Beyond Reductionism: Bridging the Gap between Science and Meaning

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Abstract

The methods of science have revealed previously unknown patterns in our experience and have greatly expanded our awareness and capabilities. Yet science as practiced and communicated is not simply a neutral tool for uncovering objective secrets of the universe. Its discoveries are often entangled with a story we refer to as the "reductionist narrative." According to this narrative, the universe is composed exclusively of fundamental particles obeying mathematical laws, and hence human existence is an inconsequential accident that is ultimately meaningless. This perspective clearly has implications far beyond the domain of science itself, permeating discourse in politics, religion, and general culture. In this essay we argue that acceptance of scientific knowledge about the world does not require acceptance of the reductionist narrative. A narrative in which meaning is a central aspect of the universe is equally consistent with scientific observations and insights. Such a narrative has the potential to heal rifts between scientific and humanistic worldviews. Further, treating meaning as a foundational principle could provide a new explanatory tool forming the basis for an intriguing new paradigm in science.

Introduction

Science has emerged as a powerful tool for investigating and understanding our surroundings. The methods of science have revealed previously unknown patterns in our experience and have greatly expanded our awareness and capabilities. It is important to recognize, however, that science as practiced and communicated is not simply a neutral tool for uncovering objective secrets of the universe. Its discoveries are entangled with a story that is often assumed to follow automatically from the success of science. But in fact this narrative is a separate layer of interpretation, distinct from the discoveries themselves.

This interpretation, which goes by various labels such as scientific materialism or reductionism, is typically expressed something like this: *We may feel subjectively that our thoughts and actions matter in some way, but this perception is an illusion. An honest look around at the universe (composed of fundamental particles obeying mathematical laws) shatters this myth and reveals that our lives are ultimately meaningless. If we are to be hard-nosed realists, limiting ourselves to scientific, evidence-based reasoning, then we must accept that human existence is an inconsequential accident of no ultimate significance in the grand scheme of things.* As Owen Flanagan expresses the dilemma, "What sense can be made of my wish to live in a genuinely meaningful way, to live a life that really matters, that makes a positive and lasting contribution, if my life is exhausted by my prospects as a finite material being living in a material world?" (2007, 1)

Our aim in this paper is to argue that acceptance of scientific knowledge about the world does *not* require accepting this particular narrative. Other narratives are equally consistent with the same set of observations and insights about the world (just as the set of lines in Figure 1 can be interpreted as either a duck or a rabbit). We offer one example of an alternative narrative that is equally consistent with the scientific facts.

The "Reductionist Narrative"

The scientific approach has proven to be a very successful way to investigate the world. This success

often carries with it an implicit narrative that tells us what it means to be a part of the "real" universe. The narrative is entangled with scientific discoveries in a way that is difficult to separate, making it challenging to pin down exactly what the narrative says. It has many nuances and labels including reductionism, materialism, physicalism, and mechanism (Davies 2008; Kauffman 2010; Talbott 2004a; von Baeyer 2005). We will refer to it as the "Reductionist Narrative," while acknowledging that the terminology is oversimplified. For concreteness, we first give our version of this narrative and discuss its implications.

The Reductionist Narrative:
It is common sense that we live in a material world. Centuries of scientific research have solidified and deepened this view and established the scientific method as the route to knowledge about the world. Following this method, we have learned that the world is made of infinitesimally tiny particles of various sorts—"elementary particles" such as electrons and quarks. Everything we come in contact with—chair, computer, sibling, stranger on the street, enemy at work—is made up of these tiny particles. Further, scientific research has led to an understanding of how these particles move and interact with each other. Mathematical models have been developed that allow us to predict with a high degree of accuracy exactly how groups of these particles will move about, join together, or break apart. The natural conclusion is that everything *about the universe—Earth orbiting the Sun, a person driving a car, a child petting a dog, a parent dying from cancer, a couple falling in love, even consciousness itself—is ultimately nothing but aggregates of vast numbers of interacting elementary particles following mathematical rules. This conclusion leaves no room in the universe for meaning.*

