlie and give rise to specific effects in the macroscopic world" (Russell 2006, 590). We contend that although emerging evidence looks somewhat promising, it is not yet clear, on currently available information, whether quantum states have enough causal power on mutations for NIODA to be evolutionarily relevant. Hence, there is uncertainty about the empirical foundations of Russell's hypothesis. Nonetheless, the emerging evidence looks somewhat promising.

Analyzing the state of evidence as it stands, the philosopher of science Jeffrey Koperski argues that "quantum determination does work as a mechanism for theistic evolution," sounding a *prima facie* hopeful note for Russell (Koperski 2015, 380). He is clear, however, that this divine causal efficacy is confined to the quantum domain, as quantum effects are for the most part isolated from the biological world. Koperski uses two key terms: "quantum protectorate" and "the amplification problem." A quantum protectorate is "a stable state of matter whose behaviour is independent of the goings-on at the quantum level," and Koperski argues that the amplification NIODA requires is blocked by many layers of protectorates between quantum occurrences and genetics (Koperski 2015, 381). This leads to the so-called amplification problem, which arises when considering the extent to which quantum occurrences amplify to higher levels, whether that be individual genes, cells, or even organisms. It is not a problem unique to quantum biology but extends to all areas of quantum physics. The central question is this: can quantum processes have meaningful effects at the macrolevel?

There are certain areas of biology that do seem to be affected by quantum occurrences, and Koperski suggests that genetic mutations are a *possible* example. Generally, however, he argues that quantum effects fall foul of the amplification problem and are thus unable to generate significant results in the macroworld of evolution. Koperski writes on this issue: "at the border of science and theology, one finds that physics giveth, and physics taketh away," and, ultimately, "whatever God might do at the quantum level, nature by and large prevents those actions from affecting the

macroscopic realm" (Koperski 2015, 378). The conclusion we take from Koperski is fundamentally ambiguous—God may well act at the quantum level, and this action may affect genetic mutations, but quantum protectorates ensure that the amplification problem *cannot* be solved. Moreover, he argues that the more frequently one must resort to exceptions (in this case: genetic mutations) to keep quantum determination alive, "the less plausible it becomes as a model of divine action" (Koperski 2015, 386). Hence, Koperski concludes that such a model of divine action is not, and could never be, robust.

An alternative, more promising, perspective for Russell is offered by pioneers of quantum biology, Jim Al Khalili and Johnjoe McFadden, who argue that quantum mechanics can and does affect the macroworld of biology. The scientific community generally rejected this view until recently, as delicate quantum states rely on coherence to exhibit the weird and wonderful properties associated with quantum mechanics. Quantum coherence was presumed to be destroyed in the warm, busy molecular environments inside living organisms. Coherence is when the wave-like properties of organisms are aligned (and thus behaving in a quantum manner), and is easily destroyed when interacting with disturbances. This phenomenon, known as *decoherence*, is the process whereby "random molecular motion disrupts carefully aligned quantum mechanical systems, and it randomly wipes out the weird quantum effects in big inanimate objects" (Al Khalili and McFadden 2015, 85–86). Organisms operate at relatively high temperatures, causing thermal vibrations in the molecules present, and making decoherence almost instantaneous in most cases. Hence, biological entities were assumed to be untouched by quantum mechanics. Nevertheless, Al Khalili and McFadden argue that there are several biological mechanisms in which quantum mechanics plays a significant role. Examples include quantum tunneling during respiration and enzyme catalysis, and the need for quantum coherence during initial photon-capturing in photosynthesis (Al Khalili and McFadden 2015, 129–140; 173–183). Thus, in at least some biological instances, amplification is possible.

