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Quantum Fundamentalism and Theological Liberty

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Quantum mechanics (QM) is astonishingly successful as a theoretical framework, underpinning countless scientific areas and providing the impetus behind entire technologies. Many scientists suspect that physical reality is fundamentally quantum in nature, even if we perceive little of this in our everyday human experience. This is the viewpoint of "quantum fundamentalism." Yet, the conceptual implications of QM defy common sense, to such an extent that popular culture largely perceives of QM as a source of counterintuitive weirdness. At the same time, bestselling self-help manuals portray QM as a source of hidden healing power within, while spiritual readings invoke QM as a bridge to the divine, or as a source of theological analogies. Scientists often denounce these mystical approaches as "quantum quackery," but I examine their serious side. I argue that, for quantum fundamentalism to function as a worldview, it should inform a sense of human purpose, something for which theological analysis is well equipped.

Introduction

This article presents the (slightly adapted) text of my inaugural lecture as the Andreas Idreos Professor of Science and Religion at the University of Oxford, delivered in the Andrew Wiles Building at Oxford's Mathematical Institute on May 29, 2024.

Let me begin with a few words about Andreas Idreos, after whom my chair is named. Born in 1917, Dr. Idreos was a medical professional, a senior officer in the World Health Organization. He took a global view of the human future, becoming convinced that deeper understanding between different cultures would be furthered by greater attention to the interaction between two great universals: the sciences and religious belief. One of Dr. Idreos's contributions to furthering this aim was to endow this chair that holds his name. I am humbled to have been appointed to play my own part in working towards his vision of increased unity between the peoples of our world. I want to pay tribute to Dr. Idreos's wider vision before becoming stuck in an academic thicket of my own choosing.

Here is what I plan to say. First, something of my personal perspective on science and religion: Why me for this job? Second and third, what it says on the tin: quantum fundamentalism and theological liberty.

Science and Religion: A Personal Perspective

First, why me? My thoughts return to the inaugural lecture I gave for my previous role as Professor of Natural Science and Theology at New College in the University of Edinburgh (Harris 2022). When I gave that lecture in 2019, I spent my time speaking of the work of my three illustrious predecessors in the college's Chair in Natural Science (John Fleming, John Duns, and James Young Simpson) and how I would take their objectives further. The New College history depicts them on a figure delightfully entitled "Professors of chairs now extinct" (Watt 1946, 224–25). Ironically, they were all biologists working on evolution and its theological implications in the nineteenth and early twentieth centuries. Since their chair then went into abeyance for nearly a century between them and me, it was fairly straightforward to demonstrate that I would be bringing something new.

Not so with my new job. Now, I cannot possibly claim to be resurrecting something that was extinct. The Andreas Idreos chair has been going strong throughout the twenty-first century. And I have three extremely illustrious predecessors, all of whom are still alive and active (John Hedley Brooke, Peter Harrison, and Alister McGrath). All three have made sizeable contributions to the field of science and religion that still stand. If I were to attempt to review their work, allotted space and time would fail me, so let me summarize it in a single sweep by saying that they have all been instrumental in developing what has become the consensus in the field over the last, say, ten to twenty years, namely that the old dualism of science versus religion is unsustainable, even if that dualism lingers on in wider society. Popular culture may still maintain that science and religion are incompatible, at loggerheads with each other, but the truth of the matter is that both sets of enterprise have evolved alongside each other in subtle and complex ways, and their relationship is similarly nuanced. For sure, there has been conflict between some scientific theories and some religious beliefs down the ages, and there are still some today—we can all think of the debate over young-Earth creationism versus evolutionary science, for instance—but there are many areas where there is little direct engagement, while there are also areas of positive interaction. My three predecessors in the Andreas Idreos Chair have been instrumental in contributing to this rich story of engagement between the sciences and religious beliefs, and I see no sign that we will run out of questions any time soon.

