Epistemology in Uncertainty: Distinguishing Science and Faith in the Quantum Age

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Lim: Epistemology in Uncertainty: Distinguishing Science and Faith in
EPISTEMOLOGY IN UNCERTAINTY: DISTINGUISHING
SCIENCE AND FAITH IN THE QUANTUM AGE

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To answer Hamlet’s famous question – to be or not to be – in the positive, requires for many a leap of faith. That leap represents the notion that there is something or someone worth living for, despite even the worst human suffering that makes the idea that human life possesses an inviolable dignity unbelievable.¹ For many, that something is God: an omnipotent and omniscient higher power that accords human beings with that inviolable dignity.

Many, of course, question taking this particular jump. These skeptics believe not only that God does not exist, but also that the reasons for humans to live can easily be found in the non-divine realm, whether in the scientific, psychological, historical, or philosophical. These reasons, many believe, can be found even in the face of the worst possible human suffering.

However, any such justifications must require taking some kind of jump. None of them can escape the cold, hard truth about the current – and, notwithstanding so far unimaginable advances in our epistemology, eternal – limits of human knowledge. For example, the simple fact is that humans cannot directly observe and experience the past or future. As such, the deceptively profound fact is that, even if we have experienced the same thing for many years, we can never say with absolute certainty that the same thing will hold as true for tomorrow. In this sense, even the most empirical and scientific observations require some jump, even if ultimately justified, to draw many of the conclusions we universally take for granted.

The complex question undergirding this Article thus arises: what exactly does it mean for human beings to take these epistemological leaps? Of course, this is a vast question, one that has been explored, time and again, by others. Rather than tackling every aspect of this question, this Article has far less ambitious, yet somewhat novel goals: to explore how these leaps are taken in modern science, which has challenged traditional paradigms of scientific empiricism, and to see what implications this field has for ascertaining the demarcation between science and faith – particularly in the eyes of the law.

To compare the epistemological methods in science and faith is, of course, not a new endeavor. Indeed, before discussing how modern science should impact debates over demarcation, this Article will explore some of the primary vehicles through which the comparison between science and religion has traditionally been made: among them, debates over whether creationism and intelligent design qualify as bona fide sciences. But, rather than attempting to add anything to these specific debates, this Article instead purports to explore the less well-tread subject of how scientific acceptance of irresolutely non-religious, modern concepts, such as string theory and multiverse theory, impacts the so-called line of demarcation between science and (normally, faith-driven) pseudoscience. These are concepts for which experimental confirmation not only remains presently elusive, but also are forever outside the capability of human observation, regardless of technology.

Narrowing its focus to this subject, this Article recognizes novel observations about making principled distinctions between science and faith. Contrary to advocating for religion as something in which human belief is somehow merited, this Article concludes that fundamental differences certainly remain between science and religion as traditionally conceived – differences for which the law must account. At the same time, in light of advances that arguably redefine science, this Article concludes that demarcation between science and faith should proceed in a different way – particularly when the law is called on to engage in such demarcation.

In particular, the growing elision between the two recommends against a legal approach that attempts to determine wholesale whether an entire theory qualifies as “scientific.” Instead, it recommends an approach that attempts to ascertain a religious purpose, which can involve a more nuanced analysis of an alleged theory’s many constituent parts, in order to smoke out religious purpose. Such an approach, this Article concludes, is consistent with the purpose of the Establishment Clause, the central question of which remains whether something is religious, as opposed to scientific. But, perhaps even more importantly, it is also consistent with the desirability of leaving room for legitimate debates about all theories, secular or otherwise – including, hypothetically, theories that demonstrate more good-faith, global commitment to scientific principles than theories like creation science, but which still challenge the traditional paradigms of science.
Part I of this Article explores the basic distinction between science and faith through the lens of the debate and litigation surrounding creation science. Part II introduces a variety of modern scientific theories, including quantum mechanics and string theory, and discusses how these fields have more recently questioned our traditional perception of what counts as science. It speaks in depth about these debates within the scientific community itself, apart from any consideration of theories motivated by religion. Finally, Part III discusses how these ideas challenge how courts go about determining what is science and what is pseudoscience that, typically with a faith component, violates the Establishment Clause of the U.S. Constitution. The Article concludes with a note about how society should proceed in such oft-divisive, but fundamentally important, inquiries.

I. SCIENCE VERSUS FAITH TRADITIONALLY

To understand how a comparison and contrast of quantum mechanics and related fields can illuminate how human beings take leaps of faith, it is helpful first to assume a bird’s eye view of what distinguishes science and mathematics from other fields, including religion. As this Part of the Article will discuss, what ultimately distinguishes these is how precisely they treat empiricism.

Perhaps nothing is more useful for exploring the differences between science and faith than considering whether something traditionally associated with faith – creationism, or so-called creation science – should actually be considered scientific. This question has generated a great deal of controversy. But perhaps most illuminating here is the controversy within the group that rejects creationism as science – a controversy over why creationism should be rejected as legitimate science. This controversy provides us insight into why empiricism matters in science – and why empiricism, too, has some limits.

In American legal history, this controversy visibly manifested itself in the wake of the case *McLean v. Arkansas*, where the teaching of creation science faced a claim in court that it violated the Establishment Clause of the U.S. Constitution. The case arose after Arkansas passed

3. *Id.* at 1256-57.
a law mandating "balanced" treatment of creation science and evolution science in schools. The U.S. District Court for the Eastern District of Arkansas ruled that the law did violate the Establishment Clause because creation science is not, in fact, a science. In doing so, Judge William Overton famously laid out why: because creation science is untestable; non-tentative – that is, dogmatic, or purporting to be the final word; and unfalsifiable.

Though the McLean decision kept creationism out of classrooms, Judge Overton’s analysis has been criticized by some who ultimately agreed with the final result. The most prominent critic has been philosopher of science Larry Laudan, who says that “to make the interlinked claims that Creationism is neither falsifiable nor testable is to assert that Creationism makes no empirical assertions whatever. That is surely false. Creationists make a wide range of testable assertions about empirical matters of fact.” Laudan highlights, for example, their position that Earth is only thousands of years old; that most of its surface has geological features that are products of the flood in Noah’s time (i.e., diluvial); and that there is a limited variety of species – all positions that flow naturally from a literal interpretation of the Old Testament. Creationists, Laudan points out, also make many factual historical claims flowing from the events described in the Old Testament. "Indeed, if any doctrine in the history of science has ever been falsified, it is the set of claims associated with creation-science," Laudan concludes.

4. Id.; see also Balanced Treatment for Creation-Science and Evolution-Science Act, ARK. CODE ANN. § 80-1663 (Supp. 1981) (“Public schools within this State shall give balanced treatment to creation-science and to evolution-science.”).

5. McLean, 529 F. Supp. at 1267 (“[The law] lacks legitimate educational value because 'creation science' as defined in that section is simply not science.”); see also id. at 1272.

6. Id. at 1267-68. Judge Overton also charged that creationism is not guided by, or explanatory by reference to, natural law, because it “depends upon a supernatural intervention.” Id.


8. Id.

9. Id.

10. Id. at 17.
Laudan does concede that there are many key suppositions of creation science that are beyond being testable in isolation— for example, the divinity of a human being. However, Laudan points out that many claims in science are not testable directly, in isolation. Put differently by theoretical physicist Brian Greene:

Objects that have always been beyond our cosmic horizon are objects that we have never observed and never will observe; conversely, they have never observed us, and never will. Yet, I think we can agree that such objects are as real as anything tangible, and so is the realism they inhabit. These examples make clear that science is no stranger to theories that include elements, from basic ingredients to derived consequences, that are inaccessible.

Laudan also criticizes Judge Overton’s argument that the non-tentative nature of creation science should disqualify it from science. Apart from the fact that creationists have changed at least some of their ideas over time, if not necessarily their core ideas, Laudan notes that in every era in the history of science, some beliefs universally accepted as scientific have been, in practice, not open to rejection. “Would Newton, for instance, have been tentative about the claim that there were forces in the world? Are quantum mechanicians willing to contemplate giving up the uncertainty relation?” Laudan asks.

Laudan concludes that it is unhelpful to deem wholesale that creation science is not a science. Rather, the individual claims made by Creationism should be criticized one by one.

As this controversy clearly shows, what is commonly viewed as a distinguishing factor between science and faith is how each treats the concept of empiricism. On the one hand, there is clearly not full agreement as to exactly how the empiricism of science can be said to

11. Id.
12. Id.
14. Laudan, supra note 7, at 17.
15. Id.
16. Id. at 18 (“Rather than taking on the creationists obliquely and in wholesale fashion by suggesting that what they are doing is ‘unscientific’ tout court . . . we should confront their claims directly and in piecemeal fashion by asking what evidence and arguments can be marshal[1]ed for and against each of them.”).
differ from the empiricism (or apparent lack thereof) in faith. On the other hand, the terms of the debate emphasize that empiricism, one way or the other, is what distinguishes what is commonly accepted as science from what is commonly conceived as faith.

For example, Laudan rightfully states that, even in science, many claims are not testable in and of themselves. However, attempting to prove or disprove that God exists, at least intuitively, seems different from attempting to prove or disprove theories that are commonly accepted as scientific even if they cannot be proven directly. For example, even to the extent that many of Christianity’s historical and scientific claims are true, to infer that Jesus was, in fact, divine seems of a different nature than to infer that, for example, subatomic particles exist even though we cannot see them. As Greene states, while a scientific theory need not have all its features be verified, it must still have a robust assortment of confirmed predictions to be accepted, which naturally requires a robust assortment of the theory’s features to be verifiable in the first place. In the case of proving the existence of subatomic particles, this threshold is surely met. Mathematical equations map out how an entire system of phenomena are linked to each other, and though some of these phenomena are not, and perhaps never can be, observable, many parts are observable, allowing for confidence in the theory as a whole.

By contrast, while Christians can argue that a number of falsifiable historical and scientific claims support their contention that Jesus not only existed, but was divine – and can hypothetically situate those

17. GREENE, supra note 13, at 169.
18. As Greene further states, “If the experimental and observational evidence supporting a theory compels you to embrace it, and if the theory is founded on such a tight mathematical structure that there’s no room for cherry-picking among its features, then you have to embrace all of it.” Id. at 170.
19. Some historical evidence for the existence of Jesus as a human being certainly exists. Historical evidence also exists showing that many people believed that Jesus was a divine figure. See generally LARRY W. HURTADO, LORD JESUS CHRIST: DEVOTION TO JESUS IN EARLIEST CHRISTIANITY (2003). Of course, historical evidence also exists to show that many people did not believe that Jesus was a divine figure – the Bible itself captures the doubt that existed during and after the period of Jesus’s life. See, e.g., Luke 22:70 (describing doubts expressed by Jesus’s contemporaries, shortly before his crucifixion, as to his status as the son of God). The totality of this evidence alone may be enough for some in the present also to believe that Jesus is a divine figure, the Son of God. To do so, however, is undoubtedly a leap
claims within a larger, purportedly comprehensive and internally consistent theory – they are undoubtedly much further from this threshold. In the absence of mathematics and the precision it provides to explain an entire system – a precision that allows for our confidence when only parts of that system are directly verifiable – the quantity and quality of falsifiable claims of Christianity cannot accomplish as much. In the end, Christianity (as with most, if not all faiths) amounts to an attempt to explain the universe and all of its constituent parts – past, present, and future, observable and unobservable – like a grand “theory of everything,” a theory that has eluded scientific history despite all its advances.