The central question for the viability of NIODA is whether quantum coherence can be preserved over biologically significant time periods, allowing biological effects to proceed from quantum causes. Al Khalili and McFadden shed some light here, also, arguing that "although decoherence can never be entirely prevented, it may be kept at bay for just long enough to be biologically useful" (Al Khalili and McFadden 2015, 165). In 1944, Erwin Schrödinger began this discussion, arguing that genes were quantum mechanical entities (Schrödinger [1944] 1967). Schrödinger's theory was confirmed by Swedish physicist Per-Olov Löwdin, who demonstrated that the hydrogen bonds that hold together the nucleotide base pairs that comprise DNA obey quantum, not classical laws.

The specifics are worth detailing. Base pairs are joined by hydrogen bonds and DNA makes copies of itself by breaking up base pairs, allowing enzymes to "read" and copy each half of the double helix.[5] Several years after Schrödinger's ideas were published, Löwdin showed that quantum tunneling meant protons could move across hydrogen bonds to generate tautomeric, mutagenic, forms of nucleotides (Al Khalili and McFadden 2015, 293). Moreover, a recent paper by a group based at Duke University Medical Centre demonstrated that the position of the proton in the bond between base pairs could affect the viability of the copies of DNA. More specifically, if the protons were in the wrong tautomeric position, then when they joined to the active site of the replicatory enzyme DNA polymerase, they would be incorporated into the replication process, likely causing a mutation (Wang, Hellinga, and Beese 2011; cf. Al Khalili and McFadden 2015, 289–96). In summary: quantum mechanics affects the behavior of the protons bonding nucleotides, and this proton behavior is *likely* to be linked to errors in copying the genetic code, causing mutations. Hence, argue Al Khalili and McFadden, quantum mechanics "is fundamental to heredity, since our genetic code is written in quantum particles" (Al Khalili and McFadden 2015, 308).

Nevertheless, they caveat this point by stating that there is much more to be done before this link can be established with certainty. Despite the future of quantum biology looking promising, "whether quantum mechanics plays an important and direct role in genetic mutations … remains to be seen" (Al Khalili and McFadden 2015, 309). Is this sufficient to establish NIODA as a form of theistic evolution? The jury is still out; no certain conclusions can be drawn thus far. Nevertheless, we acknowledge that in such interdisciplinary conversations between science and theology, uncertainty will always be a limiting factor. If theologians wish to engage in dialog with pioneering science, then that science will usually be somewhat tentative, as is common with cutting-edge work. Philosophical or theological engagement with such science should therefore be met with recognition of the limitations of working with emerging scientific disciplines. Russell could allay physical concerns by acknowledging that NIODA is based on unsettled questions in quantum biology, which are empirically tentative at the moment, and clarifying that NIODA's application is accordingly limited.[6] With this in mind, we conclude that NIODA's empirical foundations hold some promise, but entail a level of empirical uncertainty with which some may be uncomfortable.

Metaphysical Concerns

In addition to the uncertainty revealed while assessing its scientific foundations, Russell's application of NIODA to theistic evolution raises further questions concerning theodicy. We begin this section by outlining the

general difficulties that Russell's theory encounters, before sketching some possible responses, including Russell's own ideas, on how they might be combatted. NIODA constitutes a radical reconception of divine action, which necessitates an equally radical redrawing of the theodical map. Russell's theory is inevitably afflicted by difficulties surrounding the problem of evil and, despite some reasonable responses, it is not obvious that the problems faced can be surmounted within the classically theistic portrait of God he hopes to paint.

NIODA was devised to establish an immanent and intimate model of divine action, which Russell argues is an improvement on previous versions of the idea. He is acutely aware, however, of the theodical detriments of his theory, as is evident when we writes: "What I want to acknowledge and underscore at the outset is that NIODA makes the problem of theodicy more egregious than it would have been in earlier … versions of theistic evolution. If one chooses to move forward along the trajectory of theistic evolution via the strategy of NIODA, there is simply no way to avoid this problem" (Russell 2008, 252). Evolution, particularly with regard to the intense suffering it causes, is a fundamental problem Christianity must face.[7] Such metaphysical concerns are shared by Wildman, a theological contributor to the DAP: "unlike most other participants, I hold that the postulate of intentional divine action exacerbates the problem of theodicy to such a degree that we are justified in rejecting it for moral and theological reasons" (Wildman 2010, 32).

