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Quantum Mechanics and Salvation: a new meeting point for science and theology

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Abstract

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Keywords: salvation, science and religion, quantum mechanics, philosophy of time, indefinite causal order

Introduction

Time is phenomenologically fundamental, encircling all other experiences. It frames our understanding of continuous personal identity; it structures our hopes for the future and memories of the past; it is the measure by which we plan our lives. Human beings encounter the world in an inescapably temporal way. Despite its unquestionable centrality in our lives, the nature of time remains as hotly debated in metaphysics now as it was two and a half thousand years ago.[1] As Huw Price elucidates, time 'is unusual even by philosophical standards for the durability of some of its main concerns.'[2] There is a wealth of scholarship, yet no consensus on the most critical issues. Moreover, developments in (both relativistic and quantum) physics continue to add fuel to the fire, forging new arguments for various temporal theories. In light of this, time is a rich and fertile area of study both for physicists and philosophers.

Time is particularly important for theology, and yet it has not received a level of theological engagement that recognises this fact. The existing debate has been dominated by the question of whether God is temporal or atemporal,[3] and as such significant areas have been left behind. The issue with which this paper is concerned

[1] In presocratic philosophy this debate centred around Parmenides' claim commitment to a static view of reality, and Heraclitus' opposing view that reality is fundamentally in flux.
See: Graham, Daniel. W. "Heraclitus." *Stanford Encyclopaedia of Philosophy* (2019); Palmer, John. "Parmenides." *Stanford Encyclopaedia of Philosophy* (2016).

[2] Price, Huw. *Time's Arrow and Archimedes' Point.* (New York: Oxford University Press, 1996), 12

[3] On the question of God's relation to time, see Swinburne, Richard. "God and Time." In *Reasoned Faith*, 204-22. (Ithaca, London: Cornell University Press, 1993); Ganssle, Gregory E., and David M.(eds) Woodruff. *God and Time:*

is the, as yet uncharted, relationship between time and salvation.[4] Though Robert John Russell has produced an excellent exploration of the significance of the Special Theory of Relativity for Wolfhart Pannenberg's eschatology, his is the only recent work which draws science and theology together on the issue of time and salvation.[5] This is surprising – both time and salvation are linked to change, and one can only understand salvation when a philosophically and scientifically robust theory of time (which accommodates such change) is available. There is a significant gap in the literature on this issue. This paper details a collaboration between a working scientist and a working theologian contributing to this neglected area. It focuses on the methodology of, and justification for, an ongoing cross-disciplinary collaboration, and indicates some expected outcomes.

The focus of this project is a particular finding in quantum physics that has the potential to radically reshape our understanding of the nature and structure of time: Indefinite Causal Order.[6] To summarise, experimenters found that in a maze two operations A and B were in a superposition with regard to their causal order, viz. A then B *and* B then A were shown to obtain at the same time. If temporal order is not fixed at the fundamental quantum level then metaphysically orthodox theories of time may need to be revisited, and the type of change salvation requires may come into question. This paper is the first metaphysical and theological engagement with this cutting-edge research.

Quantum physics and theology are radically different thought-worlds. This raises a problem to be faced by all interdisciplinary projects – how and where do we find common ground from which to begin? Academic disciplines are highly specialised, complex endeavours. Sets of questions and methods for answering them are delineated into distinct camps, which seem to be evolving further and further away from each other. Yet humanity's preoccupation with the so-called 'big questions' is as pervasive as ever, and it is likely that all disciplines have at least one piece of the jigsaw to contribute. 'Big questions' are likely to have big answers, with elements of truth reaching out across disciplinary specialisms. Awareness of this fact has stimulated conversations between science and theology that have brought a rich wealth of insight over the last half-century. Our project is valuable in so far as it sits within this historical movement, but novel as it is the result of a collaboration between a working scientist and a working theologian.

