



# Where is Nonlocality?

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## ABSTRACT

*Nonlocality* has been supported by experimental evidence since the 1980s. This paper offers a theoretical framework for what and where it is, based on recent quantum field theories that identify three levels of nature: 1) finite local field of physical matter/energy; 2) infinite unified field; and 3) finite *nonlocal* field *in-between*. The *in-between* level is where ‘quantum mind’ is placed; and for the first time in modern science, this allows a logically coherent model of how mind causally influences brain and behavior. Importantly, these three-level models are converging toward the ancient Vedic 3-in-1 holistic account of ontological levels of nature. They reflect revolutionary progress on foundational issues about the matter-mind-consciousness relationship.

**Key Words:** locality, nonlocality, ontological levels, ‘quantum mind,’ 3-in-1 Vedic account

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## Introduction

Isaac Newton made a fundamental distinction of concrete objects and abstract space. Space was a non-changing infinite background or stage on which the play of nature took place via local objects bumping into each other—based on ordinary direct observation. Newton’s theory of gravity quantified relationships of objects such as the Sun, Earth, and Moon ‘pulling’ on each other according to their mass and distance. But it didn’t address how gravity actually does ‘pull’ on objects separated in space and not bumping into each other. Newton also believed that mind and God existed, but didn’t account for their relationship to physical objects or to space. Later, both were considered to be outside of the physical causal nexus and not observable—a core distinction used to separate science from religion. This view suggests mind—and God—differ from physical objects.

But the predominant scientific view, *physical realism*, held that mind is nothing other than physical objects. The mind-body problem was presumed to be resolved, because the mind does not exist in addition to the physical brain. This basically reduced scientific research to the

search for the essence of matter, which eventually would account for mind. Later, both mind and God were considered perhaps not existing at all. But *nonlocality* goes beyond this *one-level* model of physical realism. Empirical evidence suggests nonlocal effects actually do exist, though not accounted for as classical physical ‘field effects’ in local physical realism.

This paper distinguishes *locality* and *nonlocality*, and then summarizes contemporary three-level models of local, nonlocal, and infinite levels that propose where *nonlocality* is. These models include a real place for mind to exist, from where it could actually cause change in the physical world. This would also mean free will is real (Boyer, 2014, 2011, 2009).

## What is locality?

For a long time, it was believed that change takes place by objects physically contacting each other: the ‘billiard-ball’ model of causality. Further advances identified energy/particle *fields* that connect independent objects. Sub-atomic particles transfer energy through these fields in a somewhat more refined ‘particle-interaction’ causal model.

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Objects interact via more abstract, but still particulate, *virtual* particles emerging very briefly from these fields that transfer energy between more stable matter particles through absorption and emission. Three force-particle fields were identified: gravity, magnetism, and electricity. But this view could not explain what holds atoms together, or how they fall apart by radiating particles. This led to two additional forces: strong nuclear and weak nuclear. Also, electricity and magnetism were found to unify at smaller scales. This resulted in four fundamental fields: gravity, strong nuclear, weak nuclear, and electromagnetic.

Einstein further unified gravity, space, and time into *spacetime*. Space and time were no longer understood to be a non-changing background unaffected by the motion of objects. The gravitational force was due to the curvature of spacetime, not a separate force functioning *in* it. Gravity resulted from the presence of tangible ‘material bodies’ that produce curvatures of a smooth continuous spacetime geometry. Einstein also identified matter and energy as interchangeable ( $E=mc^2$ ), another major step of unification. However, everything was still assumed to be physical. And this monumental progress contributed further to the growing doubt whether minds—and God—actually do exist. The doubt grew even stronger with quantum theories of particles as not real but rather just abstract fluctuations of imagined *fundamentally* random, *potential* mathematical fields. But as these fields are now being theorized ultimately to be an omnipresent, omnipotent unified field, ancient views of the *concept* of an omnipresent ‘God’ are being reconsidered.

### Local causality and the light cone

A core feature of relativistic physical theory is that there is nothing outside of the spacetime gravitational field. Spacetime can expand, but seemingly reasonable questions about what exists beyond it—such as what it expands into, or possibly shrinks from—were considered meaningless because there is no background.

Another feature is that nothing can travel faster than light. Light-speed and the frame of reference of the observer define the *light cone*. There is no possibility of an object causally affecting another outside the light cone. The past light cone includes everything that causally influenced the particular observer in the past, and the observer’s future light cone expands at light-speed the range of potential causal influences into

the future. This model of *local causality* means all change and cause-effect relations are limited by light-speed, including any form and transmission of information.