The key problem that one faces when applying NIODA to theistic evolution is the level of influence that God has over events in the world under such a model. While part of the motivation behind a move toward NIODA might be triggered by a Humean understanding of miracles and a wish to alter conceptions of divine action, there are other good reasons why one might not wish to describe God's actions in the world as interventionist or objective. Russell terms the school of thought that suggests God's actions cannot intervene with laws of nature the "liberal" school. God, understood in this way, acts only in non-interventionist ways and eternally, which means that God cannot act in certain situations due to limits on God's behavior that are usually considered self-imposed. This view is in contrast to the "conservative" view, which asserts that God created the Universe and can intervene in its course in any way, regardless of laws or potential restraints. NIODA is intended as a third way between these two positions, which holds both that God need not breach laws of nature to act in the world but also that God does act in the ways described above. A liberal picture of divine action can act as a bulwark against the problem of evil, as well as being valid on its own terms—it explains why God does not act in certain instances of suffering. On the other hand, a God who intentionally and discretely acts through quantum processes to actualize outcomes such as genetic mutations must bear the

responsibility for the pain and suffering that genetic mutations frequently cause. God could have prevented them without violating natural laws, and for some reason chose not to do so. Russell himself acknowledges that a novel understanding of divine action raises these issues, writing that "the problem of evil is stunningly exacerbated by all the proposals [of special divine action] including my own, that God acts at the level of genetics" (1998, 216), but he does not sufficiently solve this exacerbation.

There are manifold examples of potential sources of intervention for a God freed from the restraints of the liberal school of thought in the realm of genetics. In each of these areas, the defender of NIODA is tasked with thinking afresh about how to respond to objections from the problem of evil. To begin with, consider Duchenne muscular dystrophy, a genetic disease caused by a single mutation in the gene that produces the protein dystrophin, causing muscular wastage and weakening. It is degenerative, beginning to show around age 4, at which point the child goes from being able to crawl, stand, and walk, to being confined to a wheelchair. While it begins with voluntary muscles, for example, in the limbs, it progresses to the respiratory muscles eventually causing respiratory failure. The average life expectancy for a Duchenne patient is 25 (McDonald and Mercuri 2018). The affected individual will live a dramatically shortened life that is marred by bodily degeneration and the knowledge of a slow, painful, yet inevitable death. Impaired bodily function is somewhat by-the-by, as disabled people largely live rich and fulfilling lives. The salient point is this: through a genetic mutation, an otherwise healthy individual who could have lived a long and healthy life is condemned to a shorter and more painful one.

One can make a similar case through the example of cancer, the tumors of which are usually caused by mutations. Cancers are frequently associated with tumors, which are formed from genetically abnormal cells.[8] These tumor cells arise most often by genetic mutations—deletions, insertions, or point mutations can all cumulatively transform a normal cell into a cancer cell. Mutations can then cause malignant cells to reproduce and spread, as well as preventing repair of the faulty DNA. There are other potential causes of tumor growth, but the most common cause is a series of mutations of exactly the kind that Russell described as sensitive to quantum action. As with Duchenne, the salient point is that it seems as though genetic mutations are permitted, or even directly, divinely caused, that bring about immense suffering. Where does NIODA fit in these pictures of gene-based suffering?