So, what am I going to do? Will I bring anything new? I certainly hope so. For one thing, I am the first physicist to hold the chair, and although I spend much of my time mixing with theologians, philosophers, and historians—and indeed, I have also trained as a theologian myself—it is physics and its hinterland that continue to grab my attention. I must admit that I am not very active in mainstream physics anymore, but thanks to some long-suffering collaborators, I am able to keep my hand in from time to time in the lab and to help with the occasional scientific publication. At any rate, I describe myself on the Oxford Faculty of Theology and Religion website as a physicist working in a theological environment. A little pretentious, I know, but it seems to capture my approach to science and religion, namely a concern with what drives working scientists most deeply as human beings with their own beliefs and convictions about their science and our human world.

We know that science changes the world. What, in fundamental terms (by which I mean human aspirations and convictions about what is most real) is it that drives the world of science? Why does science work? The working sciences cannot answer these questions; they need philosophers, theologians, and historians: the science and religion field. But there is a great deal more that this latter field could do, I suggest, to help working scientists grasp the significance of their daily work, examine their working assumptions and prejudices, and analyze their scientific hunches, some of which, I have discovered, are implicitly theological.

How should science and religion scholars—especially those who have theological interests such as me—go about this? Well, it is not straightforward: there are professional barriers to overcome. I noted earlier that there are areas of positive interaction between the sciences and religions—areas where there is a lot of traffic—but it is fair to say that the traffic is almost entirely one-way, from science to theology.

It was not ever thus. Once upon a time, there was conversation both ways. Some of the most important figures in the history of science—such as Galileo, Isaac Newton, and Robert Boyle—were not shy of analyzing and justifying their work on theological grounds. But not so today. The traffic is one way.

There are good reasons. Scientists are generally unable to engage positively with theology in their professional work, even if they have deeply held religious convictions of their own. Theologians, on the other hand, can work freely and imaginatively with scientific ideas, and they do so with great enthusiasm in certain areas, especially if those areas concern origins—the origin of the universe and the origin of humans—or the sciences of the human mind. It should not be a surprise that these two kinds of academic discipline relate so differently to each other. The natural sciences cannot, by definition, consider supernatural causes, while theologians are freely able to engage reality on every level. The traffic is therefore largely one way.

But, and this is my personal observation, all of this means that the science and religion field has not done much to examine the contemporary scientific landscape beyond a relatively small number of key areas of direct theological interest (origins and mind). This also means that the science and religion field has not done much to help most working scientists understand the human dimensions of what they do, especially the intuitions, prejudices, and hunches that guide their science, some of which, as I mentioned, are implicitly theological.[1]

I will start to explore an example of such a potential hunch here—quantum fundamentalism—that is widespread in modern physics, despite its ominous title. I argue that science and religion—which has not addressed quantum fundamentalism yet as a worldview—is in a unique position to critique and inform it. I also suggest that a belief in quantum fundamentalism can be enriched by adopting a spirit of theological liberty.

Quantum Fundamentalism

Let us begin with the obvious questions: What is quantum fundamentalism, and why might theology take an interest?[2] I am sure you are thinking that theology has quite enough fundamentalisms of its own to be getting on with and does not need another. Perhaps, but humor me.

Quantum fundamentalism is the belief that quantum physics captures what is most fundamental in our physical world, even though we might be blissfully unaware of this in our daily lives.[3] I will give you a more watertight definition in a moment, but first of all, where does this belief come from? Why would anyone want to believe that quantum mechanics (QM) is ubiquitous if we do not see it? Ah, but we do see it.

QM is a highly mathematical theoretical framework originally developed about a century ago to predict what we might see when we make observations on light and on matter at the atomic and subatomic level. Note that it is a theory of measurement, not necessarily a theory of reality in itself (Ball 2019, 11). When we try to infer from QM what is really there before we make the measurement, the theory tells us strange things. I am sure that you are familiar with Schrödinger's cat, the infamous thought experiment where the cat is ostensibly both alive and dead at the same time until we open the box and look inside. The philosophical disputes about what is really the case before we make the measurement have been ongoing for a century now and show no signs of abating. I will mention those disputes later, but my subject is the phenomenal success of QM at describing natural phenomena on all kinds of levels. We now think that QM works not just for matter at the atomic and subatomic levels, but all the way up.