And another feature is that observers with similar motion will get the same results in measuring duration and distance; but differences show up if relative motion becomes extremely different (near light-speed). This suggests that the spacetime we ordinarily think we move in is *not* a separate background. Our physical bodies are part of this field, and even how old or wide our bodies are measured to be will change compared to other objects depending on motion relative to each other. In this theory, space and time are relative; but the *spacetime interval* is absolute (the same for all observers).

Finally, another feature is that cause-and-effect is considered an unbroken, closed chain. Because this causal chain began long before we existed and has no breaks in it, it suggests we are basically robots with no free will. While it isn’t surprising that Einstein believed in this physicalist view that excludes free will, it is noteworthy that he emphasized personal responsibility—consistent with free will and seemingly inconsistent with his own theories.

After unifying gravity, space, and time, Einstein worked to develop a unified field theory. Despite his great progress toward unification, there still remained the two entities of physical objects and space, and he could not sort out which was primary. Though spending his later years on this project, Einstein did not succeed in establishing a unified field theory.

### Quantum field theory and unified field theory

Powerful indirect methods have since taken us far beyond evidence obtained directly through the ordinary senses. Investigating deeper layers, we recognized that measuring can alter the objects, making *objective* experimentation of independent objects more difficult. Moreover, it brought into question the notion of definite individual objects in the first place, and whether observed and observer are ‘independent’—core tenets of ‘*objectified*’ science.

A major change from physical to quantum theory is that these issues were recognized in the *measurement problem*. Assumptions about the object investigated, the probes, evidence of their interaction, as well as the observer’s role, now must be considered. Historically such subjective-tinged issues had been the purview of philosophy, and to some degree religion—the *mind-body*



*problem* and the more recent *hard problem* of consciousness. These issues are now prominent in quantum physics, and also in psychology and neuroscience associated with the *explanatory gap* between brain, mind, and consciousness. In physical theory and objective science generally, mind is separate from physical matter (mind-matter duality, subject-object independence), but nothing other than it—a fundamental inconsistency.

In quantum field theory, *potential* quantum fields *potentially* fluctuate at multiples of the *Planck scale*—the smallest size of any object and any physical measurement. At the smallest scales, the notion of dividing distance to a dimensionless point doesn't quite work. Particles were no longer considered tiny bits of solid matter in spacetime, but rather to have no material existence, being abstract mathematical *potentials* conceptualized as if real fields.

Further attempts to unify the fundamental fields were aided by the mathematical concept of *symmetry*. In this view, the universe emerged from its unified state in sequential symmetry breaking when the extreme initial energy and temperature dropped in an expanding 'hot big bang.' The principle of symmetry helped develop theories that posit how (at about  $10^{-16}$  cm) the electromagnetic and weak nuclear forces unify into the *electroweak* force—*Standard Model*. Research on the Higgs boson may definitively support this model. Some evidence suggests that (at about  $10^{-27}$  cm) electroweak and strong nuclear forces also unify—*Grand Unification*. But this is not yet a unified field theory that includes gravity.

In the 1970s, the principle of *super-symmetry* fostered attempts to unify matter particles and force particles, and also strong-electroweak and gravity fields, such as in quantum gravity and string/M-theories. This requires super-symmetric partners with matching opposite properties for all particles, associated with *dark matter*. This concept was proposed in part to construct theories to explain how galaxies hold together, which requires more energy than seems to exist in the 'visible' universe. It is different from *dark energy*, which in part was proposed to account for the universe's increasing rate of expansion. However, so far these super-symmetric particles haven't been found in the natural world.

It is interesting that super-symmetric unified field theory can be viewed as bringing back to science core attributes that Newton, and other

ancient views, attributed to 'God.' Whatever personal attributes are ascribed to 'God' in religious and other ancient traditions, the impersonal attributes—omnipresent, omnipotent, infinite, eternal—sound quite similar to attributes of a unified field. These theories expand the *one-level* physical model to *two-level* models, adding an unbounded unified field.

In classical one-level physical theory, mind is reducible to the brain. But despite extensive research, mind has not been found there. If mind is in the brain only, it must be in the closed physical causal chain that started long ago—with no way to add a causal influence, such as a mental intention. This fragmented view still guides technology, and its adherents are racing toward a *post-human era* of genetically reengineered life forms and man-machine cyborgs that could permanently alter and even end the human race as we know it.