Multiple Rationalities in Science and Religion: Justifying a Collaborative Methodology

Alister McGrath argues that humans are beings who yearn to understand the world and our place within it through narratives and metanarratives that constitute for us what is real and significant. We understand reality, value and identity within such frameworks of narrative meaning.[7] Science, religion, and politics offer various narratives which contextualise human identity within a broader conceptual structure in which they find meaning and purpose, with each narrative fulfilling a different function or explaining a different feature of the complex multiplicity of human existence. Intersecting webs of narratives comprise metanarratives,

~~*Essays on the Divine Nature.* (Oxford: Oxford University Press, 2002); Craig, William Lane. *God, Time and Eternity.* (Dordrecht; London: Kluwer Academic Publishers, 2001); DeWeese, Garrett J. *God and the Nature of Time.* (Aldershot: Ashgate, 2004); Leftow, Brian. *Time and Eternity.* (Ithaca; London: Cornell University Press, 1991); and most recently Leftow, Brian. "Presentism, Atemporality and Time's Way." *Faith and Philosophy* 35, 2 (2018): 173-94.~~

[4] Some interesting work has been done on the relationship between time and the incarnation, see: Torrance, Thomas. *Space, Time and Incarnation.* (London: Oxford University Press, 1969).

[5] Russell, Robert John. *Time in Eternity: Pannenberg, Physics and Eschatology in Creative Mutual Interaction.* (Notre Dame, Ind: Notre Dame University Press, 2012).

[6] Goswami, Giarmatzi, Kewming, Costa, Branciard, Romero, & White. "Indefinite Causal Order in a Quantum Switch." *Physical Review Letters* 121, no. 9 (2018).

[7] McGrath, Alister. *Narrative Apologetics.* (Grand Rapids, MI: Baker Books, 2019), 10

which situate smaller stories in wider contextual arcs. It is within these contexts that individuals, groups and cultures locate their identities. Humans have been telling such stories for thousands of years.

An example of a scientific narrative is that of human evolution – *homo sapiens* are described as evolving from primates and competing with other human groups (i.e. *homo neanderthalensis*) for dominance in their developmental domain.[8] The human evolutionary narrative reveals that humanity is a fundamental part of the world, and that we share our origin story with all the other creatures that occupy the Earth. Human identity is framed within a wider evolutionary context, connecting us with a living, breathing biosphere with which we share common ancestry. A religious narrative which similarly describes human origins within the context of a creation much larger than ourselves is the creation narrative given in Genesis 1-3. Though these narratives have been interpreted as conflicting, they need not be.[9] Insofar as each is interpreted as a context-specific narrative that is informative in its particular domain, scientific and religious narratives can be compatible and mutually enriching.[10] They present alternative layers of meaning in which human agents are situated, and considering them together can offer a richer understanding of reality than either one considered alone.[11]

Indeed, McGrath has recently expanded this to argue that we live in an age, not only of multiple narratives, but of *multiple rationalities.*[12] He defines human rationality both theoretically and practically, tracing its evolution across culture and history. The main argument is this: human rationality is a multifaceted methodology for conceptualising and encountering the world which manifests in a plurality of forms. As opposed to a theory of a single, universal rationality, McGrath moves the debate towards a more pluralistic approach which recognises multiple, situated rationalities. He uses Stephen Rose's term *epistemological pluralism* to describe his position.[13] The contribution to the science-and-religion debate is clear – each discipline is independent and its integrity when producing descriptions of the world must be respected. Nevertheless, the rational structures therein are domain-specific, and therefore do not conflict. Science and religion can, therefore, enter into a fruitful dialogue without fear that either side will negate any core claims of the other, as they employ different operational rationalities.

Epistemological pluralism is a useful concept within this project, as it creates scope to bring together the rationalities of experimental quantum physics and theology. In so far as the integrity of each rational structure is recognised and determined as fully operable in (though limited to) its own domain of applicability, there is no grounds for conflict. Science is equipped to answer scientific questions, and theology is left to answer theological questions. If only one rationality is held as sufficient to generate all knowledge, then science and theology end up in ideological conflict over the epistemic space within which meaningful questions receive answers. Epistemological pluralism, therefore, recognises the operational specificity of various practical rationalities, and allows the possibility of fruitful dialogue between different

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[8] See, Harari, Yuval Noah. *Sapiens: A Brief History of Humankind.* (London: Harvill Secker, 2014).

[9] Bethany Sollereder, for example, argues that a loving creator God (as is portrayed in the Genesis narratives) is compatible with evolutionary biology. Sollereder, Bethany. *God, Evolution, and Animal Suffering: Theodicy without a Fall.* (Abingdon & New York: Routledge, 2019).

[10] McGrath, Alister. *Enriching Our Vision of Reality.* (London: SPCK, 2016)

[11] If the Genesis account is taken literally then one arrives at young earth creationism. If human evolution is applied to the social or moral domains one can end up with the abhorrent social Darwinism. Neither of these outcomes, I argue, is desirable. Both arise when the narratives' application exceeds the boundaries of their respective domains.