Through these examples, we have demonstrated that there are cases where genetic mutations cause a large amount of suffering.[9] That this is the case is a well-evidenced fact. That God ought to be *willing* to stop it, we take for granted, for now. That God is *able* to prevent it, is what we contend must be true in the light of Russell's argument for NIODA

through theistic evolution. How might God prevent suffering? In each of these cases, the picture of God presented by Russell would have God very easily able to do so. Indeed, God not only possesses the capability to prevent mutations that lead to genetic diseases, but also wields that capability in evolutionary situations when bringing about certain mutations. Duchenne muscular dystrophy begins due to a mutation in a single gene, while cancer typically begins as the result of several low-level mutations. In both cases, one can trace an indelible line from suffering to genetic mutations, and thus quantum interactions, which ultimately caused it.[10] Either God brings about all the evils that come about as a result of genetic mutations, or, more generously, God permits quantum interactions that result in suffering-causing mutations. In either case, it seems proper to assign blame to God for not preventing the evils as God could have manipulated the mutations to be otherwise. Therefore, we agree with Russell that if NIODA plays the role in theistic evolution he designates for it, the problem of evil is significantly exacerbated.[11] Our specific examples illustrated that there are metaphysical issues with assigning God this amount of enacted agency, due to the level of suffering caused by genetic mutations that God seemingly chooses not to prevent.

Russell (1998, 221–2) propounds two main ideas pertaining to theodicy: initially, he directly avoids any attempts to "remove God from the detailed history of nature," and claim that pain and suffering are necessary consequences of the evolutionary process. He is sympathetic, however, to the position that certain natural evils of the kind that we describe may be necessary in order to create a world of genuinely free moral agents (Russell 1998, 222). This approach echoes a common refrain in the realm of theodicy—arguing that evil is not a problem because in some way or another, it is inevitable, given God's choices. One of the most prominent exponents of this technique was Gottfried Leibniz, who, in arguing that this world must be the 'best of all possible worlds', implicitly accepted that the evils that are part of it are to some extent inevitable (Leibniz 2001; Murray 2014). A modern theologian who uses a similar approach is Christopher Southgate, whose response to animal suffering and disvalues caused by evolution has been very influential. He postulates a "compound theodicy," with various elements such as the potential for postmortem "selving," and God cosuffering with creatures (Southgate 2011, 18–21). Indeed, Russell himself has expressed admiration for Southgate's approach, though not specifically pertaining to NIODA (Russell 2018b). One of the key elements to this theodicy is the "ambiguity of creation"—goods and harms are mixed together as part of creating through the evolutionary process (Southgate 2008, chapter 1). Therefore, God's actions, inasmuch as they seem to bring about suffering through the wastefulness of Darwinian natural selection, are still justified, because, given that creation overall is a positive compared to noncreation, the only way God could have

created was through the evolutionary process, with the results that we can observe.

At first blush, a defense along the lines of Leibniz/Southgate's theodicies might move NIODA forward. Russell could argue that God, at the macrolevel, was still constrained to ensure that the evolutionary process proceeded constantly. Thus, even mutations that were harmful must be allowed to exist, so as not to give the appearance of intervention. Allied to a story describing why quantum level effects randomly generate bad outcomes occasionally, one could potentially defend certain harmful effects of genetic mutations, and theistic evolution generally, by arguing that God had no choice but to permit things to be that way. When confronting the specific issues of genetic diseases like Duchenne's or cancer, however, a defense along these lines falters. In those cases, very specific quantum-level effects occur that result in immense suffering. If those quantum effects were reversed or altered, there would be no violation of natural law, nor even the appearance of interventionism. If God has power over quantum effects that result in genetic mutations, then a defense holding firm on the necessity of the evolutionary process is doomed to fail. The very indeterminacy that Russell requires in order to make NIODA work with theistic evolution makes God responsible for suffering—if he attempts to address theodicy by a Leibnizian defense, he is hoist with his own petard.