### **What is nonlocality?**

With this description of locality, we can contrast concrete locality to abstract nonlocality. This also concerns the epistemological/ontological gap between conceptual mathematics of quantum *potentials* and empirical physics of *real* objects. The initial standard (orthodox, Copenhagen) interpretations of quantum theory held that the quantum wave function in imagined mathematical space *instantaneously* collapses to a real object in ordinary physical space when observed. More recent quantum theory interpretations—including many-worlds, objective reduction, quantum information field, and especially Bohmian neorealism—have begun to bridge the gap between imagined mathematical space and real physical space. Causal mechanisms for the transition are theorized, rather than asserting *instantaneous* change with no space or time for causal mechanics (Boyer, 2009, 2011, 2012).

In other words, the quantum wave function is *no longer* just an equation in imagined mathematical space. It involves 'quantum objects' in an abstract but real field of existence. This implies a subtler meaning of spacetime beyond relativistic spacetime and Planck scale limitations, beyond notions of entangled particles, and beyond imagined physical information fields. At the Planck scale, ordinary notions of spacetime break down. But this doesn't invalidate *all* notions of it. Empirically validated nonlocality suggests a *deeper ontologically real level of spacetime* (Boyer, 2008). Nonlocality means real 'quantum objects' that are interconnected in a way not accounted for



by physical spacetime limited by light-speed, fundamental force fields, or abstract information fields in local causality.

In standard quantum theory interpretations, before measurement a 'quantum object' is sort of spread throughout the unbounded quantum field in an imagined mathematical sense. And there is at least some probability of 'it' appearing *anywhere* when measured physically. This uncertainty means that classical cause-effect relationships cannot be specified precisely, which deeply challenged even the most eminent modern scientists. Einstein, for one, argued vigorously that quantum theory is incomplete. He believed there must be unknown information or processes involved—*hidden variables*. Eventually when no longer hidden, we will get beyond probabilistic quantum theory and back to a determinate objective account of nature. As Einstein (2008) famously quipped: "I cannot believe that God plays dice with the universe." But the empirical findings of real nonlocal effects in nature showed that Einstein's meaning of 'hidden variables' was wrong.

### Empirical validation of nonlocality

In the 1980s, crucial tests of nonlocality were developed based on *Bell's theorem* (Herbert, 1985; Walker, 2000). This theorem can be interpreted as containing key assumptions about nature, including that objects have an objective existence independently of the observer, information/energy/matter cannot travel faster than light-speed, and nature follows deterministic laws of cause-and-effect. They were actual experiments similar to Einstein, Podolsky, and Rosen's (1935) thought experiment.

One example of the experimental set-up involves directing atoms into a laser light beam. The atoms absorb a photon and then give off a mirror twin pair of photons. Then each twin photon is aimed at a series of filters that allow only some photons to pass through. The probability of a photon passing through a filter depends on the angle of the filter. If one of the twin photons passes through a filter in a certain state, such as with spin up, then according to the laws of physics, this will have consequences on its twin photon if it passes through a corresponding filter—it will be spin down—with a probability determined by the filter's angle with respect to the first twin's filter. The filter angles are changed fast enough to prevent light particles from the filters reaching each other to influence the result.

The two models were compared empirically in order to test whether it is possible for the twin photons to carry information that allows them to correlate highly with each other under any filtering conditions. Bell's theorem calculates a limit on what information can be carried by the separated twin photons. This allows comparisons of any hidden variables or pre-planned information predictions to probabilistic quantum theory predictions. When the predictions were compared, the outcomes supported quantum theory (Aspect, Grangier, Roger, 1982; Aspect, Dalibard, Roger, 1982).

The findings are an example of *quantum entanglement*—specifically phase entanglement. This refers to the highly correlated behavior of particles after they interact and separate, even when light-speed would have disallowed them from exchanging information with each other after they have separated. However, the results are *not* considered an ultimate test of hidden variable theories, but of locality (Bell, 1987). Physicist Brian Greene (2004) explains:

...Einstein, Podolsky, and Rosen were proven by experiment—not by theory, not by pondering, but by nature—to be wrong.... But where could they have gone wrong? Well, remember that the Einstein, Podolsky, and Rosen argument hangs on one central assumption: if at a given moment you can determine a feature of an object by an experiment done on another, spatially distinct object, then the first object must have had this feature all along.... More precisely, since nothing goes faster than the speed of light, if your measurement on one object were somehow to cause a change in the other—for example, to cause the other to take on an identical spinning motion about a chosen axis—there would have to be a delay before this could happen, a delay at least as long as the time it would take light to traverse the distance between the two objects.... We are forced to conclude that the assumption made by Einstein, Podolsky, and Rosen, no matter how reasonable it seems, cannot be how our quantum universe works (p. 113).