The quantum framework is, arguably, the most successful collection of theories in the natural sciences, and not only if we measure success by the framework's ability to lend its terminology and explanations to the widest number of scientific disciplines. Without the quantum framework, we would have only a scant grasp of how matter on the molecular, atomic, and subatomic scales behaves and is composed. Accordingly, QM informs a wide variety of sciences, from most disciplines of the physical sciences through the life sciences and beyond. And on the macroscopic scale—preeminently the scale of human experience—quantum physics explains many of the basic properties of our everyday world that we take for granted, and it provides the basic science for entire industries, most obviously electronics and telecommunications. On a larger scale still, without quantum theory, we would not know why stars shine (nuclear fusion), nor how they make the atoms that make people and planets (nucleosynthesis). On still larger scales, cosmologists invoke quantum fluctuations as a mechanism for the Big Bang and an explanation for the distribution of galaxies in space (Wallace 2021, 94). Finally, QM underpins what is perhaps the greatest of all scientific discoveries: the periodic table of elements. Although the basic shape of the periodic table was determined by Dmitri Mendeleev in the late nineteenth century (some time before the quantum revolution), it was the realization that atoms have an internal electronic structure described by QM that provided the explanation for why the chemical elements fall into their characteristic rows and periods, and why they have many of the properties they do.

Of course, QM makes famously strange predictions. Albert Einstein, for one, could not accept the quantum property we now know as "entanglement"—where two particles can be inextricably linked even over stupendous distances—believing that QM must be incomplete or incorrect on this score at least. Yet, rigorous experimental tests to date have borne the quantum predictions out in full. Also, despite its widespread popular association with uncertainty, indeterminism, and probabilistic predictions, QM is capable of providing stunning precision in practical terms. In one renowned case (the magnetic moment of the electron), theoretical calculations agree with experiment to better than 1 part in 10^{12} (Fan et al. 2023). It is hardly surprising then, that many physicists believe that physical reality is fully quantum in nature. Here, for instance, is how one of the standard textbooks on QM begins (Cohen-Tannoudji, Diu, and Laloë 2020, 23–24):

> In the present state of scientific knowledge, quantum mechanics plays a fundamental role in the description and understanding of natural phenomena. In fact, phenomena that occur on a very small (atomic or subatomic) scale cannot be explained outside the framework of quantum physics. For example, the existence and properties of atoms, the chemical bond and the propagation of an electron in a crystal cannot be understood in terms of classical mechanics . . . Actually, there are many phenomena that reveal, on a macroscopic scale, the quantum behaviour of nature. It is in this sense that it can be said that quantum mechanics is the basis of our present understanding of all natural phenomena, including those traditionally treated in chemistry, biology, etc.

QM is the basis of our present understanding of all natural phenomena, they say, extending even into the macroscopic regime. In case you are wondering why classical physics does not take over at such a length scale—especially on our human level of pets and people, cats and dogs, where we apparently see no quantum strangeness—here is the great theorist and champion of condensed matter physics (that is, the physics of things on many length scales from the microscopic to the macroscopic), Philip Anderson (2001, 500):

> For 75 years, physicists—perhaps overwhelmed by the prestige of the authors of the Copenhagen interpretation—have adhered to the idea that there is some mysterious scale at which the quantum world changes into the classical. Decoherence is simply the code word for the null hypothesis that there is no such scale, that we are quantum all the way up. I have for long felt that the question was settled by the many examples of macroscopic quantum coherence, but I am notoriously impatient and perhaps the delicate experimental work which has gone into pinning these questions down is worthwhile. There is absolutely no experimental evidence for such a scale.

"We are quantum all the way up," maintains Anderson. Decoherence—the process by which a quantum entity's characteristic signature of quantum coherence becomes progressively watered-down by entanglement with its environment—may, for all practical purposes, make a quantum entity appear to us to behave in a classical fashion when we observe it, but the entity and its environment are no less quantum for that, in their deep physical description. Classical physics, successful as it has been, is therefore largely an approximation, we suspect, to a more profound description of nature on all length scales, which must be quantum mechanical. Of course, we currently are not sure how to combine QM with the other great theoretical success story of modern physics—general relativity—but we expect that, sooner or later, a solution will be found, and it will be thoroughly quantum in both style and content. This is a widespread hope in modern physics, and versions of it can be seen throughout the popular science literature. In short, quantum fundamentalism is uncontroversial in mainstream physics, although some of us wonder whether QM will ever be able to replace our reliance on thermodynamics in areas such as my own, condensed matter physics. Well, that is an open, and rather technical question,[4] but I have to admit that condensed matter physics would be completely unintelligible without QM. In that sense, I am undoubtedly as much of a quantum fundamentalist as anyone.