In his favor, Russell rejects the claim that evil is necessary for life, arguing that it does not solve the problem of theodicy but rather elevates it to the level of cosmology. To describe such a move, Russell introduces the term 'cosmic theodicy'. (2007, 124–5). He addresses the possibility that when God created the world, God did not have a choice about certain fundamentals of nature (such as universal constant or the mechanics of subatomic particles). Such fundamentals could stretch to the mechanics of mutation and evolution. Surely, Russell argues, an omnipotent God could have created another type of universe altogether, in which the cruelties of evolution could have been avoided?[12] (2008, 255) Russell therefore acknowledges that cosmic theodicy does not solve the central difficulty, which is that NIODA suggests that God *does act* in a gamut of quantum situations, meaning that it is reasonable to ask why God *has not acted* in the manifold other situations in which doing so would have prevented suffering. Hence, any approach along the lines of Southgate's will proves inadequate for an NIODA model of divine action.

Russell offers a second, more fruitful response: "my suggestion is that we place the topic of biological evolution within a broader theology of both creation and redemption instead of focusing narrowly on creation alone, for God is not the source of pain and death but its redeemer"(1998, 193). He argues that the problem of evil can only ever be resolved within the framework of a theology of redemption, but he does not offer a sufficiently clear picture of what that theology might resemble, or how

eschatological salvation would address present suffering. To take the example of a Duchenne patient, they may be brought into the presence of God and fulfillment, as one might infer from Russell's writings. Nonetheless, it does not seem as though the suffering permitted by God in the first place is purposive. What comfort can future redemption offer to such a suffering individual, compared to the lives of those who have not endured such suffering? The ease with which God could have prevented suffering from genetic diseases and cancers means that building eschatology and redemption into NIODA-esque theodicy is difficult. This idea will be built upon in the section to come, but Russell's initial treatment of it on its own terms does not sufficiently address our concerns.

Ultimately, theodicy presents a genuine and sustained challenge to Russell's attempted theological interpretation of evolution. The motive beneath DAP is an attempt to permit God a means of acting in the world objectively without intervention. But a God that can act under these terms, particularly with respect to genetics, has such a breadth of capabilities that one ought to expect the prevention of many more evils than it seems are prevented. Of course, the issues stemming from the problem of evil resemble many ancient difficulties with Christian theology, but they must be dealt with anew because of Russell's novel interpretation of divine action that stymies most of the usual defenses. The section to come will advertise potential means of mitigating some of the more striking difficulties caused by the problem of evil, but the fundamental problem will remain that if God has such a potentially active role in the everyday interactions of quantum objects, questions will necessarily be raised as to the legitimacy of the scale of evil that continues in the world.[13] The possible answers that Russell initially offers alongside his descriptions of NIODA and theistic evolution do not allay concerns that a God who acts is more blameworthy than one who does not, thus exacerbating the problem of evil. Metaphysical concerns about how a theist subscribing to Russell's theory might face the problem of evil are a significant detriment to his picture of divine action, even if NIODA is a theologically worthy theory for other reasons.

A Way Forward?

Reformulating theistic evolution within a framework of NIODA is no simple task. Russell's attempt to alter typical understandings of divine action in evolution was always likely to be controversial, and therefore, it has proved. Several issues with the theory have appeared and although none perhaps are grievous, they have the cumulative effect of weakening Russell's theory significantly. If they are not ameliorated, NIODA risks faltering, with its strengths as a model of divine action outweighed by weaknesses in other areas. In this final section, therefore, we proffer suggestions for future developments. Scientific difficulties could be averted to some

degree by greater caution regarding the areas where God's quantum action is efficacious, and further acknowledgement of the extent to which the jury remains out on key empirical questions. On the metaphysical front, while certain theodicies seem entirely incompatible with NIODA, or incapable of tackling the issues it raises, we believe that other kinds of theodicy can be deployed to good effect in defense of a God who acts via NIODA.

The precise problem with Russell's interpretation of divine action for theodicy was that by breaking from the liberal model of God, Russell allotted God a great deal of power which God ought to be willing to wield (i.e., God does not opt for the "not even once" strategy proposed by Clayton and Knapp 2011, chapter 3) In doing so, inevitable questions are raised about why God did not act to prevent suffering in a multitude of scenarios in which God could have done so, by acting as Russell argues, through quantum biology. Nonetheless, there is a potentially promising path to a worthwhile theodicy that coheres with NIODA and theistic evolution while defusing problems caused by evil and suffering. Our suggestion is that the most promising path is that of an Irenean defense, for which Russell has already expressed some approval (Russell 2008).