Nonlocality is sometimes taken to mean *of infinite extent*—completely unbounded, such as in imaginary mathematical space. But it might also mean just *not local*. It includes the possibility of the unified field as infinite, but also the possibility of a finite field of such vast extent as to be *almost* infinite but still finite. It can refer to being *not local* in the sense of not being limited by light-speed, classical linear causality, and relativistic spacetime gravity.



### **Nonlocal communication?**

What is so disconcerting about nonlocality is that it clearly implies action not mediated by the four known fundamental fields within the speed of light. It is quite challenging to comprehend how distant objects highly correlate with each other with no known medium to connect them. Nonetheless, based on definitive experiments, no longer can such 'action-at-a-distance' be rejected either on theoretical or empirical grounds.

However, it may be possible to accept nonlocality without accepting the type of *nonlocal communication* that is suggested, for example, by anecdotal reports in spiritual traditions throughout history. Many scientists believe no one has yet shown nonlocal communication within objective methodology. Several concerns argue against it, even if possible based on nonlocality. One concern is that the correlations demonstrating nonlocality are extremely sensitive and delicate; if a communication message were to be added, it would disrupt the correlations. And even if individual messages could travel faster than light, they could not be communication signals because they would be random with respect to each other. But these concerns also are being challenged by research on nonlocality. At this stage then, there is classical physical theory tied to ordinary experience, and more inclusive quantum field theory tied to mathematical probabilities that predict phenomena physical theory cannot.

### **Nonlocal causality?**

A model beyond classical local causality appears to be necessary in order to describe the dynamics of an ontologically real nonlocal level of nature. In such a model, causal influences might be more spread out than in classical billiard ball/particle-interaction causal models. This can be associated with a *nonlocal causal wave* (Boyer, 2008). This model would mean there is 'active' information in the nonlocal interdependent wave-field that precedes and shapes classical local events. Ordinary discrete local events with particle interaction causal mechanics would be embedded in a larger, subtler field involving nonlocal causal dynamics. Real nonlocal minds could influence local physical matter (mind over matter) via real nonlocal mental intentions (Schwartz, Begley, 2002; Boyer, 2008, 2013) in this nonlocal field. Such more advanced scientific models are developing now, associated with the concept of an underlying subtle field that includes nonlocal 'quantum mind.'

Although we ordinarily sense events as discrete in spacetime, we may also have some intuitive sense of the unseen converging precedents that shape them. We further may have some sense of the continuing aftereffects of discrete events that shape subsequent events—a richer interdependence, entanglement, or 'synchronicity' both spatially and temporally than surface discrete sensory experience. This may be at least a little more tangible in such phenomena as presentiment and precognitive processes. Presentiment relates to anticipatory responses to a local event even prior to decisions that select the event, presumably based on subtle nonlocal information not apparent in the physical causal chain. It can be somewhat analogous to the spreading out of spacetime dilation in relativity theory as light-speed is approached (Radin, Borges, 2009), but also not limited by light-speed. Physicist F. David Peat (2016) gives a helpful description for envisioning how this view of quantum holism, with a subtler real field that is not just imaginary mathematical space, might allow nonlocal causal dynamics:

[L]ocality has served physics well, which implies that our hypothetical underlying non-local effects must be extremely subtle. So where should we look for them?... I suggest that the most promising place to look is in these extraordinarily sensitive non-linear systems that are termed "chaotic".... But "chaos" may be a poor term to describe such systems for it is not so much that they are "random", "anarchic", or "orderless" as that they have an extremely complex and subtle order.... Information which is distributed globally...would be hidden within the apparent chaos of a sensitive system. Attention to individual regions of space would not be sufficient to display this non-local influence. What is required is some new, global description of these systems.... Local disturbances propagate through a system and are normally assumed to dissipate themselves, becoming lost in the random fluctuations of the medium. But in a world in which events are correlated non-locally...a vanishingly small random fluctuation may in fact be the manifestation of a global order. Extremely small perturbations, when correlated non-locally, could, for example, have the effect of initiating an inwardly moving wave of disturbance which then interferes cooperatively and give rise to a large local disturbance....



