Quantum Theology beyond Copenhagen

with Mark Harris, "Quantum Theology beyond Copenhagen: Taking Fundamentalism Literally"; Shaun C. Henson, "What Makes a Quantum Physics Belief Believable? Many-Worlds among Six Impossible Things before Breakfast"; Emily Qureshi-Hurst, "The Many Worries of Many Worlds"; Elise Crull, "Interpretation Neutrality for Quantum Theology"; Wilson C. K. Poon and Tom C. B. McLeish, "Is There a Distinctive Quantum Theology?"; and Ernest L. Simmons, "The Entangled Trinity, Quantum Biology, and Deep Incarnation."

WHAT MAKES A QUANTUM PHYSICS BELIEF BELIEVABLE? MANY-WORLDS AMONG SIX IMPOSSIBLE THINGS BEFORE BREAKFAST

by Shaun C. Henson

Abstract. An extraordinary, if circumscribed, positive shift has occurred since the mid-twentieth century in the perceived status of Hugh Everett III's 1956 theory of the universal wave function of quantum mechanics, now widely called the Many-Worlds Interpretation (MWI). Everett's starkly new interpretation denied the existence of a separate classical realm, contending that the experimental data can be seen as presenting a state vector for the whole universe. Since there is no state vector collapse, reality as a whole is strictly deterministic. Explained jointly by the dynamical variables and the state vector, "this reality is not the reality we customarily think of, but is a reality composed of many worlds," wrote Everett's colleague Bryce DeWitt. In this essay, I account briefly for the change of status in conventional scientific terms, yet chiefly in extended terms of three sets of ideas that I argue can be understood to affect believability in both scientific and religious contexts, illuminating helpfully the MWI phenomenon, and its engagement with theology: *orthodoxy and heresy*, *language and reference*, and *faith and agnosticism*. One's orientation relative to the variable content of these dynamic, socially oriented categories helps to make belief in ideas as metaphysically challenging as Everettian Quantum Mechanics, or particular ideas about God, either more or less believable. The categories will have the same function in a theology engaging Everett's theory, and in any theology at all written in a society deeply marked by what I further argue is a subtle, powerful, and pervasive mode of quasi-scientific thinking we can call

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[*Zygon*, vol. 58, no. 1 (March 2023)]
www.wileyonlinelibrary.com/journal/zygon

societal constructive agnosticism, of which anyone doing theology today must be aware.

Keywords: constructive agnosticism; Everettian Quantum Mechanics (EQM); faith; heresy; Many-Worlds Interpretation (MWI); orthodoxy; rise of "no religion"; science and religion; social science

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> At no point does this wild ontological extravaganza [the Many-Worlds Interpretation] really change the practice of physics in any way. It only reassures us that a God's-Eye View is still possible.
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> - Hilary Putnam, Realism with a Human Face (1990)
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> '[Everett's PhD supervisor John] Wheeler told me that he mostly believed my interpretation,
> but reserved Tuesdays once a month to disbelieve it.
>
> - Hugh Everett III, interviewed by Charles Misner (1977)
>
> Why, sometimes I've believed as many as six impossible things before breakfast.
>
> - The White Queen, Through the Looking Glass, And What Alice Found There (1872)

An extraordinary, if circumscribed, positive shift has occurred since the mid-twentieth century in the perceived status of Hugh Everett III's 1956 theory of the universal wave function of quantum mechanics, now widely called the Many-Worlds Interpretation (hereafter MWI). Shifts in the perceived status of scientific concepts of natural phenomena and their interpretations occur regularly throughout history, from prescientific Aristotelian views of the heavens giving way to heliocentrism, through all other scientific ideas and their successors today. While scientific method is a complex topic around which there is much subtle disagreement, roughly this is how science is commonly taught and understood to work even across disciplines, with knowledge driven forward by disciplinary methodologies with quite similar features. We might explain this as a kind of *constructive agnostic* process or *constructive agnosticism*. That is, through something called "the scientific method," so the pervasive public understanding goes, potentially true descriptions of nature are presented as hypotheses, and these potential additions to knowledge are then constructively questioned as part of the scientific process (Newton-Smith 1981, 208-235; Cowles 2020, 1–3). While this widespread public understanding of "science" may even be a myth, gathering scientific data and interpreting it according to certain principles are community activities in which some ideas are eventually discarded in whole or part, and if only revised, become more certain as theories. This scientific constructive agnostic process never ends, with all scientific knowledge seen as provisional at best as new data and understandings emerge. Thus, in time, changes may and do occur to shared perceptions of how nature works. That this same process should happen with two equally potentially true interpretations of quantum behavior between which one must decide, like the Copenhagen interpretation and Everett's, is therefore routine and unsurprising. But what determines the *believability* of one interpretation over another for individuals and communities? The answer is doubtless complex and multifaceted, not least when deciding between quantum interpretations.

In considering Everett's theory in the light of all of this, on its own and with regard to theological engagement, I shall account briefly for the change of status in conventional scientific terms, yet chiefly in extended terms, of three sets of ideas that I argue can be understood to affect believability in both scientific and religious contexts: orthodoxy and heresy, language and reference, and faith and agnosticism. One's orientation relative to the variable content of these dynamic, socially oriented categories helps to make belief in ideas as metaphysically challenging as Everettian Quantum Mechanics (hereafter EQM), or particular ideas about God, either more or less believable. This in turn helps in some measure to explain why such divergent metaphysical interpretations of quantum mechanics by equally qualified scientists and philosophers occur. Each set of categories defines a range of options at work in any shared perception that EQM is believable or not. One's orientation relative to the variable content of the categories will have the same function in any theology engaging Everett's theory. Most importantly, I argue that the same will be true today for any theology at all written in a society deeply marked by what I further suggest is a subtle, powerful, and pervasive mode of scientific thinking we can call societal constructive agnosticism, of which anyone doing theology today must be aware. Significant consideration is given to this societal constructive agnostic thought in what follows, including further reasons for the nomenclature.