At the same time, it is also clear from the controversy over creation science, particularly the controversy within the camp that rejects it as science, that the power of empiricism can only go so far. Even with the presence of empirical evidence, there remains at least a small jump to believe that something is something like a transcendental truth, even if it does align with our own experiences. One of the greatest examples in the history of science is one that Laudan uses: Newton, who could mathematically show that a force called gravity existed by which particles in the universe were attracted to each other, but remained silent as to how exactly gravity exerted its influence. It was only hundreds of years later that Albert Einstein could even theoretically posit that it was spacetime itself through which gravity worked – particularly, that the presence of massive bodies in space affected the shape of space, guiding other objects towards it. As much theory and empirical evidence existed then to support Newton’s theory of gravity, to believe in that theory during his time still required a not insubstantial jump.

Indeed, some have even questioned whether the arguably grandest ambition of science – to find immutable and final principles that explain the behavior of the particles of the universe – is not, itself, something of faith, as the existence of Jesus as traditionally thought of by Christians belies so many scientific principles otherwise thought to be set in stone – a human person being raised from the dead, for example. As lawyer and author Dean Overman has stated, “If one believes in God’s existence, it is done by faith.” DEAN L. OVERMAN, A CASE FOR THE DIVINITY OF JESUS 145 (2009).

20. Laudan, supra note 7, at 18.
22. Id. at 13-14 (describing how Einstein’s theory explains the curvature of space and time as a result of the presence of matter and energy).
outside the realms of science. As prominent theoretical physicist Lee Smolin has stated, such a fundamental theory “must in some sense exist prior to the universe, so that the things in the world may obey it from literally the first instant of the creation of the world.”23 This can be compared to the Big Bang Theory, which physicists make clear describes what happened immediately after the creation of our universe as we know it now – not the conditions of the universe at the hypothetical time zero.24 As such, “belief in a final theory shares with a belief in a god the idea that the ultimate cause of things in this world is something that does not live in the world but has an existence that, somehow, transcends it.”25 Smolin continues:

This is why the belief in god and belief in the existence in a final theory are both related to the metaphysical idea that what is really true about the world is true about a timeless transcendent realm and not about the world of the things we see around us.26

Smolin concludes that he “do[es] not see, really, how science, however much it progresses, could lead us to an understanding of these questions. In the end, perhaps there must remain a place for mysticism.”27 This calls to mind the philosophy of existentialist Jean-Paul Sartre, who argued that if “we tried to ask ourselves what ‘was there’ before a world existed, and if we replied ‘nothing,’ we would be forced to recognize that this ‘before’ like this ‘nothing’ is in effect retroactive.”28 Put differently in one of his most famous quotes,

23. Lee Smolin, The Life of the Cosmos 198 (1997) (“A universe made according to a fundamental theory is then very like a universe made by a god, in that it is made according to a rationality that exists prior to and independently of the actual universe.”).
24. Brian Greene, The Fabric of the Cosmos: Space, Time, and the Texture of Reality 272 (2004) (“A common misconception is that the big bang provides a theory of cosmic origins. It doesn’t. The big bang is a theory... that delineates a cosmic evolution from a split second after whatever happened to bring the universe into existence, but it says nothing at all about time zero itself.”).
26. Id.
27. Id. at 198.
"nothingness . . . gets its being from being." Applying this idea to the present analysis, humans are constrained in understanding what might transcend the existence of this universe by the idea that their understanding is necessarily tied to their present existence.

Humans' constrained understanding finds further support in the idea that scientific principles might not be absolute. This idea is present in a centuries-long debate: whether mathematics – to use the famous example by Kant, the proposition that \(5 + 7 = 12\) – is analytic or synthetic. Many would object to describing mathematics as anything but a self-evident and universal idea, yet this itself is unsettled for the same reasons that Smolin has identified. The same doubt is present with respect to the laws of physics. As Greene has stated, "The laws of physics didn't have to operate this way. . . . [W]e can imagine a universe in which the laws of physics with which we are familiar tell us nothing about the laws of physics on . . . the other side of the universe."

The possibility that physical laws could be variable will be explored in greater depth later in this Article, in its discussion of multiverses, a theory that allows for the idea precisely that there are variable laws throughout spacetime. For the purposes of discussion, it is sufficient to note that whether variable laws in the universe exist or not, the presence of empiricism, even in science, does not abrogate uncertainty.

Building on the idea that empiricism cannot eliminate meaningful uncertainty, this Article will further explore how aspects of modern science illuminate the epistemological leaps that must be taken in science versus religious faith. It explores how uncertainty is part and parcel of much of modern science, and how such uncertainty tests the limits of even scientifically driven empiricism.

29. Id.
30. IMMANUEL KANT, PROLEGOMENA TO ANY FUTURE METAPHYSICS 21-22 (Gary Hatfield ed. & trans., Cambridge University Press 2004) (1783); see also GREENE, supra note 13, at 296-97 ("Mathematical knowledge is the literary output of humans conversant in the unusually precise language of mathematics. And as is surely the case with literature produced in one of the world's natural language, mathematical literature is the product of human ingenuity and creativity. That's not to say that other intelligent life forms wouldn't come upon the same mathematical results we've found; they very well might. But that could easily reflect similarities in our experiences (such as the need to count, the need to trade, the need to survey, and so on) and so would provide minimal evidence that math has a transcendent existence.").
31. GREENE, supra note 24, at 222.
II. QUANTUM AGE: UNCERTAINTY IN SCIENTIFIC EMPIRICISM

Several aspects of modern science – quantum mechanics, string theory, and multiverse theory in particular – stretch the boundaries of adherence to traditional scientific principles of empiricism. This Part explores these fields.

A. Quantum Mechanics and Probability in Spacetime

Quantum mechanics has presented one of the most substantial challenges to the traditional paradigms of science, in highlighting the fundamental physical uncertainty of our observable universe, and thus shedding light on the limits of empirical observation. At its essence, quantum mechanics hypothesizes uncertainty at the core of the universe's building blocks. It posits that each constituent particle of the universe, like an electron, is not merely a point in spacetime, but also has a wave-like property – a probability wave – that is spread throughout the entire universe. This property entails that a particle's location is certain only at the time it is measured. Even with this knowledge, one cannot be certain where the particle could have been before, or will be after the time of measurement; the location can only be described by probabilities, which themselves are subject to interference. As Greene succinctly states, “it is not that the electron (or any particle for that matter) really was located at only one of these possible positions, but we simply don’t know which.” Instead, “there

32. Id. at 90; see also id. at 86-87 (describing the initial experimental origins of the theory, which showed that individual electrons, moving separately and independently from one another, can “build up the interference pattern characteristic of waves”).

33. Id. at 94 (“It’s not that the electron has a position and that we don’t know the position before we do our measurement. Rather, contrary to what you’d expect, the electron simply does not have a definite position before the measurement is taken.”); see also id. at 82 (“[A] particle can hang in a state of limbo between having one or another particular property – like an alien sphere hovering between flashing red and flashing blue before the door to its box is opened – and only when the particle is looked at (measured) does it randomly commit to one definite property or another.”).

34. Id. at 98 (“Uncertainty is built into the wave structure of quantum mechanics and exists whether or not we carry out some clumsy measurement.”).

35. Id. at 178-79.
is a sense in which the electron was at all of the locations, because each of the possibilities – each of the possible histories – contributes to what we now observe."

There are also limitations on what can be learned even at the moment the particle is measured. First, even when the same particle is measured with the exact same setup and initial conditions, its probability wave may nevertheless give rise to different measurements. Second, when a particle is measured, the experiment is necessarily contaminated because the measurement disrupts the speed of the particle. Therefore, it is universally impossible to know, at any given moment, both the position and speed of the particle.

These ideas may seem literally incredible to some. No less of a person than Einstein himself, no ordinary mortal or scientist, was consistently resistant to them. Einstein believed that particles possessed definite values. However, experimentation, time and again, has validated these ideas. To prove that particles have definite values, Einstein and his colleagues attempted to show that particles, separated by distances that even light cannot travel instantaneously, do not affect one another. Yet, experimentation has consistently shown that even these particles are, in fact, somehow interconnected. These results cast

36. Id.
37. Id. at 90 (“If quantum mechanics is right, the number of times we find the electron at a given point should be proportional to the size . . . , at that point, of the probability wave we calculated.”).
38. Id. at 97 (explaining how light required to measure the position of an electron will change the motion of that electron); see also id. at 79 (“We can’t ever know the exact location and exact velocity of even a single particle.”).
39. GREENE, supra note 24, at 121 (“Einstein’s was also a universe in which objects possess definite values of all possible physical attributes.”).
40. Id. at 90, 121.
41. Id. at 101 (explaining how Einstein and his colleagues Boris Podolsky and Nathan Rosen “sought to exploit these relationships to show that each of the particles actually has a definite position and a definite velocity at every given instant of time.”).
42. Id. at 80 (“[T]hese results, coming from both theoretical and experimental considerations, strongly support the conclusion that the universe admits interconnections that are not local. Something that happens over here can be entwined with something that happens over there even if nothing travels from here to there – and even if there isn’t enough time for anything, even light, to travel between the events.”); see also id. at 114 (“Entangled particles, even though spatially separate, do not operate autonomously.”).
serious doubt on the claim that particles have definite values, and supports the claim that a particle can have wave-like properties that pervade the entire universe. Scientists have quite recently conducted experiments confirming that atoms take a particular type of path, whether particle-like or wave-like, only after having been measured, before which the atom cannot be considered to have either such property.

It is important to note: despite the lack of direct observability of things like probability waves, the theory of quantum mechanics is backed not only by rigorous math, but also a great deal of experimental science that has consistently confirmed its predictions. Still, the phenomena described by quantum mechanics — particularly the uncertainty of the particles of nature — give us much to think about, particularly with respect to the nature of empirical observation itself.