### Three-level models

We now consider examples of models progressing toward a real non-physical, nonlocal field of nature with causally efficacious nonlocal *quantum minds*. Quantum theory recognizes the *interdependence* of mind and matter and the necessity to account for their relationship. This is exemplified in models positing a subtler, more abstract nonlocal information field, existing *in-between* the physical level and all-encompassing unified field, where real minds could exist. It is supported by the empirical validation of nonlocality and the inability to find mind and consciousness in the local physical brain (Boyer, 2008). Along with this expanded understanding, the universe is also now becoming modeled more abstractly as a 'cosmic computer' (software, information) rather than a cosmic machine (hardware, matter). Further, it is important that progress toward ontologically real three-level models has much more than coincidental correspondence with abstract concepts in some religious traditions (for just one example, Father, Son, and Holy Spirit), and in 'ancient sciences' discussed shortly. But first we briefly consider three-level models by leading theoretical physicists.

Mathematician/physicist David Bohm's three-level hierarchical model posits *quantum reality* as a nonlocal field that underlies and causally affects physical matter (Bohm, 1981; Bohm, Hiley, 1993). This model is sometimes called *neorealism* because it recovers both the fundamental principles of objectivity independent of the observer and of nature as determinate, which historically were basic to realism but not to standard quantum theory. This model holds that particles are real whether measured or not (a tree falling in the woods creates a sound whether anyone hears it). Their dynamic attributes of motion are guided in part by a nonlocal guiding wave: the *psi wave*. To match quantum probability predictions, the psi wave must be connected to every particle in the universe, classically invisible, and common in nature (Bohm, 1981)—a subtler, highly interdependent, almost maximally entangled medium. The path of a particle is influenced by classical physical forces in their environmental contexts, and also by the 'active' influence of a subtler nonlocal psi wave field.

The conscious observer is brought back into science via the psi wave as an intentional influence in this underlying real nonlocal field. This field, including nonlocal *quantum mind*, is in the brain in the sense of permeating and causally

influencing it. But it would be both smaller than (permeating) and also bigger than (encompassing) the entire physical universe. In other words, gross real *matterstuff* is embedded in a subtler real *mindstuff*. This view allows at least a logically consistent model of how your brain and arm, for example, is guided by your mind. This model goes beyond virtual particles, entangled particles, and quantized fields into a more abstract substance or medium that is finite but not limited to light-speed.

In this neorealist interpretation, the classical physical level is called the *explicate* order. It is underlain and permeated by the subtler *implicate* order, a highly interconnected nonlocal field of much more abstract wave impulses with meaning ('signal' value). Individual mental intentions in this field cause motion in physical spacetime. Further, both *explicate* and *implicate* orders exist in the *super-implicate* order (Bohm, 1981) akin to a unified field.

This three-level model has some correspondence with a model by mathematician/cosmologist Roger Penrose (2005). In a discussion of mathematical forms associated with an abstract but real 'Platonic realm' in nature, Penrose also outlines a model with three levels or 'worlds':

I have schematically indicated all of these three forms of existence—the physical, the mental, and the Platonic mathematical—as entities belonging to three separate 'worlds'... There may be a sense in which the three worlds are not separate at all, but merely reflect, individually, aspects of a deeper truth about the world as a whole of which we have little conception at the present time (pp. 20-23).

Another recent model that proposes three real forms of existence has been outlined by physicist Henry Stapp (2000, 2007). In the following quotes about quantum wave function collapse, three real levels are used to explain how objective and subjective aspects of nature might causally interact. Stapp (2000) states that consciousness is needed in quantum wave function collapse because:

...the local-reductionistic laws of physics, regarded as a causal description of nature, are incomplete.... The physical part of reality represents merely the possibilities for an actual experience, not the actually experienced reality itself (p. 213).

[F]rom the purely physical standpoint the [wave function] collapse seems to come from nowhere, as an unpredictable and undetermined 'bolt from the blue.' Something is needed to...bring



'classicality' into the dynamics, and it needs a 'cause' for the collapse, and it needs a reality to complement the 'potentia'... It must be something that exists, and the only thing that we know exists, besides the physical part of reality...is the experiential part... (p. 212).

Stapp's three-aspect model includes physical reality, experiential reality, and all-possibility Hilbert space. The concept of all-possibility Hilbert space has similarities to the super-implicate order in the neorealist model. It further has similarities to Penrose's ideas about the 'Platonic realm' in his statement just quoted (though it is not clear how Penrose's three worlds reconcile with his physicalism). These three-level models also have some correspondence with the unified field as the source and container of everything, including the finite local level and the nonlocal level that is in-between it and the infinite unified field.