Implicit within this narrative are several ideas that are important to elaborate on. We begin with a description of the scientific method, which is a process for refining our understanding of the natural world. First, a hypothesis is made about how some material system will behave under a particular set of circumstances (*e.g.* "We hypothesize that a bowling ball and a ping pong ball will take the same amount of time to fall from the top of a tower."). Next, experimental tests are performed (*e.g.* actually dropping balls from the tower), the results are compared to the hypothesis, and conclusions are drawn. Finally, these results are shared with and verified by the greater community and the process continues.

Next we expand on what is meant by elementary particles and how the scientific method has led to the conclusion that they are fundamental. For example, consider the process of describing in detail an everyday object like a metal key to the front door of our home. First we might describe its size, shape, color, and weight, which are unique to our particular key. Next, we could describe some of its less obvious physical properties. If the tip of the key comes in contact with a high temperature object like a flame, the entire key gets hot very quickly. If the key is removed from the flame, it also cools quickly. If we heat the key to a high enough temperature it starts to emit visible light (it glows red hot, for example). If we continue heating, it melts and then vaporizes. We can continue analyzing the vapor even though we no longer recognize it as a key. For example, we could take small samples of the vapor and accelerate them to very high speeds in opposite directions in an underground tunnel in Europe and smash them together to see what happens. This is essentially what is done in modern particle accelerator physics experiments such as at CERN. In these experiments many particles emerge from the collisions of tiny bits of the "key." Detectors track the resulting particles which leave trails similar to jet contrails. The particles are classified according to the properties of these trails. Amazingly, these experiments always result in just a few types of particles that are the same no matter what object we start with (not just our key). This is what is meant in the reductionist narrative by saying everything is made of elementary particles.

Finally, we elaborate on the significance of mathematical models that predict the behavior of these elementary particles within the reductionist narrative. That is, the size and shape of the contrails, the length of time it takes for them to form, and so on can be predicted to an incredible degree of accuracy using mathematical rules discerned from these experiments. The ability to use only a few rules to predict a wide variety of phenomena at many different levels is what gives scientists the confidence that *everything* can be described by this small set of mathematical rules. It is this amazing quantitative success that gives power to the reductionist narrative.

Taken together, the success of the scientific method, the observational evidence for elementary particles, and our ability to model their behavior using mathematical rules leads to the conclusion of the reductionist narrative, that this is all there is to say. That is, everything in the universe (from experiments at CERN to falling bowling balls to a child petting a dog) can be reduced to enormous numbers of elementary particles and the mathematical rules they obey.

Critiquing the reductionist narrative

In order to evaluate the reductionist narrative, it is important to distinguish between the scientific *observations* (direct measurements and experimental results) and the *interpretation* (that the universe is nothing but particles and the mathematical rules describing them) that is often assumed to automatically follow from these observations. Is this the only possible interpretation of the data? Is it the one and only true narrative? Many scientists believe so and adamantly defend it. Steven Weinberg, for example, writes:

> "The reductionist worldview *is* chilling and impersonal. It has to be accepted as it is, not because we like it, but because that is the way the world works." (1992, 53)

How can we possibly disagree with the reductionist narrative when it seems to be the inevitable conclusion of hundreds of years of scientific research? It is important to emphasize that we are not disputing the scientific observations. We are only pointing out that the *narrative* summarized by Weinberg is not the only interpretation. Just as in Fig. 1, we would not dispute the position of the lines that make up the drawing. But we would certainly dispute a claim that it is only accurate to view these lines as a duck. (A rabbit is equally well justified by the observations.) At issue is whether the scientific observations *necessarily* lead to the conclusion that the universe is inherently meaningless. A little reflection reveals significant and fundamental gaps in the conclusion that everything in the universe can be reduced to enormous numbers of elementary particles and the mathematical rules they obey.