[12] McGrath, Alister. *The Territories of Human Reason: Science and Theology in an Age of Multiple Rationalities.* (Oxford: Oxford University Press, 2019.)

[13] Rose, Stephen. 'The Biology of the Future and the Future of Biology', 128–9 c.f. McGrath, *The Territories of Human Reason,* 2

disciplinary domains. Moreover, I argue that the future of 'science and religion' should be directed toward a methodology that incorporates more dialogue between working theologians and working scientists, as opposed to individual scholars with an interest in both areas. Then, practicing scientists and practicing theologians can combine their rational and methodological tools to address complex questions. Such an approach echoes larger-scale projects such as the Divine Action Project, co-sponsored by the Vatican Observatory and the Centre for Theology and the Natural Sciences in Berkeley.[14] In synthesising disciplinary insights and bringing together working scientists and working theologians, the integrity of each discipline is maintained throughout the exploration of overlapping ideas.

Each discipline uses different research methods that are fine-tuned to the research objects of the discipline. It is for precisely this reason that various disciplines offer unique insights that can be integrated with each other. Each discipline provides an incomplete picture, and the gaps therein can only be filled by insights from other disciplines. Mary Midgely uses the analogy of multiple maps of reality to illustrate this point – an adequate account of reality can only be provided through combining various intellectual, academic, and spiritual insights together to form a more comprehensive picture than any can provide alone.[15] One can only understand, and live meaningfully within, a complex world by combining an equally complex schema for demystifying it. Theology does not have the tools to measure the light spectra from distant planets at its disposal, for example, and science is woefully unequipped to deal with moral or spiritual questions.

Interdisciplinarity is essential to avoid epistemological compartmentalization and fragmentation, and epistemological pluralism is a framework within which interdisciplinarity makes sense. Only by recognising the epistemic primacy and distinctive rationality of theology in matters of faith, and science in empirical matters, can interdisciplinarity between these fields commence. As the most beautiful paintings are created with the richest pallets, so too is the richest vision of reality constructed from a multiplicity of disciplinary insights. Edward Wilson argues similarly, that in order to develop human knowledge we must synthesise the insights of various disciplines and avoid the intellectual fragmentation of the kind the academy increasingly provides.[16] Werner Heisenberg echoes such sentiments, arguing that 'what we observe is not nature itself, but nature as it is disclosed by our methods of investigation.'[17] Here Heisenberg explicitly states that the specific research methods we use *limit* what we know. They disclose some things but cannot disclose others, because they were not developed with those in mind. An interdisciplinary synthesis of the kind Wilson advocates is necessary to weave detailed tapestries of human knowledge and deepen our understanding of the world we inhabit.

With regard to the question of time specifically, quantum mechanics, along with all branches of physics, examines time empirically. Whether time is viewed as a parameter, an operation, or a dimension of spacetime, it is mathematically quantified. Such an approach exhibits vast differences with the way that theology engages with time. Following the more phenomenologically focused schools of philosophy, theological reflections on time tend to be more experience-based. Rather than focusing on time as a mathematical feature of theories, models and equations, time is conceived as that which shapes our experience of the world in a structured way. Moreover, God's relation to time is considered in the context of God's experiential relationship with creation – is God outside time, a relation which would give God timeless

[14] For details, see Wildman, Wesley. "The Divine Action Project, 1988–2003." *Theology and Science* 2, no. 1 (2010): 31-75.
[15] Midgely, Mary. *Myths We Live By.* London, New York: Routledge, 2003.
[16] Wilson, Edward O. *Consilience: The Unity of Knowledge.* (New York: Vintage, 1999).
[17] Heisenberg, Werner. *Physik Und Philosophie*, 67-85. (Stuttgart: Hirzel, 2007), 85

and perfect knowledge of everything that takes place?[18] Or is God within time, able to observe the dynamic unfolding of events as they happen, but perhaps with knowledge of the future (viz. the free choice of agents) restricted?[19] The question 'what is time' is clearly tackled in different ways.