Mathematician/physicist Max Tegmark offers a four-level model (2014): Level I includes our universe and parallel universes in ordinary space so far away they haven't reached us; Level II also includes universes travelling away that will never reach us; Level III is abstract 'quantum objects' not in ordinary space; and Level IV is a transcendent mathematical reality.

"The Computable Universe (CUH)...mathematical structure that is our external physical reality is defined by computable functions....The Finite Universe Hypothesis (FUH) that our external physical reality is a finite mathematical structure implies the CUH and eliminates all concerns about reality being undefined.... The MUH implies that there are no undefined initial conditions: initial conditions tell us nothing about physical reality, merely about our address in the multiverse [where we happen to exist in the Level I and II parallel universes, which relates to the specific conditions that formed our habitable part].... The MUH implies that there's no fundamental randomness...." (p. 357)

Curiously, Tegmark describes physical reality as "Everything that exists (2014, p. 120)" suggestive of a one-level model, like Penrose. However, his use of inflationary big bang theory with its prediction of multiverses does go beyond the ordinary meaning of physical. His model also can be seen as a three-level model, in that Levels I and II have the same ontology—ordinary space. This mathematical model has some affinity with physicist Paul Davies' three-level model of

information-laws of nature-matter (Davies, Gregersen, 2010).

Another model with three levels, by physicist John Hagelin (1987, 1989) is an abstract mathematical *Lagrangian* formulation. It also associates the unified quantum field with Hilbert space, a complex vector space of infinite dimensions that comprises all states of a quantum mechanical system, the nature of which gives rise to operators and states in it. Hagelin uses this formulation to present a unified field theory that more explicitly includes principles identifiable with the concepts of the knower or observer and the process of knowing—not just the known as in classical physics.

The *knower* or observer quality of the field is interpreted as the property of the Hilbert *space* of states to be a non-changing, unmanifest background for all possible unitary transformations or states of the field, while itself remaining completely unchanged. The *process of knowing* quality of the field is related to quantum mechanical observables that serve as quantum mechanical *operators* in Hilbert space, generating changes of one state into another in unitary transformations. The *known* is interpreted as the stable quantum mechanical *states* themselves. This model goes beyond classical and quantum theories in the sense that it incorporates in mathematical terms the knower and process of knowing—linking more directly with the ancient Vedic 3-in-1 model.

### The holistic Vedic 3-in-1 model

The ancient knowledge tradition of *Veda* is referred to as 'total knowledge (Maharishi, 1994),' a complete account of the laws of nature similar to the aspiration of modern science. It is not a faith-based religion; rather, it is held to be an ancient *science* emphasizing both theoretical consistency and empirical validation, from which various religions and philosophies have drawn. A pivotal contribution to its reemergence is its re-clarification by Maharishi Mahesh Yogi, a contemporary proponent of holistic Vedic knowledge who focused on reviving and testing it in a scientific context as *Maharishi Vedic Science and Technology*. In ancient Vedic science, as well as other traditions albeit with various cultural and language differences, there is purported to be a transcendent universal essence of nature. This ancient account corroborates the emerging views of an all-encompassing unified field. The most parsimonious explanation is that these ancient and modern views are converging on the same



unified field (Hagelin, 1987). Logically, there is only one completely unified field.

Although there is no coherent theory in modern science of the nature of consciousness, fortunately it is now one of the most prominent topics. And cutting edge theories are finally recognizing that mind and consciousness are phenomenally real. Further in the ancient Vedic account, individual subjective minds and objects of sense (the subject-object duality) are both described as emerging *within* the transcendent infinite eternal Totality. The bottom-line is the infinitely self-interacting unified field within which phenomenally exists a subtle nonlocal, entangled, object-interdependent level, which in turn permeates our familiar gross local, object-independent physical world. Both subjective minds and their phenomenal objects of experience emerge within the unified totality that is held to be consciousness itself.

However, nonlocal 'quantum mind' as subtler than the brain does not mean some kind of 'group mind' with no individuality. The texture of the nonlocal field is attributed as having both more specificity and interdependence *simultaneously*. It would have individualized fluctuations, waves, or impulses that interact in a much more abstract and subtle way than any object in our physical world. In this view, the level in-between local physical matter and the unified field is determinate (not indeterminate and random); nonlocal (not just local); wave-like (not just particle-like); includes mind as *real* (not epiphenomenal); includes mind as subtler than matter (not emerging as a product of the brain); includes mind as causally efficacious (we are not robots); and includes nature as both subjective and objective (not subjectivity that is independent of objectivity in irreconcilable dualism).