First, it could be argued that our summary of the reductionist narrative does not accurately represent the current state of science. It is well known that things are not "really" made of particles in the sense of the hard-sphere, cartoon models often pictured in one's mind. In fact, the reductionist narrative has evolved as new scientific developments have occurred. It has transitioned from hard-sphere particle models to field theories to (perhaps) string theories or information theories. So what is the underlying essence of the narrative? It is the philosophy that there are a small number of fundamental constituents of which everything in the universe is made—that the universe is nothing but these constituents and the mathematical rules they obey. This perspective can be summarized by saying that the universe can be completely described as a "formal system." As Sean Carroll expresses it:

> "The essence of materialism is to model the world as a formal system, which is both unambiguous and complete as a description of reality. […] The materialist thesis is simply: that's all there is to the world. Once we figure out the correct formal structure, patterns, boundary conditions, and interpretation, we have obtained a complete description of reality." (2003)

This statement reveals a core philosophical narrative at work that seems even to supersede the observational data. It is a narrative that some scientists will maintain even when the whole structure of the formalism changes, *e.g.* from a notion of actual building block material particles, to a mathematical formal system. Yet whatever formal system is accepted as "true," the narrative is still preserved, as if to ensure that the universe is fundamentally meaningless, almost by definition. To gain a deeper understanding of this, refer back to Fig. 1. The reductionist narrative would say that a model describing the location, color, chemical composition—the physical make-up—of the lines is all there is to say about the figure. It denies the existence of the meta-level interpretation of the lines as representing a duck or a rabbit. That meta-level interpretation is considered to be an "epiphenomenon"—basically an illusion not as real as the lines themselves.

To better understand this line of thought, it is helpful to use a grammar analogy (Bortoft 1996; Talbott 2007). A book is a way of telling a meaningful story—a story that precedes the words through which it is expressed. But without words and their corresponding rules of grammar, the story can't be expressed. So the rules of grammar are necessary to convey the meaning. Yet by analogy to the reductionist narrative, we could uncover the rules of grammar by studying the words of a book, classifying them into categories (nouns, verbs, etc.), and analyzing how they are positioned in the text. Once uncovered, we might convince ourselves that the rules of grammar and the words that they govern are all there is to the book, and that any meaning someone might claim for the book is an "epiphenomenon" and hence an illusion. But in this case it is obvious that the meaning is the fundamental driving force of the book and the words and rules of grammar are tools used to convey that meaning. As Stephen Talbott emphasizes:

> "It is hardly impertinent to point out that if, in the interest of precision, we narrow our technical language down to an empty formalism, then we are not *discovering* the world to be meaningless; we are *insisting* that it be meaningless." (2011)

Exploring the Meaning of Meaning

As discussed above, a defining feature of the reductionist narrative is the absence of meaning. Are there alternative narratives that allow for meaning while not rejecting the scientific observations? In order to investigate this possibility, we need to further explore what we mean by "meaning." We should also acknowledge that any discussion about the nature of meaning is inherently biased by our limited perspective as humans. Humans find meaning in many venues such as the birth of a child, the death of a loved one, the beauty of a flower, the discovery of a law of nature, etc. In this discussion, our aim is to think of meaning in the most general way we can. There may very well be a larger scope to meaning that humans are tapping into when we seek meaning in our lives. This larger "universal meaning" has human meaning as a subset, but might exist even if there were no humans. But we also recognize that, since we are humans, we can only access this idea from our perspective as humans. This issue is summarized by Talbott:

> "Meaning is notoriously difficult to define—and, in fact, meaning lies at the opposite pole from precise definition. Words gain fullness of meaning only when they are removed from the dictionary and placed in a concrete context…But despite the loss of meaning in the very attempt to define it, we all have a certain sense for what meaning is, because we all know *what we mean* when we speak." (n.d.)

