A Critique of Scientific Realism Based in Vedic Principles

Robert W. Boyer

ABSTRACT

The shift from particle to field theories has been crumbling pillars of classical objective science, and is reverberating in philosophy of science. Fundamental issues implicit in objective science—process of observing, observer or subject, dividing line between objective and subjective—are now more explicit. These issues are examined in this critique of scientific realism, held to be the best argument for objective science. A developmental model of levels of reality in different states of consciousness is introduced as a more integrated framework for addressing the core challenges to scientific realism.

Key Words: structuralism, realism, idealism, ontic, epistemic, objective, subjective, yoga, 3-in-1 Vedic model

NeuroQuantology 2013; 3: 477-502

1. Introduction

We see the Sun rise in the east and set in the west. Reasoning about it, we came to believe that the Sun orbits the Earth. Studying the motion of stars and reasoning further about what we didn't directly observe, we concluded that the Earth orbits the Sun. This shift can be considered scientific progress, or deeply troubling and inconsistent because we believed one explanation and then just the opposite. Similar shifts have occurred in the history of science. The current phase is sometimes characterized as a Kuhnian revolution, in which our most trusted theories are changing and may be abandoned.

The historical example above reflects issues now prominent in philosophy of science. Is there continuity in science toward a deeper *reality*? Is the apparent continuity attributable to logical mathematical structures and relational features of phenomenal experiences, or to what is *real* about objects independent of logic and experience? Indeed, can science tell us about *reality* at all? Such questions shout out with changing views of *reality* from concrete matter to intangible quantum waves to abstract information fields toward an all-encompassing unified field.

This paper takes a new look at the ancient Vedic holistic account in examining these issues. To summarize briefly, the Vedic account emphasizes ultimate unity (like unified field theory but also with object-subject unity). It recognizes epistemic stages in which object and subject are viewed as *independent* (classical level), as *interdependent* (quantum level), and as ultimately unified (unified field) in an expanded ontology of *levels of reality*. This *developmental* framework is introduced in the last section of the paper, in order to reconcile the contemporary views discussed first. It is summarized in the deeply integrating principle from Vedic proponent Maharishi Mahesh Yogi (1972): "*Knowledge is different in different states of consciousness*."

Corresponding author: Robert W Boyer, PhD
Address: Institute for Advanced Research, Malibu CA
641-472-2566
✉ rw.boyer@yahoo.com
Relevant conflicts of interest/financial disclosures: Nothing to report. Full financial disclosures and author roles may be found in the online version of this article.
Received August 19, 2013. **Accepted** August 27, 2013.
*e*ISSN 1303-5150

2. Scientific realism

Scientific realism was based on the belief that entities or objects we can hear, touch, see, taste, and smell exist as *real* in nature on their own, independent of us. There are two main forms, the most prominent of which grounds ordinary empirical observations on belief in *real*, objective physical objects independent of the subjective observer. The other, associated with *Platonism*, goes much further to ground even abstract mathematical forms on belief in a *real* nonphysical level of nature.

Scientific realism largely emerged from and in reaction to logical positivism, the first major approach in philosophy of science. This approach was eventually recognized as inadequate, especially as we investigated theorized smaller time and distance scales beyond macroscopic sensory observation. Our conceptualizations and descriptions of *real* objects have changed dramatically in the process of probing these finer-grained layers of nature. We have discovered cellular and molecular layers, glimpsed atomic layers, and proposed unobservable objects far beyond positivist beliefs in observables to intangible particle-forces and 'imaginary' fields of abstract mathematical quantum probability waves. But how 'imaginary' mathematical quantum probability waves become observable *real* objects in the objective world still remains quite a mystery.

The gap between 'imaginary' mathematical structures in field theories (based on reasoning) and *real* macroscopic objects (based on empirical experience) placed subjectivity squarely in modern physics, associated with the measurement problem. This problem requires reconsideration of the independence of object and subject long believed by many including Einstein to be fundamental to science (Herbert, 1985). The *interdependence* of objects (e.g., quantum entanglement) and the subjective observer (e.g., quantum wave function collapse) is acknowledged—but not articulated.

Further, scientific theories are now proposed and also even evaluated on the basis of mathematical principles such as symmetry and super-symmetry without direct or indirect empirical means to validate them due to limitations of experimental methods. In this *mathematization* of science, considerable contemporary research is about 'unobservable entities'—quantum probability waves, spacetime foam, strings, branes, qubits. This has generated concern about speculative models not grounded in empiricism, and based on unverifiable *faith* in the mathematics (Smolin, 2006; Woit, 2006). It seems to be contributing further to the fervor in mainstream and some cutting edge theories to avoid subjectivity in order to keep science *objective*.

As described in a comprehensive survey paper by Ladyman (2009) extensively drawn upon here, "Scientific realism is the view that we ought to believe in the unobservable entities posited by our most successful scientific theories (p. 1)." According to the 'no-miracles' argument (Putnam, 1975), these theories predict so precisely the results of direct and indirect empirical experiments that indeed it *"...would be miraculous if scientific theories were not at least approximately true descriptions of the world* (Ladyman, 2009, p. 1)." It would be hard to deny our practical belief in these scientific theories when they are applied in technologies we risk our lives on daily. We now have strong belief in science to inform us about unseen *realities* of nature—historically a concern with religion.