Orthodoxy and Heresy—A Brief Doctrinal History of EQM

First, let us consider the history of the change from a dominant Copenhagen set of interpretations to Everett's as having occurred between an accepted early twentieth-century scientific orthodoxy to what was at first perceived to be an aggressive Everettian heresy from 1957 onward. This notion of heresy challenging orthodoxy with regard to EQM is not entirely novel. Everett himself suggested the terms "orthodox quantum theorist" and “equally orthodox quantum theorist” in a longer published version of his doctoral work when comparing the Copenhagen standard to his new interpretation (Everett 1973, 5). The language has been repeated on occasion when others have compared EQM and similarly divergent interpretations to the Copenhagen view (e.g., Osnaghi, Freitas and Freire, Jr 2009).

The Copenhagen orthodoxy, while usually referred to in the singular, is of course a plural family of related metaphysical interpretations owed to a set of several scientists including Niels Bohr, John von Neumann, Werner Heisenberg, and Eugene Wigner among others, despite the so-called Copenhagen interpretation eventually becoming associated principally with Bohr. Some of the same types of entities and forces that create such orthodoxies and heresies in religion are at work in the sciences, including social and social psychological factors, traditions adopted by given communities, exemplars like Bohr professing and embodying those traditions, and prophetic figures like Everett who are gifted at conceiving of and constructing innovations in advancing a given area of science or to resolve theoretical problems.

Radically new scientific ways of thinking are routinely at first viewed with healthy suspicion, or are seen as heretical like Everett’s was by the Copenhagen community. Innovative scientific ideas, like new religious concepts and their interpretations, may or may not eventually become deposits of an alternative orthodoxy. Everett’s interpretation has, if realistically only by becoming mainstream in communities of cosmologists and those working on quantum foundations, and as the presence of a broad Everettian school of thought at a place like Oxford University helps to demonstrate (Deutsch 1997; Saunders ed. et al. 2010).

Everett’s theory of the universal wave function, presented as the central argument of his Princeton University PhD thesis (Everett 1957, 454–62), questioned in a manner more trenchant than his predecessors key tenets of the Copenhagen interpretation. This included the von-Neumann-Dirac collapse theory and Bohr’s dualistic quantum-classical account of measurement. His full explanation of the theory can be found in three places including his doctorate, “On the Foundations of Quantum Mechanics” (Everett, Princeton University, 1957a), in a brief published article based on that work called the “’Relative State’ Formulation of Quantum Mechanics” (Everett 1957b), and in a longer version of the same work, “The Theory of the Universal Wave Function” (Everett 1973). The interpretation posits the state vector as a complete description of the physical state of the system, which never collapses as in the Copenhagen view. Instead, the state vector continues to be governed by the time-dependent Schrödinger equation, with different components of the state vector becoming associated with different components of the measuring apparatus and the observer (Barrett, Byrne 2012). This leads to a world or universe in which, as Everett’s colleague Bryce DeWitt has described matters, "reality is not the reality we customarily think of, but is a reality composed of many worlds," hence "Many-Worlds Interpretation." Everett was never quite comfortable with the "many-worlds" notion, his understanding being of one world with countless "branches" (Everett 1973).

Everett's construction can sound implausible to many, initially in postulating quantum effects spawning countless branches, with each branch and everything in it variously dissimilar to all others. Everything means everything, including multiple copies of observers each experiencing an alternative reality. Schrödinger's cat is precisely alive in one and dead in another, as Schrödinger eventually postulated in an effort to lay bare some of the same anomalies of the developing Copenhagen hegemony that prompted Everett's radically realist approach.

Despite the metaphysically dramatic nature of Everett's proposal, he was responding in part to a dual call for fresh thinking. One came from Albert Einstein, and the other from the existence of the commonly recognized measurement problem endemic to quantum mechanics. Everett's deterministic interpretation in answer to both is understood by others, despite its apparent implausibility, as conservatively straightforward compared to the Copenhagen view. Everett's proposal for its believers is championed as being derived directly from the fundamental mathematics of quantum mechanics following its evolution to logical conclusions, seeking to add nothing save a new perspective.

Einstein, having settled in Princeton by the time of Everett's doctoral studies, helped to institute quantum physics, yet was famously wary of prominent aspects of the Copenhagen interpretation, which had come to be seen as the mainstream view ("God does not play dice …," Einstein retorted; Isaacson 2007, 323–26). He argued in relation that any valid quantum physical theory must satisfy three criteria, demonstrating for him that the Copenhagen convention was at best somehow incomplete: *realism*, *locality*, and *determinism*. For Einstein, *realism* meant that purely subjective or entirely mental notions should not enter the basic quantum ontology; *locality* meant that there should be no instantaneous or delayed action at a distance; and *determinism* meant the avoidance of anything stochastic, having a random probability distribution or pattern that is statistically analyzable, but which may not be predicted precisely. Commonly argued is that quantum mechanics fails especially when these criteria are combined, and that most interpretations falter in particular regarding locality. Everett aimed to answer all three criteria with his theory (Brown 2020, 299).

The second call, the well-rehearsed measurement problem, is one arising conundrum among many since Max Planck's Nobel Prize-winning proposal that the observed emission and absorption of radiant energy on a blackbody would fit observation to theory neatly if that energy was in the form of discrete energy packets he called *quanta* rather than waves. Simple experiments with *quanta* using double slit apparatuses have revealed a small-scale world wildly unlike that which we experience at the large scale (Henson 2016). The reality revealed is "impossible, *absolutely* impossible, to explain in any classical way…" (Feynman 1989, III: sec. 1-1). While well-trodden, rehearsing the chapter and verse of the Copenhagen view helps to show the stark differences of Everett's MWI with regard to classical and quantum thinking.