One question it raises is whether human consciousness is necessary in essence to bring particles into existence. Some have posited that it

43. Nevertheless, some have argued that waves are a human invention, constituting a statistical theory that serves important scientific purposes in describing our observations about the behavior of particles. See, e.g., VICTOR J. STENDER, GOD AND THE FOLLY OF FAITH: THE INCOMPATIBILITY OF SCIENCE AND RELIGION 155-160 (2012) (arguing that particles, not waves, are what science measures). Victor Stenger argues that it is impossible to determine with complete certainty whether particles or waves (or neither) are the ultimate reality, meaning that scientists should not be making "grand metaphysical claims" about theories the purpose of which are simply to describe our observations. Id. at 163. Metaphysical claims about reality aside, it is nevertheless noteworthy that, within the realm of science that attempts to describe the world, probability plays such an important role. The challenge, as this Article explores later, is determining what level of improbability makes a particular theory scientifically unsound. See infra Parts II-B, III. Quantum mechanics necessarily destabilizes that analysis, even if it is true (albeit ultimately unobservable) that waves are indeed only a human invention.


45. While the probability waves posited by quantum mechanics remain completely and forever unobservable, the theory behind them gives rise not only to predictions, but to predictions that succeed. GREENE, supra note 24, at 207 ("But why, a detractor asks, should fundamental physics be so closely tied to human awareness? If we were not here to observe the world, would wavefunctions never collapse, or, perhaps, would the very concept of a wavefunction not exist?"); see also id. at 456 (opining that, while it is unlikely that science will find the act of conscious observation an integral element of quantum mechanics, there is no way yet of ruling this out).
is necessary – that if a tree falls and nobody hears it, it does not make a sound, and that the moon is not there when people are not looking at it – lending support to a strong version of the so-called Anthropic Principle, which is the idea that the universe must have intelligent life that is able to make observations about it. This is a viewpoint that has long had proponents in philosophy, like George Berkeley, who argued that existence cannot be without consciousness.48

On the one hand, many scientists have rejected these ideas. Perhaps reality itself fundamentally “exists” in probabilities; thus, it is not necessary for any entity in the universe, human or otherwise, to locate particles at a particular point before that particle can exist. This position accords with the position taken by many scientists that aspects of quantum mechanics speak not to what reality is (e.g., what properties particles possess), but to how humans come to know about some aspects of that reality (and not others).49 Furthermore, even accepting that reality can only exist when particles are located at definite points, many scientists have pointed to the fact that humans themselves consist of particles, raising the possibility that human consciousness is not necessary for particles to be located at definite points.50 Such ideas align


48. GEORGE BERKELEY, A TREATISE CONCERNING THE PRINCIPLES OF HUMAN KNOWLEDGE 13 (David R. Wilkins eds., 2002) (1710) (“[T]here is not any other substance than spirit, or that which perceives.”). The relation between the conscious mind and reality is even, according to philosopher Anselm, such that God must exist in actuality, as a God that exists only in human consciousness would not be the greatest thing conceivable – and since an imaginary God cannot be greater than an existing one, God must exist. ST. ANSELM, Proslogium, in PROSLOGIUM; MONOLOGIUM: AN APPENDIX IN BEHALF OF THE FOOL BY GAUNILO; AND CUR DEUS HOMO (Sidney Norton Deane trans., The Open Court Publishing Co., 1926) (1078), http://sourcebooks.fordham.edu/basis/anselm-proslogium.asp.

49. GREENE, supra note 24, at 204-05 (“One approach, with historical roots that go back to Heisenberg, is to abandon the view that wavefunctions are objective features of quantum reality, and, instead, view them merely as an embodiment of what we know about reality.”).

50. Id. at 203 (“Yet, since there is no difference between the atoms, protons, and electrons that make up the experimenter and the equipment he or she uses, and the atoms, protons, and electrons that he or she studies, why in the world is there a split in how quantum mechanics treats them? If quantum mechanics is a universal theory that applies without limitations to everything, the observed and the observer should be treated in exactly the same way.”).
with philosophical perspectives, such as that of Martin Heidegger, who famously argued that people’s subjective experiences are not at all separate from their objective physical experiences. Rather, when a person encounters something in the universe, this experience is a manifestation of that something as one of its possibilities in space.

Regardless of whether quantum mechanics provides support for such a strong version of the Anthropic Principle, there remain other ways that the phenomena described by quantum mechanics show how jumps in science must be, and actually are, taken. At a very general level, the idea that particles consist, at least in part, of probability waves that spread ubiquitously throughout the universe supports the idea that neither space nor time can be fundamentally defined as linear.

But perhaps even more importantly, quantum mechanics establish that particles are in waves rather than points, even though science generally treats observation at the super-quantum level as solely reducible to points. This is in large part because doing so has no practical consequence to humans. In the absence of a theory that can simultaneously capture what happens at both the smallest and largest possible scales of the universe, physics has drawn a general distinction between the quantum scale, the scale at which we typically view things every day, and still larger scales. For example, since we collectively view the moon as existing in the same place, we tend to think that it exists even if no human being is viewing it.

Still, we do not all view an object even so large as the moon as existing in the exact same place. We do view it as existing in generally the same place, but were we to make individual observations at the quantum level, there would certainly be differences in where exactly our minds interpret the moon. At the scale we typically view the moon, those differences are fully inconsequential. But, at the quantum level –

51. Heidegger argues that subject/object and consciousness-world distinctions are secondary, in his famous concept of “Being-in-the-world.” MARTIN HEIDEGGER, BEING AND TIME 78 (John MacQuarrie & Edward Robinson trans., 1962) (1927) (“‘Being-in-the-world’ indicates in the very way we have coined it, that it stands for a unitary phenomenon. This primary datum must be seen as a whole.”).

52. Id.

53. GREENE, supra note 24, at 329 (discussing the incompatibility traditionally of quantum mechanics and general relativity).
removed from the human utility-driven idea of what is important – these differences exist.\textsuperscript{54}

While the idea that two people can see the same moon in slightly different locations seems irrelevant, it calls into question the very nature of an absolute existence, even within our directly observable universe. Similarly, the idea that, in both the past and the future, particles are in a sense located at \textit{all} of their possible locations necessarily applies at scales larger than the quantum.\textsuperscript{55} Therefore, it should be true that, even at scales larger than the quantum, the moon has more than one definite past.

The physical laws of time, accepted as governing the universe at both the smallest and largest scales possible, further support the idea that spacetime at all levels does not fundamentally consist of particles located at absolute points. As a threshold matter it is useful to note that, even though humans intuitively see time as flowing, the past, present, and future all exist on equal terms, as a matter of science.\textsuperscript{56} This makes more sense when one considers that humans never sense things in the present; because of the time, however little, it takes for outside particles to reach our senses, everything we experience has, in fact, already happened.\textsuperscript{57} For the same reason that the present exists irrespective of whether or not it has been illuminated for us,\textsuperscript{58} the past and future are

\textsuperscript{54} See Greene, \textit{supra} note 24, at 97 ("The uncertainty principle is completely general: it applies to everything.").

\textsuperscript{55} See id.

\textsuperscript{56} Id. at 132 ("Every part of the spacetime loaf. . . exists on the same footing as every other, suggesting, as Einstein believed, that reality embraces past, present, and future equally and that the flow we envision bringing one section to light as another goes dark is illusory.").

\textsuperscript{57} Id. at 133 ("A now-list – reality in this way of thinking – is a funny thing. Nothing you see right now belongs on your now-list, because it takes time for light to reach your eyes. Anything you see right now has already happened.").

\textsuperscript{58} This idea is also supported by the concept of special relativity, which describes how two different observers moving in relative motion can have different conceptions of the present:

[S]pecial relativity tells a very different story. . . . Two observers in relative motion have \textit{nows} . . . that are different . . . . Observers moving relative to each other have different conceptions of what exists at a given moment, and hence they have different conceptions of reality." Id. at 133-34. "So, if you buy the notion that reality consists of the things in your freeze-frame mental image right now, and if you agree that your now is no more valid than the
no less real even though they are no longer illuminated for us.59 Put by Greene, "Just as we envision all of space as really being out there, as really existing, we should also envision all of time as really being out there, as really existing."60 Greene continues, "Under close scrutiny, the flowing river of time more closely resembles a giant block of ice with every moment forever frozen into place."61

More to the point, time conceptually makes sense only because there is homogeneity between all the parts of the universe, providing a comparison point by which time can be measured in a meaningful way.62 This homogeneity manifests itself in uniform radiation that originated with the Big Bang, and has continued to spread throughout the universe's hundreds of millions of light years.63 Without such a comparison point, it becomes impossible to say which particular configuration of particles comprising the universe belong to a particular "present" moment in time of that universe. That time otherwise lacks

now of someone located far away in space who can move freely, then reality encompasses all of the events in spacetime. The total loaf exists.

Id. at 138-39.

59. As Greene states:
By definition, moments don't include the passing of time - at least, not the time we're aware of - because moments just are, they are the raw material of time, they don't change. A particular moment can no more change in time than a particular location in space; if a moment were to move, it would be a different location in space; if a moment in time were to change, it would be a different moment in time. The intuitive image of a projector light that brings each new now to life just doesn't hold up to careful examination. Instead, every moment is illuminated, and every moment remains illuminated. Every moment is.

Id. at 140-41.

60. Id. at 139.

61. Id. at 140-41.

62. Id. at 236 ("It is this uniformity, this overall symmetry between one location and another, that allows us to speak sensibly of time when describing the entire universe.").

63. Id. at 228 ("The uniformity of radiation is thus a fossilized testament to the uniformity of both the laws of physics and the details of the environment across the cosmos. . . . If we take the measure of change to be a working definition of elapsed time, the uniformity of conditions throughout space is evidence of the uniformity of change throughout the cosmos, and thus implies the uniformity of elapsed time as well.").
meaning further supports a conception of spacetime where particles are measured in probabilities.

Finally, the fundamental laws of physics make no distinction with respect to direction in time—they apply equally whether moving forwards or backwards. Even the concept of entropy—that particles tend to move towards disorder rather than order—theoretically applies both backwards and forwards in time; the second law of thermodynamics actually states that, at any given moment, a physical system both will have and has had more entropy. The reality is that the Big Bang initiated our universe in a state of exceptionally low entropy, which is how time acquired a meaningful "directional arrow" in our universe. Yet, even this cannot discount the theoretical possibility, however miniscule, that particles might reverse course. This, in turn, supports the assertion that the past and future locations of any given particle are best treated as probabilities.

Despite the foregoing, in hypothesizing about phenomena at a scale larger than quantum, science generally reduces its observations to absolute and definite points. Some scientists go even further by attempting to use quantum mechanical principles directly to make conclusions about larger scales in the universe. But in so doing, they lose sight of the principle that particles may fundamentally exist in probabilities. An example is when scientists use quantum mechanics to argue that the universe is deterministic and, thus, that free will does not exist. Quantum mechanics has its basis in an equation by Erwin Schrodinger, which shows that knowing the shape of a particle's probability wave at any one time allows one to determine the particle's

64. Id. at 13 ("Each direction in time, forward and backward, is treated by the laws without distinction.... Nothing in the equations of fundamental physics shows any sign of treating one direction in time differently from the other, and that is totally at odds with everything we experience.").