### **Top-down diversification and bottom-up unification**

The one-level model of physical realism was not complete enough to locate where an ontologically real mind could exist. Fortunately, there is growing recognition that the ancient holistic Vedic account has considerable logically consistent detail on this foundational issue. In this account, it is not that survival behavior, intentional top-down causation, and consciousness are created as bottom-up emergent properties in the process of biological evolution with increasing complexity from random inert wave-particles. And it is not that higher-order top-down processes didn't exist before their emergence, or that they have no

inherent direction or purpose. Rather, they inhere in the unified field, and through long time periods become expressed, guided all along the way by subtler nonlocal causal dynamics.

In this context, emergence refers to higher-order expressions of latent functions, not emergent phenomena with no ontological substrate. Experiential reports of such higher evolutionary development run through spiritual literature and art—though sometimes quite obscure. We are closer to fitting these subtler experiences into a coherent scientific model.

In the holistic Vedic account, phenomenal nature is said to be an eternal cyclic process of the diversification of individual parts from ultimate universal wholeness, and then evolving to instantiate the underlying unity or wholeness in each part. This is a never-ending cyclic process across vast eons of time. The theory of evolutionary biological emergence can be viewed as consistent with one phase of this cycle. In other words, higher-order, top-down mental processes emerge with increasingly complex physical structures. But these complex physical structures are shaped by non-physical processes in a grand evolutionary process (in Vedic literature, associated with *Dharma* and the laws structuring phenomenal nature).

As the field of all possibilities, the unified field of universal Being is its own self-referral physiology; and contained within its fine fabric is the intelligence and energy that manifest all beings and objects. Its phenomenally grossest level is inert particles or atoms comprising rocks and earth. On this concrete physical level associated with the ordinary waking state of consciousness, the inherent intelligence and energy of nature appear to be the least integrated, and mind and matter appear to be the most separate (mind/matter duality).

At the subtle nonlocal level, energy and intelligence are more integrated. This level has more the character of subtle mind and thought forms than concrete forms of gross matter. The subtle mind initiates and directs the gross body to move, carried out through nonlocal dynamics of mental intentions that become expressed in classical biophysical mechanics. Mind and body reciprocally influence each other. As mind and body develop, more complexity and higher-order functions emerge—from plants to insects to lower animals and then to humans where top-down control of mind over matter becomes evident as free will. In other words, *innerspace* is a more expanded real field of nature that includes





*outerspace*. This is said to be directly experienced in higher evolutionary stages of human development.

According to the reductive story in modern science, subjectivity is due to collections of bottom-line, random, inert energy-matter fields. Eventually these fields somehow synthesize into complex biological organisms that can sense, think, and be aware of their surroundings for survival value, through 'blind,' meaningless random mutations and natural selection. Biological survival is considered basic to natural selection. But there is no coherent account of how the *value* of survival gets into the value-less closed physical causal chain that began long before biological organisms existed, and that has no purpose, such as survival, at all.

Higher-order biological organisms are entirely due to (supervene on) lower-order, bottom-up inert processes—called *epistemological emergence*. As increasingly complex physical structures spontaneously happened, empirically some were both more stable and adaptable, and thus able to last longer. In this view, the difference between living and non-living is a matter of systems complex and flexible enough to maintain 'themselves' (survive). By random change, these systems developed into functional units that can copy themselves.

Then it was recognized that, for these unitary-behaving biological organisms, there must be some means for guiding the lower-order parts into functional holistic units that are more than the sum of the parts—so-called *ontological emergence*. But all the processes, higher-order and lower-order, remain within the closed causal chain. There was no real top-down biophysical causal guidance, and no ontologically real unitary biological organism as a 'self.'

And then arguments were made for 'self-organizing systems' to emerge spontaneously, without any planned precedents. However, these unitary systems (selves) are now becoming recognized to require at least some intelligent orderliness and real meaningful information. The major current scientific speculations include that the order came from outside, such as in artificially intelligent systems, or from outer space such as riding on meteors, or from infinite possibilities of random fluctuations of 'nothing.' Through an incredibly extensive orderly series of fundamentally random steps, the 'right values' of nothing led to complex biological information processing systems. These systems since have managed to build upon the first spontaneous

instance of non-randomness to create self-aware and seemingly purposive organismic 'selves' such as us—of course without any purpose or value at all.