The theologian John Hick is widely known as a modernizer of the Irenean theodicy, founded upon the principle of universal salvation (Hick 1966). The key notion of such a defense is that suffering during an earthly existence is in some way compensated for or alleviated by the fact that God redeems all people in heaven, bringing them eternal flourishing. While there are further important details to Hick's interpretation of Ireneaus' theodicy, the integral feature for our purposes is that all are brought to heaven (Hick 2001). It is most keenly applied to situations of seemingly irredeemable evil, such as the suffering of newborn babies or of good people in natural disasters. Yet, it also presents a useful analysis for the problems we have presented to Russell. A person afflicted with Duchenne seems to be suffering randomly and preventably, but the knowledge that they will be brought into heaven nonetheless can act as comfort in times of suffering, and decisively tilts the balance of goods/harms permitted by God in favor of goods. Likewise, one can put the pain and death of cancer sufferers in perspective, by remembering that they are entitled to eternal life with God. God does not eliminate all sources of suffering in the world, but universal salvation can at least be offered in response.

Naturally, there are difficulties associated with a Hick/Irenean-style defense, including the matter of whether it is fair for all to be saved regardless of actions. Still more significantly, doubts linger over whether future salvation sufficiently provides comfort for, or justifies the permission of, suffering in the present.[14] Those difficulties notwithstanding, as they have been the subject of intense and lengthy discussion and there is insufficient space here to treat them thoroughly, there could still be further difficulties associated with applying this style of theodicy specifically to Russell's

theory of NIODA. It would seem as though a universal salvation theory still relies on some form of restraint upon God's actions along the lines of a "not even once" principle. In individual instances, there might still be room to question why God did not non-interventionistically alter affairs to remove genetic problems. Why is the divine plan so seemingly obscure to humanity, if God loves us all?

The answer to this question, Russell posits, lies in Hick's concept of epistemic distance. A crucial component of Hick's renewed Irenean defense is the claim that God created humanity at an epistemic distance from Godself, so that the world appears *etsi deus non daretur* ("as if there were no God") (Russell 2008, 261).[15] The cognitive freedom this affords humanity allows moral and spiritual growth, as well as providing the free choice to love God if one chooses to do so. Consequently, the world includes evil, but the benefits outweigh the costs. Russell develops this line of thinking alongside a theology of the cross, arguing that "just as God suffers with the experiences of people, God embraces the history of life on earth and suffers with it. If God enters into the physical and biological processes of the world through the Incarnation, it is the crucifixion through which God experiences the suffering of all life and offers it the possibility of redemption" (Russell 2008, 264). These steps toward an eschatology that includes both evolution and cosmology are, in Russell's view, steps toward a theologically holistic theodicy, which, if developed appropriately, could meet the issues raised by NIODA.

Indeed, further development in this direction is beneficial as it builds upon Russell's earlier suggestions that redemption was a key feature of any theodicy constructed in light of NIODA. A Hick/Irenean-style theodicy has the advantages of giving those who suffer means to come to God. It also maintains epistemic distance between Creator and creature—the lack of clarity over when God does and does not act through genetics can simply be indicative of humanity's weak knowledge of God's ineffable nature.[16] Having a theory that frames suffering as frustrated fulfillment, and allowing that frustration to be mitigated ultimately by redemption in the afterlife permits the problem of evils caused by genetic diseases to be at least partly allayed. Individual instances will not cease to be troubling, but there is an overall schema by which one can hopefully understand at least a portion of God's motivations. Hence, we recommend that, given that God has immense power to prevent suffering if Russell's picture of NIODA and theistic evolution is accepted, a turn to a theodicy involving universal salvation and epistemic distance is appropriate, because it may explain several of the particularly inexplicable instances of inaction that were highlighted earlier.