65. Id. at 160 ("A common misconception is that if, according to the second law of thermodynamics, entropy increases toward the future, then entropy necessarily decreases toward the past.").

66. Id. at 174 ("The egg splatters rather than unsplatters because it is carrying forward the drive toward higher entropy that was initiated by the extraordinarily low entropy state with which the universe began. Incredible order at the beginning is what started it all off, and we have been living through the gradual unfolding toward higher disorder ever since.").
probability wave for any other time, both past and future. This aspect of quantum mechanics is certainly deterministic. There remains the possibility that the very process of humans observing a particle at a particular location, at any given time, is itself non-deterministic. But this possibility hinges on the earlier question of whether human consciousness is vital to that particle’s existence – a question that many scientists have declined to answer in the affirmative. Based on this, some will conclude that human behavior itself is deterministic.

Nonetheless, this method of arguing determinism over non-determinism, focusing on a linear path of human behavior, misses the larger point: existence itself may be of probabilities, rather than absolutes. The idea that knowing a probability wave at one time means knowing it at all past and future times is as linear as the idea that humans alone make their own choices to act. Quantum mechanics introduces principles the power of which exists precisely in their non-linearity.

To be clear, the principles of quantum mechanics do not suggest we should change any conclusions drawn from observation and experimentation at any scale larger than the quantum. While there is a theoretical probability that a large object could exist elsewhere than we think it does, this probability is so exponentially miniscule it does not affect our daily observations. And parsimony is also a hallmark of science. At the same time, if quantum mechanics is to be believed, reality must consist not of absolute points (even absolute points of which we can have only probable knowledge), but of probability itself. In a fundamental way, then, treating observations as absolute points, even for practical reasons, amounts to taking a step that is not mathematically required. Thus, treating observations as absolute points amounts to taking a justified, but still meaningful, jump.

67. Id. at 200 ("If the probability wave is associated with a particle, such as an electron, you can use it to predict the probability that, at any specified time, an experiment will find the electron at any specified location."); see also id. at 456 (explaining how this theory, barring any yet-discovered aspect of quantum mechanics, forecloses human free will).

68. See supra note 50 and accompanying text.

69. As Greene states, “You do not worry that the atomic constituents of the air you are now breathing will suddenly disband . . . . And you are right not to fret about this outcome, because according to quantum mechanics the probability of its happening, while not zero, is absolutely small.” GREENE, supra note 24, at 92.

70. Observations at this supraquantum level may have an exponentially high likelihood of being accurate. However, this is subject to the idea that particles, at the
Ultimately, these ideas must call into question what human empiricism itself can ever definitively prove about reality in our universe. In this way, the same question that has plagued philosophers about mathematics, that is whether it is analytic or synthetic, arises here, too. The very nature of science means the discipline only cares about what humans are able to observe empirically, directly or indirectly. Along those same lines, some scientists simply do not care about whether quantum mechanics speaks to the nature of reality itself, so long as it makes accurate predictions about what human beings are able to observe. Yet, what the field of quantum mechanics has shown still stands: that any conclusion reached by human observation—including conclusions about the parts of our physical universe that we can directly observe—is necessarily limited, even with the strictest adherence to scientific principles. What is testable, falsifiable, and ultimately predictable is based on the human conscious experience. Calling to mind what the Anthropic Principle in its most modest version states, in the words of physicist Brandon Carter: “We must be prepared to take account of the fact that our location in the universe is necessarily privileged to the extent of being compatible with our existence as observers.” This version does not argue that the universe must have been designed for entities capable of observation, as the strong version does. Instead, it argues that what we can know about the universe is constrained by the very ability of entities to observe.

B. String Theory

It is easy to see how the rise of quantum mechanics in the 20th century could have enlivened debate on the precise degree to which empiricism matters in scientific inquiry. Arguably, however, science

smallest levels (and therefore any higher levels), fundamentally exist in waves. See supra notes 32-36 and accompanying text. It is also subject to the idea, explored later, that observations at the grandest of scales—i.e., observations beyond our present universe—defy such confidence in their accuracy. See infra notes 88-92 and accompanying text (regarding multiverses).

71. GREENE, supra note 13, at 236. Greene goes on to disagree, stating that “physical theories need to be mathematically coherent” and that “[t]here’s a difference between making predictions and understanding them.” Id. at 236-37.

has only recently reached the zenith of this debate – in particular, after the development of ideas that built on quantum mechanics, specifically string theory which conjectures that constituent particles of the universe are not points but one-dimensional strings. This theory was introduced precisely to reconcile quantum mechanics with the traditional theory of gravity – that is, to capture what happens at both the smallest and largest possible scales of the universe all under the same theoretical umbrella.

The challenge with string theory: though introduced for an important theoretical reason, no empirical confirmation for it has yet been found. Philosopher of science Richard Dawid explains in his 2013 book, *String Theory and the Scientific Method*, "The basic idea of string theory is a fairly simple one: the point-like elementary particles of traditional particle theories are replaced by one-dimensional strings." However, the very introduction of these particles "is chosen for entirely theoretical reasons, in order to provide a coherent unification of the particle physics research program with gravity" – the very endeavor that science has not yet achieved. "So far, no immediate empirical signatures of the extendedness of elementary objects have been observed." Instead, “Four decades of intense work on the theory . . . have not resulted in the construction of a complete theory. . . . No real breakthrough has been achieved that would allow specific quantitative calculations of observables from the fundamental principles of string theory.”

Rather than rejecting string theory as unscientific, however, Dawid makes a radical argument, igniting a current predicament in the philosophy of science: it is science itself that needs to adapt, specifically to recognize the validity of what he calls "non-empirical theory confirmation." As he states:

In the new context of particle physics, the exclusive focus of the philosophy of science on empirically confirmed theories does not seem satisfactory any more. Once theories tend to remain empirically unconfirmed for the whole range of a physicist’s active career . . . it

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74. Id. at 11.
75. Id.
76. Id. at 17.
77. Id. at 72.
becomes increasingly important to assess the theory’s status already in its empirically unconfirmed state.\textsuperscript{78}

Such confirmation is based on three main factors:

1) the absence (or existence) of alternative solutions to a particular problem ("string theorists tend to believe that their theory is the only viable option for constructing a unified theory of elementary particle interactions and gravity");\textsuperscript{79}

2) the degree to which the theory is connected to already-confirmed theories ("string theorists view their own endeavor as a natural continuation of the successful particle physics research program.");\textsuperscript{80} and

3) the number of unexpected insights to which the theory gives rise ("[o]nce the basic postulate of string physics has been stated, one observes a long sequence of unexpected deeper explanations of seemingly unconnected facts or theoretical concepts").\textsuperscript{81}

According to Dawid, the greater the degree to which these factors exist, the greater the confidence we might have in a theory – even if the theory has no empirical confirmation (or, because of fundamental constraints to our ability to observe, may never be confirmed empirically).\textsuperscript{82}

What Dawid urges is a move away from empirical falsifiability as the hallmark of science, a concept that the quintessential philosopher of science, Karl Popper, shepherded into general acceptance.\textsuperscript{83} Offering a variety of factors for assessing the scientific validity of theories in the absence of falsifiability, Dawid attempts to move science towards a Bayesian model that defines probability not as “how frequently does

\begin{itemize}
\item \textsuperscript{78} \textit{Id.} at 95.
\item \textsuperscript{79} \textit{Id.} at 31.
\item \textsuperscript{80} \textit{Id.} at 36. Dawid continues: “The fact that the standard model theory was at the end impressively confirmed by experiment conveys a specific message to particle physicists: if you knock on all doors you can think of and precisely one of them opens, the chances are good that you are on the right track.” \textit{Id.}
\item \textsuperscript{81} \textit{Id.} at 33.
\item \textsuperscript{82} \textit{Id.} at 58.
\item \textsuperscript{83} Sean O’Connor, \textit{The Supreme Court’s Philosophy of Science: Will the Real Karl Popper Please Stand Up}, 35 \textit{JURIMETRICS J.} 263, 263 (1995). See generally \textit{KARL POPPER, THE LOGIC OF SCIENTIFIC DISCOVERY} (1959). \end{itemize}
something occur?” but as “what degree of belief should we have in our knowledge?” As Dawid states, “What the classical scientific paradigm unequivocally denies is the possibility that a process of rational analysis on its own can offer an alternative strategy to empirical testing for turning a scientific hypothesis into a well-established and well-trusted theory.” 84 Dawid concludes that, though “[t]he status of a merely non-empirically confirmed theory will always differ from the status of an empirically well-tested one[,] . . . this difference in status should not be seen as a wide rigid chasm, but rather as a gap of variable and reducible width depending on the quality of the web of theoretical arguments.” 85

Dawid’s defense of string theory generated a storm of debate, particularly on the heels of a piece in Nature magazine by physicists George Ellis and Joe Silk, who criticized Dawid’s argument. Ellis and Silk urged scientists and philosophers of science to adopt a different approach to determine what is and is not science. “In our view, the issue boils down to clarifying one question: what potential observational or experimental evidence is there that would persuade you that the theory is wrong and lead you to abandoning it? If there is none, it is not a scientific theory.” 86 But others criticized Ellis and Silk, dubbing them “the falsifiability police.” 87

It is not the aim of this Article to take a position on this debate. Rather, this Article discusses this debate as a means of reasserting its central point: that modern science raises questions about empiricism as the hallmark of science. In turn, then, this debate may also cast doubt on how faith is distinguished from science – including in the eyes of the law. The inevitable question, which this Article reserves for Part III, then is: does “non-empirical theory confirmation” lend the imprimatur of science to faith, blurring the distinction between science and faith?

84. DAWID, supra note 73, at 42.
85. Id. at 154.
C. Multiverses and Human Consciousness

This section will briefly explore other arenas of science, to see how they support the ideas discussed in the previous section. In particular, it will explore two modern theories: multiverse theory and the theory of human consciousness. While each of these subjects is worthy of intensive exploration on its own right, this section has a much narrower ambition: to show how the very nature of these fields underscores the uncertainties not merely in the fundamental nature of existence, but also in the very process of science itself. Thus, these fields, too, call into question the ability of humans to draw conclusions from observation.

The idea of multiverses – that there is a set of potentially infinite universes, not limited to our own – surely underscores uncertainty. This is easy enough to see from what this idea specifically proposes about the nature of existence. One interpretation of multiverses, utilizing quantum mechanics, proposes that the probability wave of particles is actualized into every possible outcome, each in its own universe.\(^88\) Another interpretation proposes that there are only a finite number of particle arrangements, resulting in parallel universes,\(^89\) including universes that have intelligent life like ours.\(^90\) Yet another interpretation proposes that physical processes actually take place on a faraway two-dimensional surface, which in turn projects a three-dimensional hologram that comprises our daily experience of life.\(^91\) And still another

\(^88\) This approach argues that probability waves of particles do not collapse when they are measured at a particular location in the present. Instead, “each and every potential outcome embodied in a wavefunction sees the light of day; the daylight each sees, however, streams through its own separate universe.” GREENE, supra note 24, at 205.