With these caveats in mind we continue with the grammar analogy to explore what ingredients are necessary to make something meaningful. We begin with three key properties that seem essential to convey meaning in a book and extrapolate them to a broader, universal meaning.

Context – In order to convey the story in a book, there must be sequences of marks we call letters. A single mark is not sufficient for meaning. There must be other distinguishable marks and relationships among them. The set of marks and their relationships are what we call context. We can extrapolate this beyond the scope of our book analogy to a more general idea of context. In doing so, the natural tendency is to replace the "marks" with "particles" in the real universe and to say it is the interaction of these particles that provides the context. However, that would implicitly build the reductionist narrative into our language. In order to avoid this, we introduce a new concept— "perceps" —as a replacement for the notion that ultimate reality must be "made of" anything like marks on a page. These perceps are the aspects of the universe that would interact with an awareness of any scale leading to a perception (hence the name "perceps") of ultimate reality. Awareness is not necessarily needed for the perceps to exist; they are simply the aspects of external reality that would interact with awareness if it were present.

As a simple example, the same perceps would impinge on a camera as would impinge on an eye if it were at the same location. But the eye is apparently associated with awareness while the camera is not. Whether or not awareness is present, the context property of meaning is the requirement that there must be distinguishable perceps with some type of relationship among them. In the book analogy, this is simply the recognition that a story cannot be conveyed with only a single, isolated mark.

Predictability – The words on a page follow specific rules of grammar (in any given language). Without those rules, a book would consist of a random set of symbols, and could not convey any meaningful story. More generally, it is hard to imagine meaning in a universe without predictability. At least some of the relationships among perceps discussed in the context section cannot be random, but must follow some type of predictable rules or pattern in order to express meaning.

Awareness – In the grammar analogy, the ink and the fibers of the paper have no sense of experiencing the story. Any meaning to the story resides in the awareness of the author and of whoever is reading the book. Generalizing from this analogy, it is hard to imagine any sort of meaning that is not intertwined with awareness. This connection is even imbedded in the history of the word *meaning*, which shares a common Indo-European root with the word *mind* ("mean"). Some aspects of ultimate reality must have awareness—the property that there is "something it is like to be them"—in order for meaning to exist (Nagel 1974). It is the interaction of awareness with perceps that leads to the experiences of perception. We are not implying an anthropocentric view of the universe by acknowledging a link between meaning and awareness. Human awareness may be a subset of a much broader universal concept.

We suggest that these three properties are necessary for meaning. But are they sufficient? In order to answer this question, let's explore some simple scenarios that have some or all of these properties.

Example 1: Imagine a universe consisting of millions of marbles, some black, some red, all the same size. (We leave aside for now the concern that the concepts of millions, marbles, black, red, and size are products of experience and assume that they, and their associated perceps, exist independently of awareness). But, in this strange universe, there is no predictable pattern to the interactions of the marbles. Sometimes they bounce off each other, sometimes they stick together, sometimes a marble spontaneously vanishes, or transforms into a butterfly. There is no limit to the possibilities of what happens, but each transformation is completely unpredictable. This universe has the property of context (having many perceps with relationships among them). However, the lack of consistency in the relationships makes it impossible to "tell a story" as in our book analogy and hence lacks meaning.

Example 2: We can remedy at least part of what is lacking in Example 1 by requiring that the marbles obey fixed, predictable rules of interaction. In this new universe, the marbles always bounce off each other following the normal laws of physics found in our universe. This universe is capable of supporting "a story", but does it actually tell one? As in our book analogy, the existence of rules of grammar does not guarantee that the symbols on a page tell a story.

Example 3:
In order to further refine this universe, suppose that some subset of the marbles have an additional property—awareness. These marbles experience the perceps, uncover relationships between them, and perceive of being part of a larger, external universe. This awareness is not a consequence of the predictable rules of interaction that the marbles are following, but an additional property of "something it is like to be them." In this universe there seems to be a place for story to exist. This is not surprising since the properties of context, predictability, and awareness are key aspects of telling a story and what we based our idea of meaning upon.