Strangely, although physicists have operated for decades under the assumption that the universe is largely or wholly quantum on every level, the terminology of "quantum fundamentalism" has only been coined quite recently, and used mainly in the quantum foundations field, which specializes in the deep philosophical problems of the quantum world. This is why you probably have not come across the term before, even if you work in physics and are perhaps beginning to realize, "Hold on, I think I might be a quantum fundamentalist." It is a powerful term for capturing a worldview, which is where theology enters. But first, I promised you a watertight definition. Here it is, from philosopher of science, Henrik Zinkernagel (2016, 2; cf. Faye 2019; Zinkernagel 2011, 235): "Quantum Fundamentalism. Everything in the universe (if not the universe as a whole) is fundamentally of a quantum nature and ultimately describable in quantum-mechanical terms."

Everything in the universe is quantum in its very being, and ultimately (that is, in principle), everything can be described scientifically in such terms, explains Zinkernagel. Such is quantum fundamentalism: the quantum is here to stay. But notice that this definition is not entirely watertight. We need to examine the word "fundamentally," since it is doing much of the work.

Let us turn to philosophy of physics. There is a healthy dispute here about fundamentality (Aguirre, Foster, and Merali 2019; Morganti 2020; Tahko 2023). One rather old-fashioned view, which is still widespread in physics today but which has become unfashionable in philosophy, takes the physical world to be effectively stratified into many different levels, as described by the many different sciences.[5] The most fundamental level, on this view, is the level that describes the tiniest possible things: the subatomic quantum particles like the various quarks and the Higgs boson. This level is the basement on which the rest of nature is built, since those particles and quantum fields make up the matter of which every entity in the universe is composed; their behavior underpins every other level, we assume. This is a common form of quantum fundamentalism, but it is better known by the name of reductionism. Here, for instance, is how particle physicist Sabine Hossenfelder (2022, 85–87) defines "fundamental": "A fundamental property or object cannot be derived from or reduced to anything else . . . [T]he only fundamental theories we currently know of—the currently deepest level—are the **standard model of particle physics** and Einstein's general relativity, which describes gravitation."

The rest of physics, she goes on to say—together with chemistry, biology, psychology, sociology, and so on all the way up the hierarchy—all emerges from those fundamental laws of particle physics and gravitation (Hossenfelder 2022, 87). This is a full-blooded account of reductionism, which Hossenfelder is happy to own, since she regards reductionism as a well-established fact of nature (Hossenfelder 2019, 85; 2022, 82).

But not all physicists are so committed to reductionism, especially those of us who work on emergent phenomena at a much higher level than that of subatomic particles, such as in my own area of condensed matter physics. I—and many other condensed matter physicists—take a more horizontal (or at least less stratified) view of the sciences, and we find that the quantum framework is just as effective. Hence, I say that quantum fundamentalism is not the same as reductionism. We need not maintain that all of science boils down to the behavior of subatomic particles just to believe in the reality and ubiquity of quantum phenomena.

Likewise, many philosophers of science today have their doubts about reductionism (e.g., Adlam 2019, 9). Alyssa Ney, for one, has proposed a helpful alternative (Ney 2019). She explains fundamentality by looking at the ability of some scientific theories to reach far across the sciences, to influence and underpin many other theories. The "fundamental" term therefore refers to what she calls the "explanatory maximality" of a theory. Accordingly, a theory is fundamental if it is "a common source of (causal and constitutive) explanations that possess the greatest [that is, the maximal] degree of scope, accuracy, and precision of all theories that have so far been formulated" (Ney 2019, 33). In other words, a fundamental theory simply reaches much further than others, she thinks, into more areas of science. Such a theory also works to unify other scientific theories by lending them its own concepts. Such a theory may not yet be complete, nor perfect, but if it is maximally far-reaching "in ordinary scientific contexts" then it is fundamental on this view (Ney 2019, 34).