\(^89\) This approach argues that there is a limit to how much matter and energy can fit into a region of space of a given size; otherwise, it will collapse into a black hole. Because of there, there are a finite number of particles, as well as a finite number of locations and speeds, and ultimately a finite number of arrangements of those particles. GREENE, supra note 13, at 32.

\(^90\) Id. at 177 (“[M]ore galaxies means more planetary systems and hence the underlying assumption goes a greater likelihood of life, intelligent life in particular.”).

\(^91\) GREENE, supra note 24, at 482. This string theory-based approach arises from the idea that the maximum entropy of any given region of space is contingent not with the volume of that region, but with its surface area. Id.
interpretation argues that all possible universes exist, supporting the idea that there is no single theory that can describe the entire universe.\textsuperscript{92}

Not surprisingly, these theories have incited doubt in the scientific community, not only with respect to whether these theories are supportable, but also with respect to whether they are even scientific – particularly given that they speak fundamentally to things that human beings will never be able to observe, and in many respects seem unfalsifiable. However, such theories also have backers within the scientific community. Those scientists argue that, though the connection between direct observation and what multiverse theories propose may be less direct, there is a sufficiently firm connection between empirical observation and theory to justify calling these theories science.\textsuperscript{93} These proponents argue that multiverse theories may have a tight enough structure, and make predictions – however yet unproven – that are testable.\textsuperscript{94}

As with the non-empirical theory confirmation of string theory, this Article does not seek to weigh in on the debate over whether multiverse theories qualify as scientific. Rather, this Article discusses multiverses to show how they necessarily question our assumptions about how to draw conclusions from our own observations, including conclusions about the very nature of our universe. This is certainly true to the extent that any particular theory of multiverses raises doubt about the universe having defined and linear, rather than probabilistic, properties. But it also true to the extent that the very study of multiverses is not thoroughly discounted as science, even though these theories manifest a greater degree of attenuation between empiricism and conclusions than science traditionally has allowed.

\textsuperscript{92} GREENE, \textit{supra} note 13, at 294-95 (describing the “Ultimate Multiverse” theory).

\textsuperscript{93} \textit{Id.} at 165 (“Proponents counter that although the manner in which a given multiverse connects with observation may be different from what were used to – it may be more indirect, it may be less explicit, it may require fortune to shine favorably on future experiments – in respectable proposals, such connections are not fundamentally absent.”).

\textsuperscript{94} \textit{Id.} at 175 (identifying the argument that “the capacity to make predictions emerges from the multiverse evincing an underlying mathematical pattern: physical properties are distributed across the constituent universes in a sharply skewed or highly correlated manner”).
Richard Dawkins, the famous scientist and atheist, has stated that the key difference between the "genuinely extravagant God hypothesis" and the "apparently extravagant multiverse hypothesis is one of statistical improbability."\textsuperscript{95} "The multiverse may seem extravagant in sheer number of universes. But if each one of those universes is simple in its fundamental laws, we are still not postulating anything highly improbable."\textsuperscript{96} He is undoubtedly right that the parsimony of the theory contributes to its probability. At the same time, to the extent that multiverses will always be unobservable, the argument necessarily remains one of probability.\textsuperscript{97} The challenge is determining what degree of probability we will accept to conclude that a particular theory is scientifically sound. To the extent that multiverses, while not as improbable as God, are arguably still improbable, this fact exemplifies the difficulty of attempting to demarcate along these lines. And this difficulty is manifested precisely in the fierce debate over the scientific validity of these theories.

The exact same points apply to the subject of consciousness, particularly human consciousness. First, the limits to the capacities of human consciousness underscore the probabilistic nature of particles. Consider, for example, our inability to see ambiguous, or reversible images simultaneously.\textsuperscript{98} If we are to accept the particular theory of quantum mechanics that posits that human observation is what brings things into existence, then such limits to human consciousness very much affect existence itself.\textsuperscript{99} But even if we reject this theory, this inability still complements quantum mechanical principles – particularly the principle that particles have possibilities that all exist until, and only while, the particles are measured. As Daniel Dennett posits in his theory of consciousness, consciousness does not consist of


\textsuperscript{96} Id.

\textsuperscript{97} Dawkins' argument also has a caveat: "The multiverse may seem extravagant in sheer number of universes. But if each one of those universes is simple in its fundamental laws, we are still not postulating anything highly improbable." Id. at 147.


\textsuperscript{99} See supra notes 46-48 and accompanying text.
a single view that arises after having been rubber-stamped by some definitive central processing unit; rather, "[d]ifferent parts of the neural processing assert more or less control at different times."\(^{100}\)

Second, consciousness in general, but particularly human consciousness, remains as great a scientific mystery as does the origin of the universe. While some aspects of consciousness can certainly be explained, self-consciousness in particular is still a mystery. While dualism in the vein of Rene Descartes—the idea that the mind and body are separate—has long fallen out of favor, at least in the scientific community,\(^{101}\) the task of explaining consciousness from a purely physical or biological viewpoint remains unfulfilled, and ever-daunting. How can human beings' thoughts or ideas be captured solely by physical particles and processes? Science has barely begun to unravel consciousness, or present a theory that is as tightly constructed as theories explaining both much larger (i.e., the universe itself) and much smaller things (i.e., quantum particles), notwithstanding whatever gaps remain in even those theories.

However, even though we are far from being able to explain how exactly consciousness works, many believe that it is reducible to physical particles and processes.\(^{102}\) From a scientific perspective, this

\(^{100}\) DANIEL C. DENNETT, CONSCIOUSNESS EXPLAINED 253-54 (1991) ("Instead of such a single stream [of consciousness] (however wide), there are multiple channels in which specialist circuits try, in parallel pandemoniums, to do their various things, creating Multiple Drafts as they go. Most of these fragmentary drafts of 'narrative' play short-lived roles in the modulation of current activity but some get promoted to further functional roles, in swift succession, by the activity of a virtual machine in the brain.").

\(^{101}\) See, e.g., id. at 37 ("This fundamentally antiscientific stance of dualism is, to my mind, its most disqualifying feature, and is the reason why in this book I adopt the apparently dogmatic rule that dualism is to be avoided at all costs. It is not that I think I can give a knock-down proof that dualism, in all its forms, is false or incoherent, but that, given the way that dualism wallows in mystery, accepting dualism is giving up.").

\(^{102}\) See Athena Demertzis et al., Dualism Persists in the Science of Mind, 1157 ANN. N.Y. ACAD. SCI. 1, 1 (2009) (discussing conflicting attitudes on dualism among people in scientific fields surveyed on the subject). Nonetheless, that consciousness is not reducible to one place in the brain, in an interesting way, arguably is complemented by—and ultimately complements in turn—the ideas of uncertainty in quantum mechanics. Though there cannot be empirical evidence for this proposition, one could argue that this connection—particularly to the extent that quantum mechanics supports ideas like many-world multiverses—supports the idea of dualism,
is absolutely justifiable: such a theory yields testable predictions, unlike a theory of dualism. A dualist’s mind is to a human as God is to the universe. Still, that this theory is given credence again underscores how substantial, though justified jumps are taken even in science.

### III. IMPLICATIONS FOR LEGAL DISTINCTIONS BETWEEN SCIENCE AND FAITH

In the realm of science, there is much room for uncertainty, for outright unverifiable propositions, and for the absence of direct, absolute proof. This room provides some justification for human beings to question the place of other things in the world that have these same qualities – whether those things are traditionally considered scientific or not.

Thus, the very question posed at the beginning of this Article returns: how, then, to distinguish science from non-sciences, particularly in eyes of the law? In the light of advancements and debates within modern science, this Article sees the approach of Larry Laudan as providing some useful principles for this legal demarcation. An approach rejecting a wholesale determination of whether an entire theory qualifies as “scientific,” this Article argues, is less preferable in scrutinizing faith-based attempts at scientific legitimacy than an approach that attempts to ascertain religious purpose. This method may, to the extent that it posits that there is a plane which cannot be observed. See supra notes 88-92 and accompanying text. In addition, there is no evidence that consciousness is necessary for particles to become located at a definite point. See supra note 46 and accompanying text. That said, that even consciousness itself cannot be located at any particular point suggests that uncertainty pervades even when particles are considered to have a definite location. In the midst of such uncertainty, some indeed might choose to believe in a more dualist account, without being completely absent logic, albeit in a manner that should not be proclaimed scientific. Put differently, whether or not human consciousness is or is not necessary, in quantum mechanics, for there to be a definite reality, in conditions of uncertainty it is not wholly absent epistemic logic to believe so. Cf. Marcus Arvan, *A New Theory of Free Will*, 44 PHIL. F. 1 (2013) (arguing that philosophical and scientific hypotheses, including the holographic principle and multiverse theory in quantum physics, and eternalism and mind-body dualism in philosophy, together imply a theory of free will). To be clear then, the argument is that dualism exists not on the basis there is no scientific explanation – a God-of-the-gaps type of argument – but on the basis, which may be reasonable to believe even without a complete scientific explanation, that these scientific phenomena support their possibility.
consistent with the approach of Laudan, involve a more nuanced analysis of an alleged theory’s many constituent parts, in order to smoke out such religious purpose.

A. Laudan, His Critics, and a Middle Ground

To understand why this approach is preferable, it is necessary to explore further the science-religion demarcation debate in the wake of the McLean case. The decision triggered not only the response from Laudan, but also both a great deal of criticism of Laudan’s approach, as well as support from those who agreed with Laudan that the philosophy of science behind McLean was imperfect. Along these lines, as philosopher of science Maarten Boudry argues, while it is “right to champion empirical boldness as a cardinal scientific virtue,” nevertheless “[a] theory is not falsifiable until it is conjoined with background assumptions, initial conditions, and auxiliary hypotheses.” Thus, “[d]epending on how we interpret Popper’s logical criterion in light of these problems, . . . [the criterion of falsifiability] is either too restrictive, classifying some of our best theories as nonscientific, or too permissive, allowing some of the worst theories in currency (e.g., astrology) to be recognized as science.”


104. See, e.g., Stephen C. Meyer, The Demarcation of Science and Religion, in THE HISTORY OF SCIENCE AND RELIGION IN THE WESTERN TRADITION 18, 22 (Gary B. Ferngren ed., 2000) (stating that the demarcation criteria used as a basis for McLean “have proven problematic, especially as applied to the debate about biological origins”).