Measurement in classical physics is relatively unproblematic, observing and recording that which *is*; measurement in conventional quantum mechanics is quite the opposite. The quantum principle of superposition in the Copenhagen interpretation has a particle in alternative and mutually exclusive possibilities until the last moment when a measurement is made, at which point a single actuality is realized. Bohr and the Copenhagen interpreters assigned this realization to a combination of classical and quantum states, including the classical large-scale measuring apparatus of a particle gun and detector with an observer, and a quantum-scale effect upon the act of measurement. Observation, in the Copenhagen view, causes a state vector system collapse giving the particle a definite value on a single trajectory, ending the superposition (see Weinberg 2013, 83).

In Bohr's version, quantum physics does not supersede classical physics, but presupposes it in a complementary fashion to fit experiment and observation. Despite the eventually widespread acceptance of this Copenhagen convention, Harvard philosopher Hilary Putnam has noted that this would be like Isaac Newton requiring medieval physics in order to make sense of things using his new mechanics of force, mass, and motion (Putnam 1990, 4). For many, including Einstein and later Everett, something was amiss. In Everett's theory, again, there simply is no separate classical realm, and the state vector of the system including particle and observer remains in superposition, with the observer experiencing each different value and trajectory in a separate branch of the universe.

Bohr's metaphysically laden interpretation has been described as Kantian and was complex, positing that only with these paired classical and quantum understandings does one begin to approach a depiction of physical reality—which even then is not a whole picture. Bohr believed, like Kant, that such a *Ding an sich* independent of observation is beyond the human mind's capabilities (Putnam 1990, 5; Bohr 1963; Bohr 1999; Zinkernagel 2016).

Everett's innovation looked afresh at Schrödinger's fundamental 1926 wave equation, which provided the formalism describing the aforementioned behavior of a particle in a potential (Schrödinger 1926, 109–39; Schrodinger 1927). The time-dependent equation describes how the energy of a particle in a potential is at one place and then another; for example, for a particle with energy E, in one dimension x, in a region in which there is a potential V. A simple example is to say that at a future time t an atom may be in its original state A or in a different state B, which could mean that a radioactive atom/nucleus in decay, for instance, will have either decayed into *B*, or not decayed, remaining *A*; that is, the atom will have either emitted (*A*) or not (*B*) a quantum of radiation. Schrödinger's equation tells us that the atom *A* will undergo a transition from *A* into a new state $A^{\#}$. The Copenhagen interpreters described $A^{\#}$ as a superposition of two states at once, both *A* and *B*—like Schrödinger's cat—prior to an observed measurement and system collapse, referred to by Bohr and others as a wave packet collapse (Putnam 1990, 6–7). That description of what can be called a wave function ontology even for Schrödinger could not ultimately be right, however, as the description of the superpositions and collapses arguably indicated some level of incompletion (Allori 2011, 4; Allori 2013, 68).

Bohr and the Copenhagen orthodox replied that the transition of *A* to $A^{\#}$ is so completely nonclassical that any such attempts to depict it are inappropriate. The stochastic transition of $A^{\#}$ to either *A* or *B* at the collapse of the wave packet governs the measurement interaction (Putnam 1990, 7). In a series of several counter-responses beginning in the 1950s, scientific mavericks deviating from the Copenhagen view, including David Bohm and later J. S. Bell, proposed cases for hidden variables, which when added would complete the description, the "picture," properly. Their proposals, judged noteworthy and having convinced some, nevertheless have not supplanted the Copenhagen orthodoxy. Everett's bold and more starkly heterodox interpretation followed such attempts.

Everett's interpretation rejected both hidden variables and the complementarist metaphysics of the Bohrian orthodoxy. Regarding the state vector as a full description of any given closed system leads anyone inevitably, as Steven Weinberg has more recently put it, to the Many-Worlds view (Weinberg 2013, 83). In Weinberg's straightforward description, Everett's view of the evolution of the Schrödinger equation has components of the state vector under study becoming associated with the vector of the measuring apparatus and observer, eventuating in a splitting into all possible branches in accordance with different measurement results. The state vector of the entire system of particle and observer sees every possible definite trajectory happen, but with the observer—duplicated in each branch—experiencing only one trajectory in each. However theoretically extravagant that sounds, while the Copenhagen interpretation is reliant on factors beyond quantum mechanics, Everett's follows the evolution of Schrödinger's equation and quantum mechanics strictly (Weinberg 2013, 83–95; Carroll 2021). David Wallace likewise explains Everett's interpretation as neither a new physical theory nor a metaphysical addition to quantum theory, but quantum theory understood and interpreted literally and conservatively (Wallace 2012).

John Wheeler, Everett's doctoral supervisor, at first considered his work to be of unusual yet self-consistent vision, daring to change our fundamental conception of physical reality. Remarkably, Wheeler initially compared Everett's work to that of Newton, Maxwell, and Einstein (J. A. Wheeler 1957, 463–65; Dewitt and Graham 1973, 152). In a similar though less laudatory vein, Max Jammer has called it "undoubtedly one of the most daring and most ambitious theories ever constructed in the history of science" (Jammer 1974, 517).

Despite such views, a sound rejection of Everett's interpretation by the Copenhagen school and especially its leader Bohr greeted it, prompting Wheeler to moderate his support for the work. Wheeler strongly admired Bohr, and although originally championing Everett's interpretation, considered himself an orthodox Bohrian (Osnaghi, Freitas and Freire, Jr. 2009, 98). In truth, Wheeler had expressed some misgivings from the start even to Everett, who later recalled that Wheeler had told him directly that he "mostly believed my interpretation, but reserved Tuesdays once a month to disbelieve it" (Misner 1977).