Our project intends to weave together these two divergent ways of investigating time.[20] The resultant reconceptualization of core theological and moral concepts draws on empirical and theological features of time. As a working scientist and a working theologian, we bring up-to-date methodological skills to the table, as well as coming to the project from distinct, situated rationalities. The project will proceed dynamically and cooperatively, utilising the skills of a scientist and the skills of a theologian to construct an argument comprised of smaller disciplinary 'blocks.' By combining insights gained from scientific and theological rationalities, ~~The outcome will, we hope, be a~~we will arrive at a theologically and scientifically robust account of salvation in the light of Indefinite Causal Order.

God and Time

Though the arguments introduced in this paper are new, they occur against a backdrop of literature on the relationship between God and time. This debate has a rich and varied history, but the primary focus has been on whether God is temporal (inside time) or eternal (outside time). Traditionally, theologians have argued that God is eternal and therefore outside time. This view draws on the Platonic idea of divine immutability – that which is perfect cannot change as any change would necessarily be a deterioration.[21] As change is inextricably linked to time, that which is changeless is also timeless. An eternal God is outside time and observes creation in its entirety. On this view, God fundamentally separate from the spatiotemporal realm in which human lives play out. Since the medieval period, the Christian understanding of divine eternity was primarily influenced by Boethius' formulation: 'eternity is the *complete possession all at once of illimitable life*.'[22] Proponents of this view include Anselm, Aquinas, and Scotus.[23] Though an eternal God may seem impersonal or inaccessible, the atemporal view preserves God's sovereignty, in that he is not a prisoner to time's passing, and his omniscience, insofar as his direct knowledge and experience of creation is not limited to a sliver of present, passing time.

Arguments for divine temporality have increased in popularity in recent decades, and can be delineated into *logical, personal-historical,* and *theological*. Richard Swinburne argues that God must be inside time, as he is the cause of the universe coming into existence. It is logically impossible for causes, in this case God, to be simultaneous with their effects, in this case the existence of the universe. God cannot do that which is logically impossible, therefore God must be inside time.[24] Nicholas Wolterstorff echoes Swinburne's commitment to divine temporality, but for historical rather than logical reasons. He argues that the dynamic biblical representation of God shows God has a history, as well as being intimately involved with human

[18] See, for example, Leftow, *Time and Eternity.*
[19] An argument for this view can be found in Swinburne, *God and Time*, and Craig, *Time and Eternity*.
[20] As have those who have engaged with these issues before us i.e. Robert John Russell, William Lane Craig and Garrett DeWeese.
[21] i.e. as presented in *Timaeus*
[22] Boethius, *The Consolation of Philosophy*, Book V, Prose 6. c.f. Stump, E. & Kretzmann, N. (1981) *Eternity*. 430
[23] Deng, N. (2018) *Eternity in Christian Thought*.
[24] Swinburne, Richard. "God and Time." In *Reasoned Faith*, 204-22. (Ithaca, London: Cornell University Press, 1993)

history. Hence, God is temporal.[25] William Lane Craig exemplifies the theological arguments for divine temporality – though he believes God to be atemporal without (read: before, if before was not a temporal term) creation. The Christian God is immanent, responds to petitionary prayer, and interacts with creation dynamically. That 'God is creatively active in the temporal world,' Craig argues, 'is essential to Christian theism.'[26] In order for God to know tensed facts, to experience things coming into being, and to respond directly to the wants and needs of creation, Craig believes God must be temporal.

A Brief Introduction to Indefinite Causal Order

The phenomenon we are addressing is Indefinite Causal Order, and on the face of it, it throws our commonplace and our philosophical beliefs about time into doubt. Quantum mechanics operates in the world of subatomic particles, a world of unpredictability and fuzziness. This recent finding shows that such fuzziness and indeterminacy can be applied to causal and temporal relations also. Essentially, through investigating the role of causal order in quantum mechanics, physicists have discovered that the causal relations of events may not be *a priori* well defined in quantum theory. Indefinite Causal Order demands metaphysical engagement, as its implications for the nature of time could be far-reaching. Experimental evidence of this nonclassical causal structure was published by K. Goswami *et al* in 2018, so it is a very recent piece of science.[27] As such, the project is truly cutting-edge.

The experiment was designed to test whether a process will exhibit a fixed causal order in a quantum setting.[28] The experiment in question involves a polarising beam splitter which can send a photon straight through it, or reflect it at 90 degrees, depending on the polarisation of the photon. If the photon becomes polarised in one orientation it goes one way through the experimental circuit, and if it polarised another way it takes the alternative route. The route taken was readable at an endpoint C. What the experimenters designed was, in effect, a maze that could be travelled in two routes depending on the polarisation of the photon. In this maze, there are two checkpoints labelled: A and B. One route hits A first and then B, the other route hits B first and then hits A. The experimenters referred to the temporal relation *before and after* that holds between A and B the 'causal order' – one polarisation generates the causal order A then B, the other polarisation generates the causal order B then A.