Now, Ney does not articulate the following conclusion herself, but I suggest that the quantum framework qualifies strongly as a fundamental body of theory according to the logic of her argument,[6] since its concepts and explanations are ubiquitous across the sciences. No other theoretical framework is as far-reaching, nor as adaptable, I say. And no other theoretical framework is as able to unite the patchwork landscape of sciences quite so effectively either. Remember Dr. Idreos's vision of the unity of peoples. Quantum fundamentalism may not unify nations (or not yet), but it provides a starting point for a unified concept of nature, a goal that, incidentally, has been a long-standing ambition of the science and religion field (Harris 2024).

Quantum fundamentalism has a lot going for it then, and I want to commend it to you if you are not yet a convinced quantum fundamentalist. But there are some very serious downsides. Here is cosmologist Lee Smolin (2019, 3) on the matter: "Quantum mechanics has been the core of our understanding of nature for nine decades. It is ubiquitous, but it is also deeply mysterious. Little of modern science would make sense without it. But experts have a hard time agreeing what it asserts about nature."

Quantum fundamentalism can claim an impressive degree of empirical evidence in its favor then, but it struggles to provide a clear guide to reality. The basic problem is that the standard mathematical formalism of QM does not tell us clearly "this is what reality is" but rather what we should expect when we perform measurements (Ball 2019, 11). For, and in spite of the grand claims often made at the popular level, QM itself is frustratingly silent on the nature of reality when we are not looking, as it were. If we want to know how things really are in themselves, we must apply a metaphysical interpretation to the physics, but there are many such interpretations in circulation, and they tell of wildly different—if not incompatible—accounts of the natural world (Lewis 2016, 179–82; Barrett 2019, 231). Presumably one of them is right, but we do not know which, nor how to tell. Each has its supporters. You will no doubt have heard of the Copenhagen interpretation, which avoids making definitive pronouncements about what the quantum world is like when we are not looking, or the many-worlds interpretation, which says that there are many branches of reality coexisting (many worlds, effectively): the cat is alive in one branch, dead in another. But there are still other interpretations. All of them are challenging (if not outlandish) at a human level. They raise difficult questions about what we take for granted in our everyday experience, such as the distinction between cause and effect, or between subject and object.

These are serious problems for quantum fundamentalism and should not be underestimated. The science of QM has bound us to a set of more or less absurd scenarios and abandoned us there. The science has given us freedom to choose between the interpretations but no liberty to make an informed decision. To put it bluntly, quantum fundamentalism may claim massive scientific support, but if it cannot help us to make human sense of the science, then what earthly good is it as a worldview?

The humanities subjects can help. What might quantum fundamentalism mean for human being and human becoming when it is seen through a humane perspective, illuminated by subjects such as the creative arts, or literature, or even theology and ethics? This is the wider aim of our project here in Oxford: what we are beginning to call the "quantum humanities." Among those perspectives, I suggest that theology is particularly farsighted, which is why I want now to speak of theological liberty.

Theological Liberty

There is one obvious way theology can help quantum fundamentalism. If there are many competing quantum interpretations of reality that are empirically equivalent, then the only way to adjudicate between them is to bring our human suspicions and convictions about what lies beyond the measurable world to bear. Theology therefore represents a privileged vantage point, a liberty inaccessible to science of itself.

But theology can shed yet more light. Notice that when I was trying to describe quantum fundamentalism earlier, I was forced into using words like "aspire," "hope," "suspicion," "hunch," "conviction," words more appropriate to the maintenance of a worldview than a firmly empirical fact of the matter. Quantum fundamentalism—for all its scientific support—is in the same conceptual space as theology when it draws conclusions about the way the world really is. Few physicists commit to one or other of the quantum interpretations in practice—partly because we have the same misgivings as everyone else – while we believe firmly in the reality of a quantum world (Harris 2023, 192). In other words, we adopt a kind of vague but aspirational quantum realism that draws us into the same conceptual space, I suggest, as theology.