Beyond Wheeler, a prevalent respect for Bohr and the monocracy of the Copenhagen interpretation from the early to mid-twentieth century, combined with the principally instrumentalist approach to physics prevalent at the time (and still today), has caused unusual interpretations from the likes of Bohm, Bell's later work with Bohm's idea of hidden variables, and Everett's interpretation to be dismissed almost blithely.

This overwhelmingly practical attitude in physics kept virtually *any* discussion of interpreting quantum physics at bay for a considerable while, with even Bohr's complementarity initially seen as obscure and extravagantly philosophical. Of 43 quantum mechanics textbooks published between 1928 and 1937, only eight even mentioned complementarity, while 40 discussed in detail Heisenberg's uncertainty principle. "Copenhagen school" was, in fact, used in derision with the intention of naming any such orthodoxy as *myth* (Osnaghi, Freitas and Freire, Jr. 2009, 98), and "Copenhagen interpretation" was invoked in *opposition* to Bohr's complementarity (Faye 2019). Nevertheless, the notion of an orthodox view of quantum mechanics grew from the 1930s to the advent of Bohm, Bell, and Everett in the 1950s onward, and Bohr rose to be its representative incarnate. In characteristic scientific (and similarly often religious) fashion, what was at first viewed suspiciously became *de rigueur*.

The reasons for this developmental history are doubtless complex and multifaceted, but by numerous accounts were not least also driven by social and social psychological factors. Bohr during his lifetime was commonly perceived to be intellectually and interpersonally charismatic, and vitally as having been crucial to the initial development of quantum mechanics. Mara Beller has compared charismatic religious and scientific figures as being quite similar in their social effects, noting of Bohr that, "as the founder of the philosophy of complementarity, Bohr was declared by his followers to be not merely a great philosopher, but a person of exceptional—perhaps superhuman—wisdom, both in science and life." Some disciples called Bohr "the wisest of living men" (Beller 1999b, 254–57). Even Einstein, their famous debate aside, referred to Bohr as "a prophet," and Bohr in turn "playfully characterized himself as such" (Beller 1999, 256). Wheeler, perchance prone to unwarranted comparisons given his early estimation of Everett as another Newton, similarly likened Bohr's intelligence and judgment, writing in a 1985 career retrospective, to that of Confucius and Buddha, Jesus and Pericles, Erasmus and Lincoln (Wheeler 1985, 226; Osnaghi, Freitas and Freire, Jr. 2009, 100).

Still, such ensuing reverence was cautiously twinned with what Beller has described as "physicists … willing to repeat 'Bohr's Sunday word of worship', [yet] in physics proper they maintained a fruitful balance between humble reverence and free creativity" (Beller 1999b, 257). This vital sense of freedom to think experimentally is what allowed Everett to craft his radical interpretation, to meet with Bohr to discuss his objections to the Copenhagen interpretation and explain his MWI, and Wheeler cautiously but clearly to argue Everett's case with Bohr and other figures of the Copenhagen circle (Byrne 2010, 160–77).

None of this, however, including personal visits by both Wheeler and Everett to Copenhagen, prevented a harsh rejection by Bohr and the Copenhagen orthodox of Everett's ideas, joined by eminent physicists elsewhere including Richard Feynman. Léon Rosenfeld, among Bohr's closest colleagues and a crucial contributor to the Copenhagen reading, with a passion and intolerance usually thought characteristic of theological doctrinal disputes, called Everett's heterodox theory "hopelessly wrong" and "damned nonsense," crudely describing Everett himself as "indescribably stupid" (Osnaghi, Freitas and Freire, Jr. 2009, 113). And a great part of the problem from the start was Everett's awkward and unusual use of ordinary language and references to which the orthodox could not relate, and to which we now turn.

Language and Reference

The precise use of language and the careful interpretation of that to which it refers is fundamental to the fruitful work of both science and theology, and to differentiating between orthodox and heterodox formulations and interpretations of scientific and theological concepts. A cursory review of the history of the heavily disputed Christian trinitarian *filioque* clause, "and [from] the Son," is all that one needs to be reminded of these truths in matters religious. That short and deceptively simple phrase has divided interpretations and their relevant authorities for centuries and across principalities. No less is true nor more far-reaching than in physics, with the precision of mathematical language, and with the formulation and interpretation of equations like Schrödinger's, by Everett's reckoning, dividing our world into countless branches, and creating by the reckoning of others issues as great as a multiple universes hierarchy (Tegmark 2007; Carr 2007).

Physicists, fortunately, can and do also use words to explain mathematics and their theories. Everett's categorization of "orthodox quantum theorists" and "equally orthodox quantum theorists," and the extension of that terminology by various quantum commentators to discussions of "orthodoxy" and "heresy" regarding the Copenhagen and Many-Worlds interpretations, can be entertained further to observing the general importance of language and reference in the Copenhagen/MWI disputes.

John Wheeler's impression that Everett's conception of the universal wave function was significant was unmistakably expressed, but his misgivings about Everett's first full submitted doctoral thesis draft were such that he refused to allow Everett to submit it for examination without substantial revision. The final product under Wheeler's unusually close direction was so altered that Everett, greatly disappointed by that and the controversy surrounding his ideas, never published on quantum physics again excepting edits to his thesis, ending his academic career at its origins. This is ironic given the efforts spent in the decades since Everett's death analyzing, defending, promoting, and improving that one piece of work.

Wheeler reportedly required Everett to modify and excise as much as 75% of the initial doctoral draft after showing it to Bohr, threatening to revoke Everett's PhD unless he altered the text precisely as directed (Barrett 2022, 987). Positively, the quality of the redacted final product, despite Everett's displeasure, is what freed Wheeler to compare Everett so enthusiastically to the likes of Newton, Maxwell, and Einstein (Byrne 2010, 160–61).