This last example contains all three of the necessary properties of meaning. But, is meaning guaranteed in the universe of Example 3? We argue that the answer is no. There are two subtle but important questions that have been ignored so far.

First, how are perceps and their relationships embedded in the universe? Apparently, there must be a "higher level" meta-context within which the "lower level" context's perceps and relationships are embedded. In this meta-context there are "higher level" meta-perceps and meta-relationships that are external to, but consistent with, the "lower level" perceps and relationships. If so, there must be an "even higher level" meta-meta-context where the meta-perceps and meta-relationships are embedded. This quickly leads to an infinite nesting of contexts. As a concrete example, consider the book analogy where the perceps correspond to the sequences of marks and the relationships correspond to the predictable rules of grammar. What is the meta-context? The marks might be made of ink on a sheet of paper or pixels on a computer screen. So the marks and rules of grammar are embedded in the physical substrate of the ink, paper, and computer. Or, to put it another way, the perceps that correspond to the marks and the relationships that correspond to the rules of grammar are embedded in, and must be consistent with, the perceps that correspond to the ink, paper, and computer and the relationships between those. Which brings us back to the question of the embedding context for the perceps and relationships corresponding to the ink, paper, and computer and so on. The only alternative to this infinite nesting of contexts seems to be that, at some level of meta-context, the

perceps and relationships in that level are self-referential: the context is its own meta-context.

Second, do the relationships *cause* the perceps? Or are the relationships merely *consistent* with the perceps? In our book analogy these questions seem somewhat silly. It is clear that the rules of grammar are consistent with, but do not cause, the sequences of marks. But, as we go up the chain of meta-contexts this seems much less clear. At the level where perceps correspond to ink, paper, and computer, it is the laws of physics that correspond to the relationships. And some *would* argue that the laws of physics cause the perceps in this case. In that event, the rules of grammar are a consequence of the laws of physics. And, in fact, the awareness that was needed to invent the rules of grammar is also a consequence of the laws of physics. However, this argument all happens within a certain level of context—one in which the perceps are "made of stuff" and the relationships "cause" everything, even the "stuff" of which the perceps are made. We argue that there is still a meta-context in which the perceps and relationships of ink, paper, computers, people, rules of grammar, and laws of physics are embedded. And, again, either there must be an infinite nesting of levels of meta-context or there is a level that is its own meta-context. In either case, it becomes less natural to think of relationships as causing perceps, and more natural to think of perceps *and* their relationships as being patterns that are not "made of" anything more fundamental than themselves.

We postulate that these seemingly paradoxical aspects of the universe, which we will call "mystery," comprise a fourth requirement for meaning:

Mystery – In our book analogy the first three components of meaning are the tools we need to tell the story. But where does the story itself come from? There would not be a story to tell without the "author" and "readers" which are inherently part of a meta-context outside of the book. Are the author and readers part of an infinite nesting of meta-levels of context? Or is there a meta-level somewhere along the chain that serves as its own context? More generally, the observation that perceps and their relationships require a meta-context no matter what meta-level is being considered leads to paradoxes. We argue that paradoxes of this nature are not just nuisances to be explained away. They are inherent to the universe and essential to meaning. Extending the book analogy, the universe might be viewed as a story that must create its own language in order to tell itself. A visual representation of this is provided by Escher's famous lithograph, "Drawing Hands" (1948).