105. Maarten Boudry, Loki’s Wager and Laudan’s Error: On Genuine and Territorial Demarcation, in PHILOSOPHY OF PSEUDOSCIENCE: RECONSIDERING THE DEMARCATION PROBLEM 79, 87 (Massimo Pigliucci & Maarten Boudry eds., 2013). As Ladyman also argues, in agreement with Laudan, testability and falsifiability are weak requirements. James Ladyman, Toward a Demarcation of Science from Pseudoscience, in PHILOSOPHY OF PSEUDOSCIENCE: RECONSIDERING THE DEMARCATION PROBLEM 45, 54 (Massimo Pigliucci & Maarten Boudry eds., 2013). For example, “the requirement of testability or falsifiability is too strong, at least when applied to individual propositions, because high-level scientific hypotheses have no direct empirical consequences. Hence, there are many scientific statements that are not falsifiable, or at least not directly.” Id.

106. Boudry, supra note 105, at 87.
Ultimately, some, like Boudry, have argued that both approaches are imperfect, and, to that end, attempted to propose alternate demarcation criteria that would account for the problems posed by both.107

Despite advances in this debate in the wake of McLean, a fundamental problem is unavoidable with any demarcation criteria. As philosopher Sven Ove Hannson has argued, there are two basic types of demarcation criteria, which are necessarily exclusive of one another: general and specific.108 General and timeless demarcation principles are attractive for obvious reasons.109 However, they “cannot then provide us with concrete criteria for the evaluation of specific investigations, statements, or theories. Such criteria will have to refer to methodological particulars that differ between subject areas and change with the passage of time.”110

Examples of general principles for demarcation include those that can be used to disqualify theories as scientific based, not on the probability of any specific content, but on their more global commitments. For example, theories that contend that only some people have special ability to determine truth or falsehood, and theories that flat out reject being tested, should be ruled out by these principles.111 These principles should also rule out theories that reject the concept of methodological naturalism — the idea that science cannot appeal to supernatural interventions to explain processes.112 A manifestation of this idea is the so-called God-of-the-gaps argument: that unexplainable phenomenon can be explained by appeal to God.113

107. See generally PHILOSOPHY OF PSEUDOSCIENCE: RECONSIDERING THE DEMARCATION PROBLEM, supra note 105.


109. Id.

110. Id. at 74.

111. Id. at 72-73.


Such criteria could disqualify ideas like creation science or intelligent design. Manifesting their lack of good faith commitment to scientific principles, such theories simultaneously argue that demarcating science is impossible, yet cite to some of its criteria to argue that creationism or intelligent design is, indeed, scientific. Pseudoscience, broadly defined by some, is precisely scientific pretense — for example, as Boudry argues, intelligent design theorists “refuse to flesh out their design hypothesis and use convenient immunizations that make the theory impervious to criticism.” Put more bluntly by another philosopher of science, James Ladyman, pseudoscience “resist[s] refutation by not making definite claims at all. They progressively disconnect us from the truth in a way that is more insidious than lying, for we may end up not just with false beliefs but with no beliefs at all.”

Yet, this does not dispose of the need for more specific demarcation criteria to deal with other claims. As Boudry further argues, methodological naturalism “fuels the common misconception that only ‘science’ possesses epistemic authority, whereas metaphysical questions, traditionally the trade of philosophers, are a matter of idle speculation only, which, interesting though it may be, can be safely ignored in scientific matters.” To this end, as biologist Martin Mahner argues, not only is there a distinction between pseudoscience as defined above and simply bad science, which at least is committed in good faith to scientific principles, but also not everything non-

114. Id.
115. See Boudry, supra note 105, at 86.
116. See Ladyman, supra note 105, at 53.
117. See Boudry, supra note 105, at 85. As he further argues:
Given that the very concept of the supernatural is notoriously shaky, it is ill advised to erect any form of demarcation on its shoulders. To give substance to such a territorial demarcation claim, one needs to come up with a coherent and nontrivial definition of natural versus supernatural that does not already presuppose the demarcation between science and non-science.

Id. To wit, he criticizes those who “simply equate[] testability and naturalness and leaves us with a circular and self-serving definition of supernatural as that which is beyond scientific investigation by definition.” Id.

118. Martin Mahner, Science and Pseudoscience: How to Demarcate after the (Alleged) Demise of the Demarcation Problem, in PHILOSOPHY OF PSEUDOSCIENCE: RECONSIDERING THE DEMARCATION PROBLEM, supra note 105, at 31 (“A scientist who follows a sloppy and careless experimental protocol, or who even omits a few
scientific is pseudoscientific: "Ordinary knowledge as well as the arts and humanities are not sciences, yet they are not pseudosciences."\textsuperscript{119} And as Hansson points out, "the sciences and the humanities have something important in common: their very raison d’être is to provide us with the most epistemically warranted statements that can be made, at the time being, on the subject matter within their respective domains."\textsuperscript{120}

As Boudry has argued, "because we have grown weary of creationist hypotheses that, when push comes to shove, boil down to ‘God did it and his ways are mysterious,’ we can hardly imagine any other supernatural hypothesis to be viable."\textsuperscript{121} But "even if all current theories with property X happen to be pseudoscientific, this does not mean that talk of X is off limits."\textsuperscript{122} This argument is only emphasized by advancements in science that have no trace of religion as we traditionally conceive it, but nevertheless come closer to the line of pseudoscience. On the one hand, a lack of honest commitment to the principles of science should be fatal to a theory, as far as considering it science. On the other hand, honest commitment to those principles is not automatically less fatal – for example, a theory that is committed to

data from his report to obtain ‘smoother’ graphs and results (which borders on scientific fraud), is a bad scientist but not (yet) a pseudoscientist.”).\textsuperscript{123}

\textsuperscript{119.} \textit{Id.}

\textsuperscript{120.} \textit{See} Hansson, \textit{supra} note 108, at 63 (emphasis added). Hansson argues: Together they form a community of knowledge disciplines characterized by mutual respect for each other’s results and methods. . . . An archaeologist or a historian will have to accept the outcome of a state-of-the art chemical analysis of an archaeological artifact. In the same way, a zoologist will have to accept the historians’ judgments on the reliability of an ancient text describing extinct animals. To understand ancient descriptions of diseases, we need cooperation between classical scholars and medical scientists – not between classical scholars and homeopaths or between medical scientists and bibliomancers. . . . Science in a broad sense seeks knowledge about nature (natural science), about ourselves (psychology and medicine), about our societies (social science and history), about our physical constructions (technological science), and about our thought constructions (linguistics, literary studies, mathematics, and philosophy). (Philosophy, of course, is a science in this broad sense of the word . . . .

\textit{Id.} at 63-64.

\textsuperscript{121.} \textit{See} Boudry, \textit{supra} note 105, at 94.

\textsuperscript{122.} \textit{Id.}
empiricism, but is either methodologically flawed or in the end falsified.

For this reason, he concludes:

The appropriate way of dealing with a supernaturalist pseudoscience like ID creationism is not to relegate it to a domain where science has no authority, but to confront the conceptual and empirical problems of the theory head on. In that respect, Laudan is completely on the mark when he writes that "our focus should be squarely on the empirical and conceptual credentials for claims about the world."\(^{123}\)

At the same time, he argues that Laudan fails by reducing the problem to evaluating specific \textit{claims per se}, which is distinguishable from proposing more specific demarcation criteria to evaluate \textit{specific methodologies}.\(^{124}\) In particular: "But Laudan (as well as Popper) was wide of the mark when he reduced the demarcation job to evaluating the propositional content of the theory. . . . Pseudoscience is too messy to be analyzed on the level of the theory-in-itself, and demarcationists need more refined instruments of analysis."\(^{125}\)

\textbf{B. Crafting A Legal Approach}

It is clear, then, that Laudan's approach, while recognizing the limits of general demarcation principles, does not sufficiently address the problem. However, Laudan's approach still has much to recommend to it, particularly with respect to how \textit{legal} demarcations between religion and faith should proceed. On the one hand, one could argue: how can something like creation science be deemed to violate the Establishment Clause if it is not, on the whole, deemed as

\begin{itemize}
  \item \textit{Id.} He further states:
  
  Although I have argued that Laudan is wrong and that the normative demarcation problem is tractable, this does not mean no borderline cases exist. In particular, epistemic warrant is not constant over time, so theories may move in and out of the domain of science as new evidence accumulates and conceptual progress is made A twilight zone does exist, with theories that are neither scientific nor quite pseudoscientific, but we can readily come up with clear instances of both kinds, which is all that is needed for the viability of the normative demarcation project . . . .

  \textit{Id.} at 92.
  \item \textit{Id.} at 94.
  \item \textit{Id.}
\end{itemize}
unscientific in nature? This claim is arguably different from the approach that Laudan proposes, which is to argue that the claims of creationism amount to bad science.

On the other hand, Laudan’s approach of looking at theoretical claims in a more piecemeal fashion may be another way to find Establishment Clause violations, if applied as part of a broader approach that looks for evidence that some religious purpose appears to motivate the theory as a whole. If any particular claim purports to be scientific, yet does not hold up to empirical testing, it might not automatically violate the Establishment Clause – but it could, if the failure to hold up to empirical testing complements or even directly constitutes evidence that the theory appears to be motivated by religious faith.

This was the approach taken by the U.S. Supreme Court when it ultimately considered creation science in Edwards v. Aguillard,126 a 1987 case regarding a law in Louisiana requiring that creation science be taught along with evolution. Without deciding whether creation science qualified as an actual science, the Court struck down the law on the grounds that the law lacked a secular purpose – one of the three prongs of the Lemon test127 – and therefore violated the Establishment Clause.128 In doing so, the Court rejected the state’s argument that the law sought to protect academic freedom and so had a secular purpose, on the basis that, rather than giving teachers freedom, the law conversely limited their ability to determine what should be taught.129 The Court also stated that “[t]eaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction.”130

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127. In order to pass the Lemon test, a government action: (1) must have a legitimate secular purpose; (2) must not have the primary effect of either advancing or inhibiting religion; and (3) must not result in “excessive entanglement” of religion and the government. Lemon v. Kurtzman, 403 U.S. 602, 612-613 (1971).
128. Edwards, 482 U.S. at 585-94.
129. Id. at 587-89.
130. Id. at 594.
This approach was also taken in *Selman v. Cobb County School District*,\(^\text{131}\) where the U.S. District Court for the Northern District of Georgia ruled that the practice of a public school placing a sticker on a science textbook stating that “evolution is a theory, not a fact” violated the Establishment Clause.\(^\text{132}\) The court ruled that, while the policy did advance legitimate secular purposes – encouraging critical thinking and reducing offense to those whose beliefs might conflict with evolution – the policy had the effect of advancing religion, as “an informed, reasonable observer would interpret the Sticker to convey a message of endorsement of religion.”\(^\text{133}\) Ultimately,

[T]here has been a lengthy debate between advocates of evolution and proponents of religious theories of origin specifically concerning whether evolution should be taught as a fact or as a theory, and the School Board *appears* to have sided with the proponents of religious theories of origin in violation of the Establishment Clause.\(^\text{134}\)

*Selman* was later remanded to the court by the Eleventh Circuit for further fact-finding, after which it was settled out of court.\(^\text{135}\)

Some courts have departed from this approach, as seen more recently in debates in the aughts over intelligent design (or ID). In *Kitzmiller v. Dover Area School District*,\(^\text{136}\) the U.S. District Court for the Middle District of Pennsylvania ruled that a Pennsylvania school district policy requiring the teaching of intelligent design, as an alternative to evolution, violated the Establishment Clause.\(^\text{137}\)

In doing so, the court ruled that intelligent design failed to qualify as a science, for among other reasons because it employed the same false logic – that to the extent evolutionary theory is discredited, intelligent design is confirmed – that “doomed creation science in the


\(^{132}\) *Id.* at 1312.