Wheeler's initial reservations and the trenchant dismissals of Bohr and the Copenhagen circle were precisely primarily to do with language and reference. Everett had a penchant for an unusual and awkward use of words in attempting to explain his universal wave function. "Until this whole issue of words is straightened out," Wheeler warned, there would be no doctoral examination, and hence no degree (Byrne 2010, 163). Aage Petersen, who with Bohr had met Wheeler in Copenhagen to discuss Everett's work, asserted, "Math can never be used in physics until [we] have words. [We] aren't comparing [our]selves with servomechanisms. What [we] mean by physics is what can be expressed unambiguously in ordinary language" (Byrne 2010, 164).

That comment was among many documenting the highs and lows of intense conceptual and personal struggles that ensued between Wheeler, Everett, Bohr, Petersen and additional interested parties from Bohr's inner circle. Such was unveiled in never-before-seen detail with the discovery of stacks of private notes and correspondences in the basement of Everett's Los Angeles home in 2007, 25 years after his death. The Niels Bohr

Archive in Copenhagen, the American Philosophical Society in Philadelphia, and the American Institute of Physics in College Park, Maryland have collected and released further documentation. Olival Freire, Anja Jacobsen, Stefano Asnaghi, and Fabio Freitas have catalogued, studied, and analyzed the records, aided by Peter Byrne who had made the initial discovery in Everett's home (Byrne 2010, 163n10). Their distillation of these materials shows us exactly what the points of discord were.

Compounding the impression of metaphysical extravagance in Everett's interpretation in the light of the accepted Copenhagen view, there are recurring points of linguistic and referential confusion that are clear in correspondence between Wheeler and Everett, Wheeler, Bohr, and the Copenhagen circle, and between Everett and each of the same. These are to do with discrete concepts fundamental to Everett's view including "splitting" and "branches," the meaning of "universal wave function," the notion of "observer" and multiple "observers," and what the Copenhagen group called a "symbolic limbo" plaguing Everett's written work, by which they meant that his ideas were without connection to any experimental evidence. None of this improved to the satisfaction of those so perplexed, even following Everett's efforts to respond to their points.

While essential to Everett's novel quantum interpretation is the concept of splitting and the resulting branching, his language to describe each was identified early even by Wheeler as problematic. What are these "branches" and what does it mean that they "split?," Wheeler wanted to know. He wrote tersely, "Split? Better words needed." Everett, attempting to explain the concepts in a short essay of 1955 prior to his first full thesis draft, used biological analogies like splitting "amoeba" rather than physics terms, which instead of helping further obfuscated matters. Wheeler continued his objections, "This analogy seems to me quite capable of misleading readers in what is a very subtle point. Suggest omission." Affirming Everett's efforts at clarification but rejecting them as making matters worse, Wheeler added that a careful recasting of terms would be required not least to prevent "mystical misinterpretations by too many unskilled readers." Wheeler's concern was that Everett's language and clumsy analogies would lead to further confusion, but also that in the worst-case scenario the problems might be concealing deeper flaws in Everett's interpretation (Osnaghi, Freitas and Freire, Jr. 2009, 110).

Wheeler met Bohr in person the next year, 1956, sending ahead of him a bound copy of Everett's *Wave Mechanics Without Probability*, which outlined in detail his central interpretative notions. Even the title concerned Wheeler, who wrote to Bohr with the essay in a prevenient apologetic move, "The title itself … like so many ideas in it, need further analysis and rephrasing" (Osnaghi, Freitas and Freire, Jr. 2009, 110). Wheeler also arranged a meeting between Everett and Bohr in person at Copenhagen, hoping to get Bohr himself to "discuss the issue with [him] directly and arrive at a set of words to describe his formalism that would make sense and be free from misunderstandings for this purpose" (John A. Wheeler to Niels Bohr, 24 May 1956; Osnaghi, Freitas and Freire, Jr. 2009, 111).

These endeavors failed. No such set of words were to be arrived at with Bohr. Such encounters, and further controversy concerning his ideas, led Everett to give up on the venture of explaining himself using any words or terms of reference entirely beyond completing his PhD and publishing the three versions of the same work (Everett 1956, 1957, 1957b, and 1973; Freire 2022).

Faith and Agnosticism: Many-Worlds among Six Impossible Things Before Breakfast

I have thus far been arguing through the imposition of a framework of categories—to this point orthodoxy and heresy, and language and reference—that these sets of ideas, while artificially imposed and alien to most considerations of Everett's MWI, are applicable and illuminative toward accounting for its reception in terms of believability in scientific and related communities. The entire focus of this essay is believability in science and religion, as much as anything to do with Everett's MWI among fundamentalist, realist concepts in quantum foundations. Everett's interpretation should be taken seriously among such realist concepts, and therefore in terms of its potential promise for theological engagement, *because* there has been a positive shift since the mid-twentieth century in its perceived status. While difficult to quantify precisely, several recent studies indicate that the shift is demonstrable, not to mention extraordinary given its metaphysical challenges, although its reception is also circumscribed for the same reasons (Polkinghorne 1986; Tegmark 1998, 855–62; Schlosshauer, Kofler and Zeilinger 2013, 222–230; Penrose 2016; Battiston et al. 2019). Another recent study shows that when physicists make such choices, the driving forces are eminently social in character (Tripodi, Chiaromonte and Lillo 2020). For many physicists and philosophers especially of the extant and still patently larger "shut up and calculate" instrumentalist school, the MWI is like one of the "six impossible things before breakfast" that the White Queen claimed to entertain regularly in Lewis Carroll's *Through the Looking Glass*, his sequel to *Alice in Wonderland*. She encouraged Alice to do likewise. "I can't believe *that*!" Alice replied upon hearing of the Queen's implausible age, because "one *can't* believe impossible things." "Can't you?," the Queen queried. The secret, the Queen counseled, was simply to "draw a long breath, and shut your eyes," and most importantly, "try again" (Carroll 1872, 100).