In case you do not believe me, let me point out that the religious uptake of QM has been remarkable. Quantum fundamentalism has been a gift to religious and spiritual commentators as well as lifestyle gurus. Like the physicists, such people adopt a vague but aspirational quantum realism, but they are in the conceptual space of theology to begin with. Christian theologians, for instance, have found that QM is a fantastically rich source of metaphor for models of God's activity in the world and of God's relationship with the natural order, for the mysteries of Christ as fully human and fully divine, and even for that deep enigma of Christian thought: the nature of God's Trinitarian being.[7] Characteristic features of QM—wave/particle duality, indeterminacy, and entanglement—crop up repeatedly. Not only do these features offer stunning analogies for theological mysteries but they allow the contemporary theologian to retrieve traditional categories of God's presence and providence in the world, categories the rigidly mechanical pictures of classical physics seemed to have precluded for good before the quantum came along.

Not only Christian theologians but many other religious thinkers have borrowed enthusiastically from QM to support ancient spiritual worldviews, especially from Hinduism, Buddhism, and Daoism. Fritjof Capra's *Tao of Physics* led the way in what has become a fertile cultural trend (Capra 1976), a synthesized "quantum mysticism" that downplays the material world in favor of mind, consciousness, and the deep unity of all things. Quantum mysticism has been popular in New Age spirituality, for instance, and has percolated far and wide into health and lifestyle consultancy, coaching, and alternative medicine.[8]

Let me illustrate with two quantum lifestyle books, which are not ostensibly about religion, although they both take thoroughly mystical angles on QM. First, Deepak Chopra's book, *Quantum Healing* (Chopra 2015). This has been a remarkably successful book, still in print 35 years after it was first published in 1989. It is important to know that Chopra is a medical doctor who specializes in oncology. In the book, he describes how many of his patients experience miraculous remissions of their cancer symptoms by practicing the spiritual techniques he prescribes, inspired by his interest in Hinduism. His point is that the human mind influences the development of our body, even our genes; QM confirms this for us, Chopra argues. The physics teaches us about an invisible quantum domain—the most fundamental dimension of reality—from which mind and body emerge and unite (Chopra 2015, xii). Every cell in our body is conscious, since on the quantum level we are fully embedded in one mind, a cosmic intelligence that creates, governs, and controls reality (Chopra 2015, xviii). Chopra describes how, when his patients learn this truth, they make a quantum leap to a new level of consciousness, and their symptoms improve (Chopra 2015, 9).

A much more recent book, Larry Farwell's *The Science of Creating Miracles* (Farwell 2021), makes similar moves, but it does not focus on healing or cancer so much as your entire life.[9] If you are unhappy in your career or relationship, QM can help you, Farwell promises. He believes that consciousness is fundamental because QM is fundamental, and that through our own consciousness, we can each alter the outcome of quantum events in the universe (since such events are observer dependent, he argues). This means, Farwell believes, that each of us can control our future, and ensure the best outcome, even if such an outcome is extremely unlikely or apparently impossible (a miracle). As he explains: "Since the entire physical universe consists of quantum mechanical particle/wave phenomena, this means that we can consciously influence the physical universe to move in accord with our desires and intentions" (Farwell 2021, 127).

There is less explicit religion in Farwell's book than Chopra's—Farwell repeatedly emphasizes his scientific background and successes—but like Chopra he is influenced by varieties of Hindu and Buddhist idealism, where consciousness is primary and the physical is secondary.

These are just two examples of well-known authors in the genre. A few seconds' googling will reveal many more resources. But the backlash from professional scientists has been uncompromising. "Pseudoscience" is one of the more polite accusations leveled at quantum mysticism (Hassani 2016). Here are some more: "quantum flapdoodle" (Barr 2016, 91), "quantum hype" (Polkinghorne 2007, ix), "quantum woo" (Moriarty 2023), and, perhaps the most widespread insult, "quantum quackery" (Shermer 2005). The charge being made here is that the proposals of mystical thinkers like Chopra and Farwell are scientifically illiterate at best—showing no great understanding of the quantum science—and potentially harmful at worst, undermining mainstream medicine by peddling untested fixes to vulnerable people. These criticisms are important, I feel. Like many other scientists, I object strongly to the misrepresentation of science.