\(^{133}\) *Id.* at 1306.

\(^{134}\) *Id.* at 1307 (emphasis added).


\(^{137}\) *Id.* at 765-66 (stating that it was “abundantly clear that the Board’s ID Policy violates the Establishment Clause”).

http://scholarlycommons.law.cwsl.edu/cwlr/vol53/iss1/6
1980s." It also failed to qualify as a science because it "violates the centuries-old ground rules of science by invoking and permitting supernatural causation," its "negative attacks on evolution have been refuted by the scientific community," and it "has failed to gain acceptance in the scientific community, it has not generated peer-reviewed publications, nor has it been the subject of testing and research." Therefore, "since ID is not science, the conclusion is inescapable that the only real effect of the ID Policy is the advancement of religion." The policy thus violated the Establishment Clause.

Many lauded the reasoning of the court. As law professor Peter Irons states, "the question of whether ID is science was essential to the court's ruling against the Dover school board's effort to include ID in the biology curriculum." This is because, Irons argues, if intelligent design were actually a legitimate scientific theory, it would be irrelevant even if the motives of those who adopted the policy were religious in nature. "Consider, for example, civil rights legislation. Even if legislators who sponsor such laws proclaim their belief that racial discrimination is morally sinful and violates Biblical commands, the purely secular nature of civil rights laws makes these professions of religious belief irrelevant to their constitutionality."

But there are several problems with this argument. First, religious motivation, or appearance thereof, could matter even if something has a legitimate non-religious purpose. The "evolution is a theory, not a fact" sticker example in the Selman case makes this point.

Second, and conversely, merely because something is not a science does not make it an Establishment Clause violation. A difference exists between a claim that something cannot be taught because it is not good science – which is not necessarily a constitutional violation – and a claim that something cannot be taught because it is motivated by religious purpose – which is a constitutional violation. Even

138. Id. at 735.
139. Id.
140. Id. at 764.
141. Id.
143. Id.
144. Id.
pseudoscience need not amount to an Establishment Clause violation if there is no religiosity behind it. This is why it is important to look into purpose to find an Establishment Clause violation.

Here the piecemeal approach advocated by Laudan can aid, not only in determining that something should not be taught in classrooms because it is not sound information — regardless of whether religion might also be a factor — but also in smoking out what is, in fact, motivated by religious purpose. This is comparable to the way that inconsistencies in claimed legitimate justifications can snuff out illegitimate purposes in antidiscrimination law. Some religious claims can, and in fact are, made inductively, within traditionally scientific constraints. Some of those claims are nonetheless dubious, which leads us to reject those claims. In the process, courts can smoke out ostensible appeals to scientific legitimacy.

Third is the difficulty in deciding whether something is science or not. This is the argument of Laudan, and it is an argument supported by other examples that have nothing to do with religion, such as the multiverse theories, over which those in the scientific community are split (and thus would be split as to whether they should be taught in classrooms as legitimate, sound science). Here it is necessary to note that, whether or not religion might be involved, courts do have to make decisions about what qualifies as adhering to scientific method and what does not.

In fact, beyond controversies over creation science or intelligent design, which are relatively rare, far more common are decisions that courts must make about admitting expert witness testimony under the *Daubert* standard, which requires that testimony adhere to scientific methodology to be allowed in court.145 This comparison, however, only further illuminates the sensibility of the approach advocated by Laudan.

First, some scholars have criticized the *Daubert* approach, arguing that judges are not equipped to make determinations about what qualifies as adhering to scientific methodology and what does not.146 The same criticism applies here, and while scientists themselves are certainly capable of determining whether something like creation

science is in fact a science, avoidance of that entire question is both possible and practical for reaching the same result in most, if not all, cases.

Here, the brief filed by Nobel Laureate Nicolaas Bloembergen in Daubert is apposite.147 Bloembergen is among the camp arguing against the adoption of the Daubert standard, and instead retaining the Frye standard, which required that admissible evidence achieved general acceptance in the relevant scientific community.148 Bloembergen argues that a critical difference between science and law is that "while in science it is recognized that 'truth' is extremely mutable, in adjudication 'truth' for the limited purpose of resolving disputes must become final and immutable in a relatively short time.”149

By using publication and peer review as a standard, the determination whether particular principles and methodology have received acceptance within the scientific community is one which courts can make. The determination whether particular scientific conclusions are or are not correct or accepted by science is one which judges need not make.150

Adopting the standard Bloembergen advocates leads to the same result, as faith would certainly not be seen as a science, and so would not be seen as scientific in the eyes of law. However, it is the concession that Bloembergen makes to undergird his argument – that, in science, truth is mutable – where the greater point lies. This concession is particularly compelling in light of the doubt that modern science casts on the very method of scientific inquiry to get to the truth.

Second, even accepting the Daubert approach as sensible, there is arguably a substantial difference between determining whether specific testimony passes scientific muster and determining whether an entire field of alleged science does. The multiverse example, which has divided scientists themselves, shows the insensibility of judges making such determinations, and even of relying on general acceptance among scientists. The piecemeal approach advocated by Laudan, and further

148. Id. (referencing Frye v. U.S., 293 F. 1013 (D.C. Cir. 1923)).
149. Id. at 22.
150. Id. at 25.
supported by this Article, is far more consistent with the Daubert approach, than that taken by the courts in McLean or Kitzmiller.

To be clear, this approach does not deny that certain pseudoscientific theories could, in fact, be weeded out by taking alternative approaches. For example, creation science and intelligent design could be categorized as pseudoscientific for their evident lack of good faith commitment to methodological naturalism.\(^{151}\)

For the purposes of an Establishment Clause challenge, however, this approach is unnecessary. Consistent with Boudry’s argument, while a piecemeal approach may be insufficient standing alone to distinguish science from pseudoscience, what qualifies as sufficient is an ever more complex question, in light of the advancements of science. For courts, it should be easier to determine that something is religiously motivated than to wade into this morass. The alternative approach of deferring to experts, as consistent with the pre-Daubert regime, is no better, as it creates the possibility of excluding science that, again, is not religious, but could nevertheless be claimed to be pseudoscientific.

In the end, if the legal issue is that the government shall not establish one religion over another, the central question remains whether a theory is religious or not – not whether that theory is or is not science. It is not that demarcation (albeit, not fully principled) is not possible; it is that demarcation, in this context, is not necessary, and arguably unmanageable for courts to do in a consistently principled way.

C. The Implications of Non-Empirical Theory Confirmation

The concept of non-empirical theory confirmation only adds fresh support for this alternative approach. What has motivated the development of this concept is the need to evaluate claims the scientific nature of which is in doubt, but where religion nevertheless is not at issue. At the same time, this concept still intends to separate legitimate science from non-legitimate science, whether theories that fail to meet its threshold are considered simply insupportable (i.e., bad science), or not sufficiently scientific in nature even given some leeway for non-

empiricism (i.e., fully non-science). Additionally, the concept of non-empirical theory confirmation makes the distinction between religious and scientific claims more difficult to justify. This distinction becomes more challenging to support particularly to the extent that some claims of religion can make epistemic assertions with good faith intention to commit to scientific principles (whether or not those claims are in the end valid in content). Still others may commit to principles to which non-scientific — yet otherwise valid and not pseudoscientific — fields adhere.

For example, according to Dawid, one critical factor supporting the validity of a theory is the absence of alternative solutions to the problems that the theory addresses. And, just as some believe that string theory is the only viable way to unify quantum mechanics and gravity, religionists certainly claim that their faiths are the only way to explain many phenomena. This is hardly a viable argument — but, as a matter of principle, it demonstrates how it becomes increasingly, if at the extremes only marginally harder, to make the distinction.

In fact, the concept of non-empirical theory confirmation dovetails with the epistemic logic used in non-scientific, but not pseudoscientific fields. The three criteria that Dawid identifies — the absence of alternative solutions, the connection to already-confirmed theories, and the number of unexpected insights that arise — are hardly criteria that are limited to evaluating claims based on scientific empiricism. Thus, to the extent that the non-empirical theory confirmation supports the continued inclusion of theories like string theory within the umbrella of science, it can also support the idea that theories of the type Boudry discusses should be analyzed under a legal framework that looks for religiosity, not for the arguably more complex issue of being scientific. These theories fall outside of the conventional, but perhaps should not automatically be categorized as theories with only a flimsy pretextual commitment to scientific principles.

 Appropriately enough, as Dawid himself explicitly recognizes, his work builds on the work of Laudan, who has argued that there need not be a strict hierarchy between empirical and theoretical methods to assess theories. In some cases, theoretical methods may be more important than empirical methods. This argument is thematically

152. See supra note 79 and accompanying text.
153. DAWID, supra note 73, at 43.
consistent with Laudan’s imploring of the scientific community to assess creation science (where, on the whole, theory still takes precedence over the empirical) in its parts, as the path to demonstrating its illegitimacy.

Laudan’s ideas are complementary: because theoretical methods might sometimes be as important as empirical ones, ideas should not be dismissed in full merely because they rely so heavily on theory to have explanatory power. Instead, sometimes we might better be served by evaluating the many claims that comprise an entire belief system, on their own terms. The reason being that even when we reject those claims resoundingly—for example, the creationist idea that the Earth is only several thousand years old—we learn more by forcing ourselves to articulate exactly why a given claim is invalid. And more to the point in the context of an Establishment Clause claim, we also still show why pretextual claims to science are just that.

Not surprisingly, then, the approach of Laudan may also have value in evaluating (both as a matter of scientific and legal demarcation) scientific advances today, advances that no one is legitimately claiming to be motivated by religious faith. For example, even though both the ability to explain and the ability to predict are important in science, theories that have yet to be mathematically reconciled with quantum phenomena (e.g., gravity) should not necessarily be considered unscientific. These theories should not be unconsidered unscientific despite the need, in the absence of a unifying theory that can reconcile the quantum with the massive scales of the universe, for them to overlook some of the fundamental scientific facts about uncertainty arising from quantum observation, facts that logically apply to all scales of the universe. To this same point, that, as per quantum mechanics, the same starting conditions in an experiment will not guarantee the same results, should not fundamentally cast doubt on prediction-making as a hallmark of scientific inquiry. Instead, these very phenomena urge a different, more nuanced understanding of such inquiry.