My argument in this final summative section builds upon all that has preceded it to say that the same factors that can be shown to affect believability within scientific and related communities regarding the metaphysically challenging MWI, can be expected to have some similar effect upon any theology engaging Everett's theory. Further, the social context in which anyone would write any such theological engagement is verifiably changing so much that it is becoming impossible to discount consideration of the kinds of socially oriented categories I am imposing upon the MWI phenomenon when seeking to engage it theologically. Further still, it should be understood going forward that the dynamics of these categories now must be given consideration in *any theology at all* written in a society deeply marked by what I further suggest is a subtle, powerful, and pervasive mode of quasi-scientific thinking we can call societal constructive agnosticism, of which anyone doing theology today should be aware. One's orientation relative to the variable content of these dynamic ideas that affect believability—deciding with others what can be counted as orthodox or heretical, what language and references reinforce or challenge these categories, and ultimately determining what one can put one's faith in or question—will make belief in metaphysically challenging ideas like the MWI, or particular ideas about God, either more or less believable.

As far as engaging Everett's interpretation theologically, there is a limited sense in which having done all of the above, using socially oriented categories that can be understood to be equally applicable to science and theology, one is already engaging science with theology. One could also pose particular Christian doctrines or doctrinal emphases in the light of the MWI, seeking either to forge positive connections or point to potentially cautious or negative possibilities for theology should the MWI somehow eventually prove to be true. Emily Qureshi-Hurst does this well in this collection of essays.

There are instead of these two other obvious ways, and a third more difficult and not so evident way, to heighten theological engagement with the MWI to which I shall refer. A most obvious and unquestionably potentially fruitful way to engage with the MWI theologically would be to mine its history and concepts with regard to any direct or at least implicit theology already present, as one can do with Galileo's sixteenth-century affair with the Church or Darwin's in the nineteenth. Direct connections between Everett the person and faith in God, or anything remotely theological, can in fact be made, but only in the negative. Everett graduated from the Catholic University of America prior to his enrolment at Princeton, and he did have to take some religious courses, including "Fundamental Beliefs and Spiritual Foundations of American Life." He reportedly aced all of his science courses, including an "A" in "Philosophy of Science," and got a mediocre "C" in "Fundamental Beliefs." In truth, he was an atheist and open about it, even seeking to construct a case against the very idea of God in the form of a fresh retort to St. Anselm's ontological argument and Kurt Gödel's attempt to improve upon it. Everett considered both to be tautologous and absurd. His case against faith while an undergraduate extended to causing one of his professors to question entirely his own beliefs in response to Everett's quite ingenious application of the "universal existence theorem" to a discussion of the mythological winged horse Pegasus. Everett substituted the horse for God, his logic prompting an admission by the professor that belief in God is a matter of faith, and is not subject to mathematical proof. Later in life after formulating his new quantum interpretation, Everett did encounter some who attempted to apply a kind of loose Many-Worlds philosophy to the idea of God—in effect that if all things exist then God must exist—but these he also easily dismissed since with his theory of a universal wave function, aka Many-Worlds, it does not, in fact, obtain that all things, including God, must exist (Byrne 2010, 30–35). That was a misunderstanding.

A second, and more subtle and interesting way of engagement, of loosely framed indirect thoughts of a theological likeness regarding Everett and the MWI, have been offered by philosopher Hilary Putnam (Putnam 1990). Writing at length on Bohr, the Copenhagen interpretation, and Many-Worlds, he says that, "At no point does this wild ontological extravaganza [the Many-Worlds Interpretation] really change the practice of physics in any way. It only reassures us that a God's-Eye View is still possible" (Putnam 1990, 10). A quite similar point had been made *against* Everett's MWI during his lifetime by Alexander Stern, then in residence at Bohr's institute, in correspondence with John Wheeler. In definite disparagement, Stern, fixed on the assumption that measurement requires an external observer, and missing the point that Everett was eliminating the role of external observation altogether, had argued that if "Everett's universal wave equation demands a universal observer, an idealized observer, then this becomes a matter of theology …" (Byrne 2010, 164–65). What Putnam implies is something logical, not necessarily seriously theological. He places Everett's interpretation as having come along after a line of failed attempts in which ideas working to replace the Copenhagen cut between the system and observer with what he calls a "God's-Eye View" had been tried and rejected. Everett's attempt, in Putnam's eyes, is simply a more extreme attempt than, for example, the hidden variable theory of Bohm and its later attempted amelioration by Bell (Bohm 1952 and 1980).

In the MWI, with every fact described by the maximal state of the whole universe and its branches, only for an ordinary observer are some facts hidden. "But no fact is hidden from God, or from any omniscient mind, since the omniscient observer knows the 'state function of the whole Universe (sic),' and that state function codes *all* the information about *all* the 'branches'—all the 'parallel worlds'" (Putnam 1990, 8–9). Everett's work makes God, for Putnam, the "Omniscient Quantum Physicist—and it is the Omniscient Quantum Physicist's point of view that this interpretation tries to capture." And despite his elegant argument explaining the MWI as attempting to reassure us that a God's-Eye View is still possible, he does not himself find it believable. "For, alas," he writes, "we don't find that this picture is one we can *believe*. What good is a metaphysical picture one can't believe?" (Putnam 1990, 10).