Nevertheless, Russell's eschatology must address God's *objective* action in NIODA if it is to defuse the metaphysical concerns raised here fully. NIODA claims that God acts objectively and directly to bring about

events that would not have happened were it not for God's specific action. This still leaves God responsible for causing (or allowing) mutations that cause disease and suffering. This is where an NIODA-specific response remains necessary. Hick addresses suffering in a world in which it appears that there is no God and offers a solution that claims that God must maintain an epistemic distance and refrain from acting when nature or human cause suffering. Russell's proposal, however, holds that God *does* act, repeatedly, in the natural world through quantum processes. As such, the question of how an Irenean defense works given NIODA remains open. While the outline of a satisfying solution is available, through retaining God's redemption as the loving father of all, further work is needed to explain that the problematic gene-based suffering God is responsible for through NIODA.

To conclude, Russell's project to construct a novel means of God engaging with the world has intriguing implications for theistic evolution. Despite its strengths, we have identified two sets of concerns that arise when considering the viability of NIODA, which we characterized as physical and metaphysical. The physical issues arising from applying NIODA to evolution pivoted on the amplification problem, namely, whether the ontological uncertainty contained in the Copenhagen Interpretation amplifies to the level of organisms. Despite reservations from Koperski, we argued, with Al Khalili and McFadden, that the developing field of quantum biology is producing data that seem compatible with NIODA. Although there are not yet definitive conclusions, the connection between quantum mechanics and genetic mutations (and therefore evolution) is beginning to be uncovered, surpassing the amplification problem. Jim Al Khalili and Johnjoe McFadden are taking significant steps forward in this area.

Moreover, we noted that any engagement with cutting-edge science will inevitably face limitations of empirical uncertainty, but that the cost of this has the potential to be outweighed by the benefits. On this reading, NIODA is a reinterpretation of core theological claims regarding divine action in light of quantum physics and quantum biology. A necessary consequence of such an intellectual endeavor will be a level of tentativeness with respect to empirical claims, insofar as those claims are at the forefront of scientific development. If there are hermeneutical uncertainties with the science, then these need not be held as fatal flaws for the theology. Russell's theory would be improved by a stronger statement of the level of certainty required for NIODA. In his most recent paper on the topic Russell does return to the area of quantum genetics, but as he again gives very little detail our concerns are not wholly allayed (Russell 2018a). To strengthen, Russell could state that God acts at least through prevention of harmful mutations, and perhaps through some limited causation of certain, beneficial mutations. In doing so, Russell's theistic evolution would have a firmer empirical foundation, with greater appreciation for the

uncertainty that seems inherent to quantum biology, especially as it applies to mutations. Nevertheless, physical concerns are not fatal, and may well be allayed by future developments in science.

A more significant difficulty was found in the metaphysical implications of allowing God such radical and unencumbered agency with regard to genetic mutations. Russell's God wields immense power over evolution, and NIODA holds that God is objectively and directly responsible for the genetic mutations that drive it. Hence, God seems particularly at fault for suffering that stems from genetic defects. Either these defects would not have come about were it not from the direct action of God, or God bears at least indirect responsibility for failing to prevent harmful mutations in a realm in which God is regularly active. Still, a counter based around universal salvation may hold merit for Russell, as a potential explanation of God's permission of evil. Within a wider redemptive framework that stresses the importance of epistemic distance, the existence of preventable evils stemming from genetic mutations could perhaps be reconciled with the existence of a God who acts via NIODA. Whether this would solve the problem of the suffering individual remains to be seen. While we have highlighted two serious challenges to Russell's application of NIODA to evolution, there is hope for future work that may address our concerns, making the overall theory more physically and metaphysically sound.