But I am not sure that these self-help manuals can be dismissed too easily, at least not their religious and spiritual aspirations. Like I said earlier, quantum fundamentalism moves in the same conceptual space as theology. The ordinary non-physicist realizes this. She may well find the technicalities of QM impenetrable (including the conceptual questions about its interpretation), but she knows full well that quantum physics is deeply strange and mysterious when we try to apprehend it on a human level. She can hardly be blamed when she concludes that the science confirms ancient religious wisdom about the mystery at the heart of reality—that consciousness and mind are not secondary byproducts of the physical —especially when some of the great figures of twentieth-century quantum physics, like Niels Bohr, Werner Heisenberg, and Erwin Schrödinger, made similar mystical connections in their popular-level writing. Quite simply, quantum fundamentalism exerts a powerful pull on the modern religious imagination. Another way of saying this is that ordinary human beings (by which I mean the vast majority who are not physicists or philosophers) need the mediation of religious and spiritual interpretations in order to apprehend quantum fundamentalism.

Let me put that in terms of two thesis statements: the central argument of my article, if you like. First, ordinary human beings frequently grasp for religious or spiritual or mystical mediation when they want to make sense of quantum fundamentalism. Second, quantum fundamentalism needs responsible (that is, in tandem with full and informed respect for the science) religious and spiritual enrichment in order to liberate human beings.

But do not take my word for it. Here is Erwin Schrödinger (2014, 95–97):

> [T]he scientific picture of the real world around me is very deficient. It gives a lot of factual information, puts all our experience in a magnificently consistent order, but it is ghastly silent about all and sundry that is really near to our heart, that really matters to us. It cannot tell us a word about red and blue, bitter and sweet, physical pain and physical delight; it knows nothing of beautiful and ugly, good or bad, God and eternity. Science sometimes pretends to answer questions in these domains, but the answers are very often so silly that we are not inclined to take them seriously . . . And the reason for this disconcerting situation is just this, that, for the purpose of constructing the picture of the external world, we have used the greatly simplifying device of cutting our own personality out, removing it; hence it is gone, it has evaporated, it is ostensibly not needed . . . [T]his is the reason why the scientific world-view contains of itself no ethical values, no aesthetical values, not a word about our own ultimate scope or destination, and no God, if you please. When came I, wither go I? . . . Science is, very usually, branded as being atheistic. After what we have said, this is not astonishing. If its world-picture does not even contain blue, yellow, bitter, sweet—beauty, delight and sorrow,—if personality is cut out of it by agreement, how should it contain the most sublime idea that presents itself to human mind?

Taking Schrödinger's lament on the scientific method to heart, I suggest that quantum fundamentalism needs to be liberated theologically. Human beings need a supplementary method to that of science in order to apprehend science in humane terms, a method that can recognize blue, yellow, bitter, sweet—not to mention the "most sublime idea that presents itself to the human mind." We need a method that celebrates our joys and sorrows, one that liberates the subject to contemplate the object with wonder. Theology is clearly in view here, but that should come as no surprise if you agree with me that quantum fundamentalism took us into that conceptual space to begin with.[10]

Therefore, to determine what quantum fundamentalism means for human beings—for both scientists and non-scientists—I suggest that we need to supplement the scientific method with a further methodology that is equipped to take religious, ethical, and aesthetic convictions about reality seriously, all the while treating the science respectfully and responsibly. Any claim about what is most fundamental to our existence will automatically have religious and ethical implications, since questions concerning human flourishing—by which I mean the growing into mature realization of our deepest-held values and purposes—come into focus, questions that cannot be answered empirically even if they first arise from empirical quantum physics. Is there a methodology that can handle all these weighty demands? Happily, there is just such a methodology at hand. It is called science and religion.[11]

As I draw to a close then, let me flag up where I want to go from here using the theological and philosophical tools of the science and religion enterprise. I should point out that this article is a scene-setter for a much bigger collaborative enterprise taking place in Oxford and beyond. There are many avenues that our research group plans to take to investigate the human and theological dimensions of quantum fundamentalism. We have already begun to look at some of the quantum conceptual interpretations in ethical, theological, and existential terms, but we also want to bring a fresh pair of eyes to other implicitly theological issues in modern science, such as the status of quantum physics as laws of nature. For instance, there is a venerable tradition going back at least as far as Newton that says the laws of nature are expressions of God's will as creator of all. The basic question is this: What on earth was God thinking when God invented QM and put it at the heart of creation? That is a serious theological question, and one that has barely been addressed yet, but I hope we can provide some serious constructive answers. In the fullness of time, we are ambitious to persuade other humanities perspectives to be involved—art, film, literature, for instance—to help us investigate what quantum fundamentalism means for human flourishing. But that is some way off.