Constructive Agnosticism

Investigations into realist quantum foundational ideas like Everett's MWI with respect to making fruitful theological connections is exactly about creating metaphysical pictures that one can believe. In this last part of the summative section on faith and agnosticism, I continue the theme of believability in the context of socially oriented dynamics as I argue, finally, that a renewed look at those for whom we are creating such metaphysical pictures is now required, and the clear evidence is that this will be increasingly necessary. Alongside this argument, I then want to offer in my conclusions below just one key suggestion regarding this third more difficult, not so evident, yet potentially more richly rewarding way to heighten theological engagement with the MWI and other quantum foundational ideas like it in the work of the science and religion field. Doing all of this requires modulation to think broadly about trends of belief in society at large that I suggest should no longer be only the preserve of the occasional scholar or research project with an interest in social science. Such socially oriented concerns have been for quite some time practically non-existent in the science and religion field of inquiry, which is of course odd since all science and religion interactions are at some level social interactions. Rightly this is beginning to change quite recently (e.g., Ecklund 2017 and 2019). My hypothesis following several years of research in this direction is that a certain unmistakable growing trend in societal beliefs *en masse* may be in part due to a subtle, powerful, and pervasive mode of scientific thinking that I call societal constructive agnosticism, of which anyone doing theology today really must be aware.

The unmistakable trend in western society is toward what *appears* at first glance to be a gradual loss of religious faith, precisely a crisis of beliefs, and of practically epic proportions. The phenomenon, known in emerging research circles as the rise of "no religion" has by 2023 firmly unsettled an otherwise familiar western religious landscape. "Nones," so named by the common characteristic of declaring "no religion" on government census data and comparable surveys, is now the largest single "religious" group in North America, the United Kingdom, and other western regions, continuing a trend of rapid growth that began to be charted especially from the 1990s. Recent regional figures include that even several years ago by September 2017, for example, 53% of those polled in Great Britain had so identified themselves. The numbers increase significantly when lower ages are considered. More than 70% of those aged 18–24 years, or of university undergraduate and graduate age, now declare "no religion," and the state Church of England, for instance, is particularly underrepresented among them with only 3% identifying as Anglican. The UK's most recent national census (2021) has definitively confirmed these trends, with critics now calling for the disestablishment of the state-sponsored Church. While a quite small number of scholars, like the sociologists Linda Woodhead and Stephen Bullivant, are researching the rise of "no religion" from social scientific perspectives, the results are at this stage mostly statistical and just beginning to move toward explanations (Woodhead 2017; Bullivant 2019 and 2023). Research offering a much deeper sociological, philosophical, and religious analysis is embryonic, and constructive responses from religious bodies are virtually entirely absent. Certainly, few are researching "nones" from a science and religion perspective, despite a significant percentage of them naming science as among the principal reasons for their lack of religious beliefs and adherences to organized faith practices. Stereotypical responses including science versus miracles, common sense, logic, more studying on their part, and an overall related lack of evidence are commonly uncovered by Woodhead, Bullivant, and others. Significantly for the writing of science and theology going forward, whether about ideas like Everett's MWI or *any* theology generally, most "nones," the research also shows, are paradoxically not entirely opposed to religion, often do hold theistic beliefs, and vigorously tend to deny labels like "atheist." In other words, this is not the gradual secularization caused by science prophesied widely for centuries and of late hoped for by New Atheism. The most prevalent characteristic is a robust agnosticism about *everything*, which I hypothesize derives from a combined vague grasp and at once a misunderstanding of the true nature and processes of science, and equal misapprehensions concerning the nature of faith and religious adherences where theology is concerned.

Western education has especially since the nineteenth century been steeped in science as one vital focus, and I believe there is an important connection here to be made. Henry Cowles has carefully documented this recently in *The Scientific Method: An Evolution of Thinking from Darwin to Dewey*, and contends that what has not been adequately explained in this grand educational process is the difference between *scientific method* and something widely now called "the scientific method." It would be difficult to accept fully any argument that scientific methodology between disciplines like physics, biology, and even sociology bear no common features whatsoever that make them all scientific. Yet the idea of a single universal scientific method consisting of several simple steps like observation, measurement, experiment, and the formulation, testing, and modification of hypotheses shared across all such disciplines and teachable even to children, is just over 100 years old. Cowles systematically details how, since the nineteenth century, the idea of science itself has evolved from being one important kind of knowledge taught to the inheritance of an entire western way of thinking and approaching the world based on this thing called "the scientific method" (Cowles 2020). One would not want to make the mistake of arguing simplistically that this "scientific" cultural inheritance is the monocausal explanation for the current rise of so-called "no religion." But it is difficult to believe that this phenomenon marked arguably most of all by a fascinating kind of agnostic, yet constructive, view of more or less all things is unconnected. There is a factual, historical, and intimate connection between scientific thought and agnostic thinking, as Thomas Henry Huxley taught us when he first coined the very term "agnostic," searching for just the right word to describe both science and his own predispositions and philosophy (Huxley 1894).

With a nod back toward Everett and physics, I think it is no coincidence that this same scientifically positioned western culture, assuming Cowles to be correct, is obviously also fascinated by scientifically oriented ideas specifically like multiple parallel worlds. Culture is replete today with recent artistic references for every age level like the universally acclaimed 2022 film *Everything Everywhere All at Once* in which the main character comes to understand that every life choice, each decision, creates a new alternate universe. While this is fiction and is not based directly on Everett's interpretation, clearly the general public understands a concept like many worlds just enough that such widely well received artistic expressions are possible. My view, connecting all of this, is that there is both a connection and a dissonance between the scientific methodology in physics that prompted Hugh Everett's work and the perception of something called "the scientific method" as perceived by an educated western society at large. The same properly scientific constructive agnostic process that drives a thinker like Everett to doubt the Copenhagen interpretation and propose an alternative, is at some level also at work, if in a form misunderstood and misapprehended, in creating a broadly scientifically oriented western culture quite agnostic about most things, and at once fascinated with a concept like many worlds.