And string theory and multiverse theories should not be dismissed necessarily as unscientific (and potentially excluded as evidence under Daubert), even though they have not yet led to testable (or tested) predictions. Rather, such theories should be evaluated, when possible, at more of a retail level. Any such theories will still exist on a grand, ambitious scale; particularly given that direct observability is not possible, one must draw inferences throughout the entirety of the theory.
in order to make it work. Still, there is a difference between scrutinizing these parts, then concluding that the entire theory fails, and evaluating the theory as a whole by standards of what qualifies as science, then concluding not merely that the theory fails, but that it is simply not scientific.

Naturally, for purposes of adjudication under Daubert, courts must wade more into the demarcation morass when religion is not an issue. In those situations, the Establishment Clause approach is unavailable to complement the piecemeal approach, which itself is arguably insufficient standing alone to distinguish science from pseudoscience. Nevertheless, the approach should still play a significant, if not necessarily determinative part in weeding out what theories cannot be introduced, either because they are bad science or non-scientific, to complement approaches like Dawid’s non-empirical theory confirmation. This method is appropriate considering that, in this particular arena where there is less likely to be a bad-faith appeal to science, it will be more difficult to delineate science from pseudoscience simply by looking to any given theory’s global commitments to general scientific principles.

In the end, these cutting-edge scientific theories do in fact blur the distinction between science and faith. Because it is important to preserve the integrity of science, perhaps the best way to do so is to take even seemingly outlandish claims in religion and science seriously enough to confront them. This would not only be for the purpose of getting closer to yet-unknown truths, but also for the purposes of legal adjudication of claims. Great value may lie in grappling with the grandest of ideas – even where complete empirical verification will always be just beyond the horizon.

CONCLUSION

In these ways, the most cutting-edge advances in modern science, ironically, shed light on how we might, under the law, address the most ancient and traditional human beliefs. On the one hand, whether something is or is not scientific under the law need not have any bearing on the legitimacy of the personal decisions about faith. There are certainly legitimate arguments against the existence of God (and, at
that, a perfect one). And the advancements of modern science cannot change the propositional content of arguments for God.

On the other hand, these advancements arguably provide support for preserving individuals' ability to make personal decisions about faith in conditions of uncertainty – without the law, in seeking to avoid the endorsement of any religion, making unnecessarily broad proclamations about those beliefs. The very consciousness by which humans experience pleasure, pain, and other sensations is the very consciousness that allows them to experience reality, in quantum terms, as definite points, rather than indefinite waves. This ability is thus extraordinary: consciousness matters not merely because it affords our remarkable autonomy (including the ability to make decisions about religious belief or non-belief) but also because consciousness encapsulates, even more broadly than human capability for autonomy and intention, the entire range of human experience. At the same time, this very consciousness is restricted by the limits of human observation as applied to science, religion, and any other field. Consciousness thus urges a more nuanced demarcation between such fields.

It is no surprise that, regardless of what someone ultimately believes to be true or not true, these issues are exceedingly difficult to grapple with. Even those who choose seriously to contend with them can hardly seem to differentiate at times, in a principled, consistent way, between fact, falsehood, and opinion. The threshold at which people decide to believe that something is, indeed, a fact is difficult, if not impossible to define with accuracy. This threshold is different for everyone, and perhaps even variable within the same person. The state of science is such that even human beings who actively seek knowledge are still, in many respects, operating in much blindness about the

154. For example, even putting science aside, from a purely philosophical perspective, human suffering, especially at its worst, is a phenomenon for which even the best faith-based explanations arguably fall short. If every moment is, indeed, frozen in time, then the passage of time – and, ultimately, the occurrence of human death – does not undo suffering.

155. It is the Author's opinion that it is impossible for humans to not, to some degree, value consciousness: those who value pleasure in any measure certainly must value it, and, consistent with the Anthropic Principle, even those that proclaim not to value consciousness must implicitly value rationality – which comes only from a conscious ability.
universe. Science establishes that human beings are fighting against a number of different other phenomena as well: the entropy of the universe in general, and (for practical purposes) the inevitable mortality of humans, phenomena that speak not merely to our metaphysics, but also to the limits of our epistemology.

A last lesson that flows from all of this is the wisdom of tolerating the beliefs of others — whether they are traditional faiths or otherwise. It is not just our consciousness that we necessarily value, but also those of others. Against this backdrop of multiple uncertainties and confines, quantum mechanics suggests that people are fighting not just to live, but, in a very concrete way, for reality. Human beings are fighting to create a reality that is unique and irreplaceable, scientifically frozen into place. In an important way, that reality cannot be taken away — not by any event in the future, and not even if every other person in the world did not recognize that reality. But it also cannot be shaped any other way, by any other entity. When a life ends, there is, from all we know, a finality: there is a unique, untrodden path that life could have taken, yet which will never be taken, by that life or by any other conscious being in spacetime. In the face of such immense stakes we all have no choice but to live life in the face of so much that remains unknown and inaccessible about the universe, and, in turn, about the fundamental nature of being.

This wisdom further urges an alternative approach to demarcating science from faith under the law. Sometimes in matters of life and death, which often come into play in other aspects of the law beyond the Establishment Clause, there is much less room for tolerance of personal beliefs. Yet, it remains that beliefs about life and death themselves are very personal; the answers can be very hard to arrive at and come with great personal cost. Those beliefs should thus be respected, to the greatest extent possible.

156. For a lengthy discussion of such issues by the Author, see Marvin Lim, A New Approach to the Ethics of Life: The “Will to Live” in Lieu of Inherent Dignity and Autonomy-Based Approaches, 24 S. CAL. INTERDISC. L.J. 27 (2015).

157. This is not to say that broad societal interests, which drive some to impose certain faith and morality on others, are not important; they may even capture a very real effect on individuals. But ultimately, the impact of any decision is usually most felt at the level of the individual, who must experience, and ultimately live, with the choices he or she makes. Cf. ISAIAH BERLIN, FOUR ESSAYS ON LIBERTY 131 (1969) (“I wish to be somebody, not nobody; a doer — deciding, not being decided for, self-
Hamlet’s question of to be or not, the words of philosopher Ronald Dworkin seem equally applicable here: what is right for an individual “depends on so much else that is special about him—about the shape and character of his life and his own sense of his integrity and critical interests—that no uniform collective decision can possibly hope to serve everyone even decently.”158

Regardless of the ultimate decisions one makes, to answer Hamlet’s question of “to be or not to be,” still requires a (broadly defined) leap of faith. And, at the end of the day, human beings, whether with intention or by effect, must choose to answer Hamlet’s question of being or not being. This question is outside the realm of science, which cannot make the judgment calls that are needed to answer it. With related, similarly grand questions—like why there is existence rather than none, and what, if anything, allowed the universe (or any universe) to be—science would firmly say it does not have the equipment to answer.

It may, however, be in the realm of other disciplines—particularly those that are outside the realm of empirical science, but which need not be pseudoscientific and may utilize epistemic logic, in good faith, nonetheless. These disciplines may be better equipped to say whether, in the midst of inevitable uncertainty, there is some not insignificant chance that some omnipresent entity like a god could pervade the world. Dawkins’ argument that the “God hypothesis” is genuinely extravagant is from one perspective, understandable. From another perspective, the possibilities posed by infinite universes—along with an idea that some omnipresent force, while perhaps not what many traditionally think a

directed and not acted upon by external nature or by other men as if I were a thing, or an animal, or a slave incapable of playing a human role, that is, of conceiving goals and policies of my own and realizing them.”). People shall be encouraged to recognize the impact of their actions on other persons, who live their own unique and irreplaceable lives. And often people make decisions that, knowingly or unknowingly, hurt themselves. But, it is the Author’s opinion that, barring exceptional circumstances like imminent threats (i.e., to life), they should make those decisions as they wish, to live their lives as only they can live them. In the end, these are difficult decisions, which urge tolerance. Cf. Joseph Raz, Autonomy, Toleration, and the Harm Principle, in Justifying Toleration: Conceptual and Historical Perspectives 158 (Susan Mendus ed., 1988) (“[A]utonomy requires that many morally acceptable, though incompatible, forms of life be available to a person.”).

god is, nevertheless infinitely pervades time, space, and being, in lieu of the possibility of nothingness – may not be so extravagant, despite being outside of the realm of science. In such uncertainty, and within the limits of the possibility of human consciousness, to infer some meaningful likelihood that there is such a force, on these bases, is arguably as valid as deducing there certainly is not.

Put differently, choosing to have religious faith seems slightly less unreasonable if one can understand how epistemological leaps are made in both faith and science alike. With such understanding, it certainly

159. In the Author’s opinion, this “god” may or may not be perfect, and may or may not have any particular designs or intentions for intelligent human life that we are capable of inferring, even assuming the intention for such life to exist in the first place.

160. The idea, which has some support from science, that the world has always existed – that the past is infinite – is mystifying to the extent that we believe that moments that have not yet occurred expand in only one direction, the future, while the past has already happened and is frozen in time. To the extent our logic cannot comprehend an infinity in both directions, the idea of a being that reconciles these concepts by reconceptualizing traditional notions of time and causality – whether everything must have a cause, whether something can come from nothing (and what nothing actually is), whether the universe might be beginningless – is as attractive to some as cosmological explanations that not only remain in debate, but also, many say, are simply beyond human capacity to verify scientifically. Indeed, our natural intuitions about cause-and-effect are called into question whether one believes that our universe originated from nothing or believes that it always existed. For discussion of these debates, see GRAHAM ROBERT OPPY, ARGUING ABOUT GODS (2006) and David Albert, On the Origin of Everything, NY TIMES (Mar. 23, 2012), http://www.nytimes.com/2012/03/25/books/review/a-universe-from-nothing-by-lawrence-m-krauss.html?_r=0. This would be a being, whose own infinite existence is beyond human comprehension, permitting the past to extend into infinity. As Oppy states:

[I]t seems to me to be plausible to suppose that one could be faced with interlocutors who are able to go on giving answers to these questions that do not indicate any evident lapses from rationality, but who disagree greatly with one another on the answers to given questions. On the one hand, I suppose that there can be theists who have answers to all of these questions that, taken together, form a coherent and rationally defensible view of the world. On the other hand, I suppose that there can be non-theists who have answers to all of these questions that, taken together, form a coherent and rationally defensible view of the world. If these suppositions are correct, then we should be very sceptical about claims that there are successful cosmological arguments that serve to vindicate either theism or atheism.

OPPY, supra, at 173.
becomes clearer that life is valuable because of what human experience, however temporary and uncertain, means to reality. That value arguably exists irrespective of one's exact faith; for some, that value is deepened because of faith.