Notes

1. It is noteworthy that the idea of *laws of nature* was a recent development in Hume's day. See Harrison (2008; 1995)
2. For a survey of the peaks and pitfalls of the Humean challenge, see Russell (2017, section 6; McGrew 2019).
3. Russell discusses ontological indeterminacy in Quantum Mechanics in detail (1998, 200–205).
4. The Copenhagen Interpretation is not the only interpretation of the quantum formalism available, though it is favored by the scientific community at the present time. On the matter, Russell writes: "The response chosen here, then, is to engage in this conversation, but in full realization of the tentativeness of the project. Clearly, we must keep in mind not only that a future theory might undercut the positions taken here but also that existing alternative interpretations of quantum physics already have the potential to do so. However, most scholars now agree that any future theory concerned with the atomic and subatomic realms will have to favor either nonlocal realism or local antirealism. In short, we will never return to the metaphysics of classical physics … We are driven, therefore, to follow out the consequences of taking radically seriously a given vein of secular work, recognizing as well its hypothetical character and seeking to discover what can be gained when both the theological and the secular views are given their day in court" (Russell 1997, 58).
5. The high level of accuracy in this process (about one error in every billion) was one of Schrödinger's primary reasons for supposing that quantum mechanics and genetics were intertwined.
6. Such a caveat, we imagine, would resemble Russell's acknowledgment that NIODA is based on the Copenhagen Interpretation of QM, which is popular but not empirically confirmed.
7. Russell does avowedly state that he views his project of NIODA as a constructive theology of nature, rather than natural theology. Still, we do not believe that this notion makes him immune to the kinds of arguments that we put in this paper, because to be a fully fledged

worldview, Russell's theory must ultimately face natural theological objections. To this end, one can construe this section's motive as pointing out pressing areas for attention by Russell, if his application of NIODA to theistic evolution was to face more skeptical eyes in the realm of natural theology.

8. There are variations of cancer, such as leukemia, that do not involve tumors, and variants that do not stem from genetic mutations. But for simplicity's sake, we concentrate on the multitude of cancers that do present in that way (Al Khalili and McFadden 2015, 273).

9. Further examples that one could add to this picture would include Huntingdon's Disease and Hemophilia, which are diseases caused by mutations that, like cancer and Duchenne, bring about significant difficulties. Furthermore, in the animal realm, infectious tumors in Tasmanian devils and a high propensity of genetic deformities in ferrets are two examples where mutations frequently bring about premature death and pain.

10. There are, of course, mutations that bring about both benefit and harm, such as the fact that the gene that codes for sickle-cell anemia also provides immunity from malaria. Nonetheless, we feel safe in asserting that this does not apply to any significant extent to the examples of Duchenne or many cancers.

11. We are sure that Russell himself has considered these possible difficulties, but aim to expand upon the precise way in which his model of theistic evolution reinvigorates them.

12. Russell also raises the interesting question of whether, given constraints upon creation, life was worth creating. That question is indubitably intriguing, but beyond the scope of this paper (2007, 128–30).

13. Even to discuss only genetic diseases is to ignore the historic suffering that the evolutionary process has caused—for the sake of space, we cannot address such matters here but it seems reasonable to raise the question of why God chose to create through the medium of mutations, given that so many are either harmful or useless. For further reading on the matter of animal suffering and the wastefulness of the evolutionary process as a factor in the problem of evil, see Rowe (1979), Sollereder (2018), Murray (2008), and Hoggard Creegan (2018).

14. Kane offers a critique along these lines, while Barnwell attacks soul-making theodicy's notion of freedom. For more on these debates, see Kane (1975) and Barnwell (2017)

15. Russell makes a parallel argument regarding an epistemic distance being necessary for science, which is unfortunately outside the scope of this paper. See (Russell 2008).

16. The term "epistemic distance" was introduced by Hick to describe creatures' relative lack of understanding, compared to their creator (Hick 1966, 373).

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