In this part of the story, the synthesizing of parts into wholes is emphasized. What is missing for a coherent account is the other part: the all-encompassing unified field as orderly and whole. In that part of the story, nature diversifies into parts and then synthesizes into wholes, from unity to diversity and then back to unity, in an eternal cycle.

This phenomenal process is unfolded in the Veda. For example, as enumerated in the *Sankhya* part of Vedic literature (Maharishi, 1967), the sequence of manifestation from wholeness to parts is from the unmanifest unified field of consciousness (called *Purusha/Prakriti*) to the subtlest manifest level (*Mahat* or cosmic ego), to Ahamkara (sometimes called cosmic intellect, or also *Buddhi*), to mind (*Manas*), to the organs of sense (*Indriyas*) and organs of action (*Karmendriyas*), to the subtle objects of sense, the five essences of space, air, fire, water, and earth (*Tanmatras*), and finally to the ordinary gross objects of sense, the five gross elements (*Mahabhutas*). The gross elements relate to quantum wave-particle fields emerging in a type of symmetry-breaking. This means that all levels of phenomenal nature exist as relatively *real*, whether or not any particular individual is observing/measuring them. However, what is experienced when observed depends on the level of nature being observed and processes used for observing.

With the phenomenal structure of levels already in place to be observed, we human observers initially observed the gross surface level. Eventually we developed objective methodology (third-person perspective) for investigation, and the gross physical level appeared to be inert (earth, water, air and so on), independent of us, devoid of sentience, and the most *real* from the object/subject duality of experience in the ordinary waking state.

In the holistic Vedic account, the gross parts naturally congealed into more complex wholes of intelligent biological 'selves' with power to direct their own behavior (Boyer, 2014). With more refined experiences in higher states, the subtler, interdependent, non-physical, nonlocal level associated more with sentience appears even more *real* than the local physical level. In the highest evolutionary development, all phenomena are experienced as *Maya*, ever-changing



'measurable' existence, and their essence as infinite, eternal, never-changing universal Being is the only *reality*.

This again is the holistic Vedic 3-in-1 model, experienced as relatively *real* at the gross local level, eventually experienced as relatively more real at the subtle non-local level, and finally as the *ultimate reality* at the infinite eternal unified field of the universal Self. In the following quote from 1963 (pp. 32-33), Maharishi summarizes steps of progress toward the holistic 3-in-1 Vedic model of nature in modern science:

"Certainly, in his attempts to scientifically establish the unified field theory, Einstein seems to have been clearly aware of the possibility of one ultimate basis of all diversity.... If and when physical science arrives at what Einstein was trying to pinpoint by his unified field theory, one element will be established as the basis of all relative creation.... It may be given a different name but the content will establish the principle of unity in the midst of diversity.... The discovery of the field of this one basis of material existence will mark the ultimate achievement in the history of development of physical science. This will serve to turn the world of physical science to the science of mental phenomena. Theories of mind, intellect, and ego will supersede the findings of physical science. At the ultimate or the extreme limit of investigation into the nature of reality in the field of the mind will eventually be located the state of pure consciousness, the field of the transcendental nature lying beyond all relative existence of material and mental values of life.... The Science of Being transcends the science of mind which in its turn transcends the science of matter which, again, in turn, transcends the diversity of material existence...."

### Summary and conclusion

This paper briefly overviewed modern scientific progress from observable evidence of the local, concrete, finite, physical world to indirect evidence of an underlying nonlocal, abstract, finite, non-physical world—to identify 'where' nonlocality is. Nonlocality relates to the subtle information field *in-between* the local physical field and the unified field, associated with the subtle level of *quantum mind*. The historically predominant one-level local physical ontology has been superseded by more expanded models, importantly supported by empirical validation of nonlocality. The implications of nonlocality include real conscious minds and real free will. It is a more logically coherent scientific view than

the reductive physicalism that bred existential meaninglessness, randomness, and purposeless.

This paper also introduced the ancient holistic Vedic 3-in-1 account as re-clarified in Maharishi Vedic Science and Technology, with a real place for nonlocality and for mind. The holistic account is now being investigated using modern indirect experimental (third-person) and also ancient systematic direct experiential (first-person) methods to explore the matter-mind-consciousness relationship—a profound integration that is of revolutionary practical significance for modern science and technology.

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