What is the basis for this claim that mystery is essential to meaning? In seeking to understand ultimate reality, models (scientific, religious, philosophical, etc.) are developed that attempt to describe the universe as completely as possible. However, as others have pointed out, these models attempt to describe a fundamental reality that is beyond complete description by any particular model. For example, Edward Harrison argues that models are like masks fitted over an unknown and unknowable Universe (2011). Similarly, Joseph Campbell states that "the ultimate mystery of being is beyond all categories of thought" (1988). Henri Bortoft elucidates related ideas in describing "wholeness" in nature (1996). In science, this same idea arises in the form of paradoxes that emerge in the process of developing formal system laws that describe nature. These often occur when analyzing situations that have aspects outside of the formal system under consideration. For example, the twin paradox arises in special relativity in a situation that involves accelerating reference frames, which is beyond the normal scope of that formal system. Some scientists such as Niels Bohr even seek out paradoxes within their fields of research as important avenues to progress. Kurt Gödel (1931) developed his incompleteness theorem in response to Alfred Whitehead and Bertrand Russell's (1910-1913) challenge of finding a set of axioms and rules from which all mathematical truths can be derived. Douglas Hofstadter also

recognizes the essential importance of paradoxes within formal systems and uses them in an attempt to understand consciousness (1980). All of these examples show that paradoxes are abundant in our study of nature. These paradoxes reflect the fact that our models of reality are never complete—mystery is crucial and irreducible.

An Alternative Narrative

Guided by these insights into the nature of meaning, we now have a more solid foundation for evaluating the question we raised earlier: Are there narratives that allow for meaning without rejecting scientific observations? Meaning is absent from the reductionist narrative because it only includes two (or perhaps three) of the required properties for meaning as we have defined it. It certainly includes context and predictability. One might argue that it includes awareness as an epiphenomenon. However, mystery (as described above) is not included in the narrative and thus neither is meaning. With this perspective in mind, we propose an alternative narrative that explicitly includes all four elements for meaning.

The Meaningful Universe Narrative:
It is common sense that we live in a meaningful universe. The most directly obvious fact of our everyday lives is our own awareness. Through this awareness we experience predictable patterns within the universe. Centuries of scientific research have established the scientific method as a route to knowledge about these predictable patterns. Following this method, we have learned that we can model some of the predictable patterns we observe as infinitesimally tiny particles of various sorts—"elementary particles" such as electrons and quarks. Everything we come in contact with—chair, computer, sibling, stranger on the street, enemy at work, even our own thoughts and feelings—exhibits certain patterns and some of these patterns can be modeled as an expression of these tiny particles. Further, scientific research has led to an understanding of how these particles move and interact with each other. Mathematical models have been developed that allow us to predict with a high degree of accuracy exactly how groups of particles will move about, join together, or break apart. Scientific research also reminds us as we explore, that a naïve attachment to these models breaks down, revealing paradoxes inherent to the universe. These paradoxes emerge whenever we look deeply enough into any aspect of our experience. They reflect the underlying nature of a universe that can be viewed as a meaningful story, which is creating its own language to tell itself. It is through the interplay of context, predictability, awareness, and mystery that meaning arises. The natural conclusion is that everything *about the universe—Earth orbiting the Sun, a person driving a car, a child petting a dog, a parent dying of cancer, a couple falling in love, even consciousness itself—is ultimately an expression of this deeply mysterious meaning of the universe.*

It is important to recognize that both the reductionist narrative and the meaningful universe narrative are consistent with scientific observations. They differ only in the philosophical perspective through which they interpret these observations. Just as there is no observational reason to choose the duck over the rabbit in Fig. 1, there is no obvious observational reason to choose the reductionist narrative over the meaningful universe narrative. The meaningful universe narrative simply views the same set of observations about the world from a different perspective. This perspective is nicely captured by Talbott in the context of the grammar analogy: "The pattern of syntactic lawfulness in a sentence, far from tyrannizing over the sentence and eliminating the possibility of meaningful content, is itself an expression of the meaning" (Talbott 2004b). Similarly, the meaningful universe narrative points out that the patterns we call particles and laws of nature, far from "tyrannizing over" reality and leaving no

room for meaning, can just as well be viewed as a necessary expression of the unfolding meaning in the universe.