My final word is simply to express a personal aspiration: I hope that I have done enough here to convince you that there is a viable research program in view, and that this may have useful things to say to working scientists who might just possibly also be human beings.

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Notes

1 This is not to say that there has been no attempt to examine the religious convictions of working scientists; the work of social scientists such as Elaine Ecklund, Renny Thomas, and coworkers stands out for pointing to the great richness and variety of religious attitudes among working scientists around the globe.

2 I have already begun to examine theological interest in quantum fundamentalism—especially the divine action debate—in an earlier publication (Harris 2023).

3 I will use various terms to refer to the amalgam of quantum ideas that inform quantum fundamentalism, such as quantum science, quantum physics, quantum theory, and the quantum framework. At their heart is the mathematical formalism of the 1920s and 1930s known as quantum mechanics, upon which all later theoretical developments—including quantum electrodynamics and quantum field theory – are based. I will therefore also speak of QM as a set of core ideas that holds a wider body of quantum theory and key experimental results together.

4 Steane (2018, 30–36) considers the relationship between thermodynamics and quantum theory in detail, especially the question of which is more fundamental. He declines to opt for one or the other, insisting that both play a valid and important role in our understanding of the physical world. Incidentally, I have personally taken much inspiration from Steane's book; his subtitle of "A Humane Philosophy of Science and Religion" is a perfect headline for what I am hoping to achieve in my own small way in this article.

5 This is the view developed in Paul Oppenheim and Hilary Putnam's famous paper on the unity of science (Oppenheim and Putnam 1958; cf Ney 2019, 29).

6 Ney does not make this point presumably because she has in mind the goal of a "unified theory" (Ney 2019, 34) rather than the loose agglomeration of theories, mathematical tools, and methodologies that make up the quantum framework.

7 Of a very rich and diverse theological literature, I merely cite some representative examples: Kaiser (1976), O'Murchu (2004), Russell et al. (2001), Saunders (2002), Simmons (2014), Wegter-McNelly (2011), and Wildman (2004).

8 The history behind this amazingly successful cultural development is told to great effect by David Kaiser (2011).

9 Note that this book is enthusiastically endorsed by Chopra himself.

10 Another way of developing this point is to say that realist interpretations of QM tend to be deeply challenging on a human level, since they propose ontologies that conflict strongly with the everyday world of human experience. It is no coincidence that these are the very same interpretations that are most guilty of "cutting our own personality out" (as Schrödinger put it in the quotation), i.e., of removing the subjective observer from consideration. Antirealist/idealist interpretations, on the other hand, are much easier to grasp on a human level, especially if one is already predisposed to uphold the primacy of mind and consciousness, as in many Hindu, Daoist, and Buddhist religious traditions (but also in some Abrahamic traditions). These antireal/idealist approaches emphasize (rely upon) the presence of the subjective observer, and so are much more readily apprehended at the human level than the realist interpretations.

[11] I realise that what I have said in this sentence may come across as a pat and evasive answer, but my point is serious. The development of such a supplementary methodology to the scientific method has been a central research program of the science and religion field for decades. Notwithstanding the fact that this research program has not reached a satisfactory conclusion yet, it indicates the key relevance of the science and religion field to the humane dimensions of science. Those of us who work in the field are highly motivated to uncover and analyze the deep undercurrents of science and its discoveries, and we do so using philosophical, theological, historical, and sociological tools. In short, we realize that science cannot be understood without its humane significance. To repeat what I said much earlier in this article: Why does science work? Science, of itself, is unable to answer that question, but needs to call upon humanities disciplines for help, preeminently philosophy and theology, and increasingly (I suggest) other humanities disciplines too. This is the motivation behind the "quantum humanities" research project based in and around Oxford.

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