The indeterminacy enters the fray as a result of the superposition principle.[29] This principle explains how quantum objects can occupy multiple states at once. In this case the photon was prepared in a superposition with regards to its polarisation, meaning it was polarised in both directions *at the same time*. The experimenters found, therefore, that the two operations A and B were in a superposition with regard to their two possible orders. Thus, both A happened before B, *and* B happened before A. This is Indefinite

[25] Wolterstorff, Nicholas. "Unqualified Divine Temporality." In *God & Time: Four Views*, 187-213. (Downers Grove: InterVarsity Press, 2001.) 188

[26] Craig, William Lane. "The Eternal Present and Stump-Kretzmann Eternity." *American Catholic Philosophical Quarterly* 73, 4 (1999) 522

[27] Goswami, Giarmatzi, Kewming, Costa, Branciard, Romero, & White. "Indefinite Causal Order in a Quantum Switch." *Physical Review Letters* 121, no. 9 (2018).

[28] It must be clarified the term 'causal order' was used by the physicists to denote what philosophers would call temporal order. The experiment is concerned with the temporal succession of events rather than the causal relations between those events.

[29] For an introduction to quantum mechanics and its core principles, see Ismael, Jenann. "Quantum Mechanics." *Stanford Encyclopaedia of Philosophy* (2015).

Causal Order.[30] It reveals that at the quantum level, time, something we intuitively believe to be fixed, flowing, and fundamental, is fuzzy.

This project intends to explore the implications of Indefinite Causal Order for philosophy and for religion. It is not within the scope of this methodologically focused paper to give a detailed explication of our ongoing engagement with these questions. Suffice it to say that our focus is primarily on how this finding could inform our understanding of salvation. Salvation requires change – a transition from a prior state of sin to a subsequent state of salvation. This transformative mechanism can only take place within a temporal ontology that permits such change. In order to examine whether there is scope for such change in the model of time this finding supports, we must engage with the metaphysics.

Situating Indefinite Causal Order within the Metaphysics of Time

The A and B theories, first introduced by J.M.E. McTaggart in 1908, are our point of entry.[31] The A-theory includes passing time, the unreality of the future, and describes the present as a moving instant. Tense is understood as an ontological feature of reality, and the present is the point at which potential future things and events become real. There are two primary A-theories. The first is presentism, in which all that exists is that which is simultaneous with the present. The past is gone, and the future is yet to exist. The second, the growing block, also claims that the present moment functions as the frontier of becoming at which point potential future events become present and actual. It differs in the claim that present moments are cumulatively added to the past, comprising a 'growing block' of existing things and events.[32] The B-theory, on the other hand, models time as relevantly similar to space in that all temporal points co-exist (conceived, since Einstein's theories) as forming a four-dimensional manifold with the dimensions of space.[33] Time does not actually flow, and temporal passage is a persuasive illusion. The B-theory is also referred to as the 'block universe' and is generally understood to be a static theory of time.[34]

The A-theory describes temporal passage as a chain of events that are actualised in a clear order at successive objective present moments.[35] Indefinite Causal Order violates this most basic assumption. It is not clear at any moment whilst the experiment is underway whether A has happened, or B has happened – thus the idea that time passes objectively giving substance to one moment and then the next in a fixed order is thrown into doubt. If the present is fuzzy and causal order is not fixed, then the knife-edge present moment required for an A-theory of time doesn't seem possible. Nevertheless, just because these findings don't

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[30] There is also further theoretical support for Indefinite Causal Order in the context of spacetime. An experiment which could test this has been proposed: Zych, Magdalena & Costa, Fabio & Pikovski, Igor & Brunker, Časlav. "Bell's Theorem for Temporal Order." *Nature Communications* 10 (2019): 3772.

[31] McTaggart, J.M.E. "The Unreality of Time." *Mind 17 (68)* (1908): 457-74.