Conclusion

In this paper we have challenged the argument that the universe must be meaningless in light of scientific evidence. By clarifying the concept of meaning, and offering a concrete alternative to the reductionist narrative, we have demonstrated that one does not have to believe in a meaningless universe in order to be scientifically rigorous. Of course, one could quibble with our definition of meaning and say that it is biased by our experience in a way that guarantees our universe will be meaningful according to this definition. But meaning is an inherently subtle concept, and since the perspective we are arguing against claims that scientific evidence implies a meaningless universe, without clearly defining what is meant by meaning, any reasonable definition seems sufficient to counter this argument.

We have shown that scientific evidence is consistent with more than one narrative. In particular, we have articulated a narrative that has meaning as a core principle, yet is also consistent with scientific observations. This need not imply a preference for any one narrative, only that the choice of narrative is not dictated by scientific observations. The choice requires a separate philosophical input by the individual. With this in mind, it is natural to question whether there are reasons for choosing one narrative over another. We believe there are at least two reasons.

First, the choice of narratives has important social consequences. Humans are inherently meaning-seeking creatures, in the sense that we want purpose and significance to our lives. As Viktor Frankl points out, "Man's search for meaning is the primary motivation in his life" (1984). An interpretation of science that rejects this core driving force risks alienating people and causing them to reject the scientific perspective entirely. As journalist Bryan Appleyard laments, "On the maps provided by science we find everything except ourselves" (1992). If science has no room for human meaning in its worldview, why should humans make room for science in their worldviews? This rift between scientific and humanistic worldviews is evident in many aspects of today's society. For example, people often look to religion and spirituality in their search for meaning. Yet, they also look to science for solutions to practical problems such as curing disease or convenient transportation. These perspectives overlap because science also has things to say about where humans come from and the origin of the universe that can conflict with religious stories from which people often derive their sense of meaning. In order to cope with this conflict, individuals may develop hybrid beliefs such as the "soul" residing within their DNA (Pollack 2014), or the nihilism associated with being a speck in a vast universe. Similarly, there are aspects of religious narratives that proclaim to have a complete picture of the universe that is inconsistent with scientific observations. For example, individuals may believe that the Earth is 6000 years old rather than the scientifically accepted age of 4.6 billion years. As long as the reductionist narrative dominates the common view of science, people will feel an internal tension as they try to reconcile these two perspectives. In healing this rift, it is important to recognize that both narratives are *pointers* to the deeper mystery of the nature of reality—a mystery that transcends any literal description offered by any particular tradition. Thus, a scientifically accurate perspective that also contains meaning can help bridge this divide between science and religion.

Secondly, it may matter even from a strictly scientific point of view. Dramatic shifts in perspective

have led to many fundamental advances in our understanding of reality. The postulate that meaning is a foundational principle of the universe might play this role, leading to new insights that would be missed within the reductionist narrative. The principle of relativity provides an excellent example of an analogous paradigm shift. In the Newtonian worldview, distance and time intervals were thought to be the same for all observers while the speed of light was expected to depend upon the motion of the observers. Within this perspective, laboratory measurements of the speed of light seemed paradoxical. But, the same observations followed naturally from Einstein's principle of relativity. The lesson here is that a new, general principle can provide a simplified interpretation of previously challenging observations. Some researchers are now applying this approach to better understand the counterintuitive observations described by quantum mechanics (Rovelli 1996). In a similar way, topics that seem paradoxical within the reductionist narrative might be more naturally explained within a meaning-centered narrative. The hard problem of consciousness is perhaps the most obvious example. From the perspective of the reductionist narrative, it seems almost intractable (Hanlon 2013) (hence the name, "hard problem"), while from the meaningful universe narrative it's not really even a problem (Duncan 2009). Other examples can be found in a wide variety of foundational physics questions such as those articulated by John Wheeler. In this sense, treating meaning as a foundational principle could provide a new explanatory tool forming the basis for an intriguing new paradigm in science.

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