Conclusions

In the course of this essay on "What Makes a Quantum Physics Belief *Believable?*," I have sought to answer this question regarding Hugh Everett III's 1957 MWI with due reference to conventional scientific terms, but with a substantial eye toward those factors often not adequately counted, of a social scientific variety. Quantum mechanics as analyzed in terms of, and in various forms of engagement with, the humanities and particularly the social sciences has become more common especially over the past several decades. Quite complex ideas like Karen Barad's agential realism, which attempts to inform social theorizing using as its basis Bohr's interpretation of quantum mechanics, have been floated and variously received

(Barad 1984; Barad 1988; Barad 2003; Barad 2007; Barad 2022; Faye and Jaksland 2021). More recently than Barad, Alexander Wendt, in *Quantum Mind and Social Science*, has advanced the somewhat radical claim that all of social life itself should be understood in quantum mechanical terms (Wendt 2015). That, too, while lauded as having been done "refreshingly and brilliantly," has received sharp criticisms in essays bearing titles summarily dismissive of the entire quantum mechanics/social sciences phenomenon like, "Schrödinger's Cat and the Dog That Didn't Bark: Why Quantum Mechanics is (Probably) Irrelevant to the Social Sciences" (Waldner 2017). Attempts like Barad's and Wendt's have been, however, somewhat complex engagements altogether, complicated further by intricate theorizing, and which have been rejected by some for equally intricate reasons.

My analysis in this essay has been far less complicated, and with simpler aims reminiscent of more straightforward suggestions like Max Jammer's midway through his 1974 classic *The Philosophy of Quantum Mechanics*. There he suggested the worthiness of investigating, though he did not himself seek to prove, whether the waning of the Copenhagen monocracy from the 1950s with space created for new interpretations might be understood to be owed to a noteworthy extent to social and social-psychological factors and forces, such as a growing interest in Marxist ideology. Similar suggestions, after all, had been made elsewhere regarding how "Weimar culture" might have shaped early quantum theory (Jammer 1974, 250–51). Here I am suggesting something quite simple and less intentionally laden than even Jammer's suggestion in several regards. That is, that something generative and helpful might be gained by looking afresh at Everett's MWI, and its rejection by the Copenhagen school and acceptance by others in terms of believability, as understandable in terms of ideas intimately connected with social interactions relevant both to science and religion: orthodoxy and heresy, language and reference, and faith and agnosticism. These categories, artificially imposed, could have been otherwise. That is, other terms employed to make the same socially oriented points might have worked equally well. The bottom line is that our beliefs and believability generally, whether regarding quite complex scientific theories like Many-Worlds, theological notions in relation, and in doing theology at all, are forged, challenged, made, and sometimes broken alongside other people. Our beliefs and believability broadly are doubtless complex phenomena with many layers, which one might explain and understand for example within a recapitulation of evolutionary history and phenomenological accounts of perception (Wolpert 2006; Ward 2014). Recent arguments from affect theory contend for an emotional element, challenging the conventional wisdom that says feeling and thinking are separate whatever the subject and whatever our beliefs, as Donovan O. Schaefer does well in *Wild Experiment: Feeling Science and Secularism*

After Darwin (Schaefer 2022). Nevertheless, and one could say undergirding even each of these recent explorations, the social point still stands.

Having done all of this has made it possible to modulate at the end to reflect, I would argue most importantly, also on belief and believability in a western culture today that is radically changing from previous generations in terms of religious beliefs and adherences. Adherence is falling sharply and regularly in response to a fascinating turn, particularly over the last century, to a more agnostic-yet-constructive mode of thought prevalent in society. Following studies like that by Cowles, I have suggested that there is a plausible correlation to scientific education and a related way of thinking. This is worthy of further exploration at length and elsewhere.[1] My promised one key concluding suggestion is this: that increasingly theology written in an apposite hypothetical mode, like Everett and all other scientists employ when questioning one theory or interpretation and positing another, is likely to be of greatest appeal to this rapidly expanding majority audience. This quite simply means starting theological discourse on any given issue a bit further back from anything confessional in nature, instead positing theological ideas first as open-minded hypotheses. Endeavoring to do so is far from meaning that one cannot engage doctrinally with orthodox Christian ideas, as a thinker like Wolfhart Pannenberg has done even when writing his eventual three-volume systematic theology (Pannenberg 1998-1993). Those who work in the field of science and religion tend already to think and write in this mode. If all of that is true, those who work in science and religion are ideally placed to address today's world. As we do so, we must arguably take more careful account of the changing parameters in both science and theology of what counts as orthodoxy and heresy, and take greater care regarding the language that we use in explaining that to which it refers, as how we do these things will affect that which people place faith in and what they doubt, constructively or not.

In the end, Everett was, to use the terms employed and emphasized by Mark Harris in this collection, enacting a kind of realist quantum fundamentalism, believing that "everything in the universe (if not the universe as a whole) is fundamentally of a quantum nature and ultimately describable in quantum-mechanical terms" (Zinkernagel 2015; cf. Faye 2019). We are only at the beginnings in many ways of engaging this quantum fundamentalist framework, and specific ideas within it like Everett's, theologically. Our task is indeed much like the White Queen's efforts to entreat Alice in *Through the Looking-Glass, And What Alice Found There* to shut her eyes, draw a long breath, and "try again" to consider seemingly impossible things. What counts today as "six impossible things before breakfast" in science, theology, and therefore the interactions between them seems destined to change. What people find there will greatly be determined by how we carry out the task of entreating them as we work to deliver metaphysical pictures that one can believe.

Note

1. The trajectory of my research interests in science and religion has taken a decidedly social scientific turn beginning with the John Fell Funded (Oxford University Press) pilot project, "God, Science, and the Rise of 'No Religion'" on which I was Principal Investigator with an international group of colleagues including Alister McGrath, Linda Woodhead, Stephen Bullivant, Donovan Schaefer, and others. That ended during the COVID-19 pandemic in April 2021. The research is continuing in 2023 in a multi-faceted longer-term science and religion project with colleagues Alister McGrath and Stephen Bullivant, "New Principles of Constructive Engagement in Science and (Non)Religion."

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