[32] For an introduction to presentism, see Mozersky, Joshua. "Presentism." In *The Oxford Handbook of Philosophy of Time*, edited by Craig Callender. (Oxford: Oxford University Press, 2011).
For an introduction to the growing block theory, see Broad, Charles Dunbar. *Scientific Thought.* (London: Kegan Paul, 1923).
A final A-theory to which few adhere is the moving spotlight theory. For an account of the theory, see Cameron, R. *The Moving Spotlight.* (Online Version: Oxford Scholarship Online, 2015).

[33] Maudlin, Tim. *The Metaphysics within Physics.* (New York: Oxford University Press, 2007); Bohm, David. *The Special Theory of Relativity.* (London: Routledge Classics, 2006); Grünbaum, Adolf. "The Meaning of Time." In *Basic Issues in the Philosophy of Time*, edited by Eugene Freeman and Wilfrid Sellars, 195-228: (Open Court, 1971).

[34] Craig, William Lane *The Tenseless Theory of Time: A Critical Examination.* (Dordrecht: Kluwer Academic Publishers, 2000).

[35] Craig, William Lane *The Tensed Theory of Time: A Critical Examination.* (Dordrecht: Kluwer Academic Publishers, 2000).

support an A-theory, this does not entail that they support a B-theory. A B-theory holds that a fundamental description of time can be given by describing events in their fixed temporal relations. This claim is clearly violated by Indefinite Causal Order. It is a very real possibility that the metaphysically orthodox bifurcation between the A-theory and B-theory needs to be reconsidered following this data, and alternative models of time need to be put forward. This is an open question, and metaphysicians of time will certainly find this a rich and fruitful area for future exploration. Currently, we are working towards constructing an argument claiming that Indefinite Causal Order can support the B-theory. However, the B-theory will have to undergo modification if it is to accommodate indefinite temporal relations, due to the temporal relations *earlier than, later than,* and *simultaneous with* being key features of a classical B-theoretic description of the world. Despite this, it seems to us that Indefinite Causal Order can be much more easily accommodated within a B-theory than an A-theory, as no objective present moment is required in the B-theory.

Once the metaphysical work has been done, and Indefinite Causal Order is situated within a broader temporal metaphysic, theological questions loom large. Our focus is on salvation, particularly the notion of salvific change. Salvation requires change, and objective temporal passage is required to substantiate this distinction.[36] As the B-theory renders change a contentious topic, salvation needs to be re-examined. There is fruitful work to be done here if Indefinite Causal Order does indeed support the B-theory, which we hope to show.

Understanding Salvation in a B-theoretic Framework

Salvation has a multiplicity of meanings and formulations vary between different faiths and denominations.[37] Though much soteriological discourse focuses on 'end times' and is distinctly future-focused, we intend to leave eschatological questions largely to one side and focus instead on the experience of salvation in the life of individuals. This focus is on *personal, present* salvation that occurs within the spatiotemporal realm, not on eschatological redemption at the final judgement. A core feature of salvation thus conceived is that it is *transformative*, viz. the individual experiences a change from a state of sin or fallenness to a state of atonement, reconciliation or a renewed relationship with the divine. By necessity, in so far as the individual enters into a new state of being, this is a process and requires *becoming*. In a B-theoretic temporal framework, in which all events coexist at all times, there is no obvious scope for such becoming. In this sense, then, the concept of salvation is challenged by Indefinite Causal Order and the B-theory of time. Without the dynamic temporal ontology of the A-theory, it is hard to imagine how the individual genuinely changes from being sinful to being saved. Moreover, the Christian doctrine of the Incarnation describes Jesus, the second trinitarian person, as entering into the created order to be present in a way that he was not before. The block universe contains all events timelessly, as in Scripture: 'what has been will be again, what has been done will be done again; there is nothing new under the sun.' (Ecclesiastes 1:9) The challenge to salvation, in so far as salvation requires a transformation to a *new state,* is clear.

B-theorists are aware of this type of problem. Change is a fundamental phenomenological feature of human experience, and anyone denying its reality must provide compelling explanation for our perception of change that does not rely on dynamic time. In responding to such a challenge, B-theorists have constructed various mechanisms that account for phenomenological change and passage without recourse to any A-theoretic ontological claims. One such mechanism is that of *mind-dependent becoming* proposed by thinkers

[36] In introducing the A-series and B-series, McTaggart argued that change is an essential part of time, and without change time is unreal: McTaggart, *The Unreality of Time*

[37] For a survey of the concept of salvation across Christian history, see Fiddes, Paul. *Past Event and Present Salvation: The Christian Idea of Atonement.* London: Darton, Longman & Todd, 1989.

such as Adolf Grünbaum and Adrian Bardon.[38] On this view, one's perceptual awareness of events having occurred in a certain order, and having been experienced by a conscious mind in that order, is sufficient to phenomenologically ground temporal passage. B-theoretic relations between static events are fundamental, yet consciousness *imposes* passage onto them by experiencing them in a certain order. It is on this basis that both change and transformation are accommodated. As Grünbaum writes: 'becoming is mind-dependent, because it is not an attribute of physical events per se but requires the occurrence of states of *conceptualized awareness*. These states of awareness register the occurrence of physical and mental events as sustaining certain apparent time relations to the states of awareness.'[39] We are in the process of constructing a model for salvation relying heavily on this idea. Just as the mind pieces together passage out of static events, so too can the mind *perceive* their salvation as a transformation despite it not being, strictly speaking, new from the perspective of the four-dimensional spacetime manifold of timeless things and events. Though one's salvation will have always been in one's future, one may still *experience* it as a life-changing transformation. In short, on a B-theory salvation must be subjective. This need not diminish its significance for the individual. Our experience of passage is overwhelmingly compelling, and subjective salvation can have similar phenomenological power for the individual. Though this discussion has been brief, I hope to have illustrated the directions in which this project is moving.

Conclusions

In this paper I hope to have shown that science and theology ask similar questions about the world, and by combining their respective methodologies in collaborative projects, innovative answers to such questions may well be uncovered. Collaborative ventures between working scientists and working theologians, promise to move 'science and religion' forward to more rigorous and, ultimately, more ambitious conclusions. Academic disciplines are becoming ever-more specialised, and academics are increasingly restricted to their specific domain. Whilst this undoubtedly produces high-quality, detailed work, we risk losing out on the benefits of a more holistic approach. The 'big questions' that have resonated throughout philosophy's history cannot be answered without the wisdom of a multiplicity of disciplines. Science and theology, arguably the two most powerful metanarratives in human history, should continue to tackle these questions together. Epistemological pluralism is a helpful framework within which this endeavour makes sense.

Indefinite Causal Order opens up new intellectual possibilities, particularly in the area of salvation and soteriological change, but also with regard to divine action and free will. Indefinite Causal Order will likely also have interesting implications for divine action, particularly regarding Robert John Russell's work on Quantum Mechanics and Non-Interventionist Objective Divine Action.[40] Moreover, there is scope to do interesting work in relation to free will.[41] The type of indeterminism provided by the Copenhagen

[38] Grünbaum, Adolf. "The Status of Temporal Becoming." *Annals of the New York Academy of Sciences* 138 (1967): 374-95; Bardon, Adrian. *A Brief History of the Philosophy of Time.* New York: Oxford University Press, 2013. Chapter 4.
[39] Grünbaum, Adolf. (1967) *The Status of Temporal Becoming*. 375
[40] Russell, Robert John. "Does 'the God Who Acts' Really Act? New Approaches to Divine Action in the Light of Science." *Theology Today vol 56* (1997): 43-65; Russell, Robert John. "Quantum Physics and the Theology of Non-Interventionist Objective Divine Action." In *The Oxford Handbook of Science and Religion*, 579-95. (Oxford: Oxford University Press, 2006); Russell, Robert John. "What We Learned from Quantum Mechanics About Noninterventionist Objective Divine Action in Nature - and Its Remaining Challenges." In *God's Providence and Randomness in Nature: Scientific and Theological Perspectives*, edited by Joshua M. Moritz & Robert John Russell. (West Conshohocken, PA: Templeton Press, 2018).
[41] Stapp, Henry. P. "Philosophy of Mind and the Problem of Free Will in the Light of Quantum Mechanics." *Open Access* (2008).

Interpretation of quantum mechanics has been viewed by some as giving scientific legitimacy to an indeterminate universe in which the choices of rational agents are not deterministically constrained. Indefinite Causal Order provides yet more material to use in engagement with the concept of free will, particularly with regard to the question of whether Indefinite Causal Order obtains in human brain-states and what this might mean for neural processing. Our primary focus going forward is salvation. The concept of mind-dependent becoming will be instrumental in this endeavour, as it is a synthesis between phenomenological becoming and a static temporal ontology. We hope this project will bring new insights and generate further scholarship in the exciting area of quantum mechanics, time and theology.

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