On the other hand, critics of scientific realism argue that empirical evidence is not sufficient to determine which scientific theories uniquely describe unobservable entities and their causal determinants; that is, the theories are 'underdetermined.'

> "While the underdetermination argument is often cited as giving grounds for skepticism about theories of unobservable entities, arguably the most powerful arguments against scientific realism are based on the history of radical theory change in science. The best-known...is the notorious pessimistic meta-induction, according to which reflection on the abandonment of theories in the history of science motivates the expectation that our best current scientific theories will themselves be abandoned, and hence that we ought not to assent to them (Ladyman, 2009, p.1)."

Critics further question how we rationally can accept the claims of current scientific theories if even perhaps the most accepted ones are likely to be abandoned, and if the objects or entities posited in the theories are unobservable, and if we cannot eliminate competing models of them or of their causal determinants. In response, various views are being put forth to shore up scientific realism,

especially *structural realism*. We will briefly review the major criticisms and supportive views, and then consider the Vedic developmental perspective as a basis for integrating them.

3. Anti-realism, idealism, and non-realism

Anti-realism and its partners question claims that unobservable entities described in scientific theories—e.g., sub-atomic particles or quantum probability waves—exist as *real*. And they question further whether we can ever validate *objective reality*, because any validation depends on us as subjective observers. The claim of Platonism that even abstract mathematical forms exist objectively independent of subjective minds is also denied. We will later discuss the belief that we have no access to a mind-independent *reality* anyway, and further that there are no *non-conceptual experiences*.

> "[T]he realist naturally thinks that there is a distinction between our ideas or concepts and that which they represent, namely, the world. The ultimate court of appeal for judging the validity of our representations is this independent world.... The idealist, on the other hand, quickly points out that we have no access to such an independent world except through our representations. We cannot stand outside of ourselves to behold the degree of fit that our representations might have with the world. In fact, we simply have no idea of what the outside world is except that it is the presumed object of our representations. Taking this point to the extreme, the idealist argues that the very idea of a world independent of representations is itself only another of our representations... (Varela, Thompson & Rosch, 1993, p.161)."

> "There is no such thing as philosophy-free science; there is only science whose philosophical baggage is taken on board without examination (Dennett, 1995)."

Taking the next step in this direction, it is useful to recognize that all third-person *objective* observations are also first-person subjective observations. Rigorous experimental methods and consensual validation, hallmarks of *objective* science, are based on *intra-subjective* (first-person) and *inter-subjective* (second and third-person) consistency (Boyer, 2008). Recognition that subjectivity underlies all objectivity opens up serious consideration of systematic means to develop our subjective minds directly in order to gain reliable scientific knowledge—the purpose of the ancient Vedic developmental account and missing ingredient in modern science, to be discussed later.

Science is further criticized for not having a unifying methodology, not providing evidence for its own philosophical bases, and actively suppressing views not easily fitting into its mainstream beliefs:

> "[W]e have theories that work in restricted regions, we have purely formal attempts to condense them into a single formula, we have lots of unfounded claims (such as the claim that all of chemistry can be reduced to physics), [and] phenomena that do not fit into the accepted framework are suppressed (Feyerabend, 1987, p. 100).

3.1 Instrumentalism

The instrumentalist approach to non-realism takes an agnostic view of these issues. Whether unobservable entities exist as ontologically *real* and whether science produces knowledge that is *true* are not necessary to address—and cannot be known. In this approach, unobservable entities in scientific theories serve as instruments to help construct more accessible or imaginable models of what nature might be like. But theories should be evaluated on their ability to predict phenomena, not their 'truth-value' in describing and explaining presumed ontologically *real* entities in nature.

4. Structural realism

The most prominent approach in support of scientific realism is *structural realism*. Ladyman (2009, p.1) states that it is "considered by many realists and antirealists alike to be the most defensible form of scientific realism." Attributed to Worrall (1989), it attempts to address contrasting positions of the 'no-miracles' argument (Putnam, 1975) supporting scientific realism, versus the counter-argument of not putting our trust in theories that are likely to be abandoned later (Ladyman, 2009). According to Worrall (1989), we should neither trust in standard scientific realism that unobservable entities are correctly described by our theories, nor reject science due to its discontinuity as evidenced in theory change. He points to aspects of scientific theories that reflect continuity; especially their logical structures or

relations such as are expressed in the mathematical equations.

Structural realism emphasizes commitment only to the core aspect of scientific theories that reflect continuity across theory change. Worrall (1989) argued that this core aspect is their *mathematical or structural content*, not descriptions of the presumed intrinsic nature of the objects. In this view, scientific theories are about the relational structure of unobservable entities, not about what they *really* might be like (Ladyman (2009). Relationism emphasizes relationships *per se*, apart from entities—e.g., space and time are constituted of relationships rather than substance. Substantivalism emphasizes entities as existing in their own right, apart from their relationships—e.g., space and time exist independent of what happens in them. Structural realism can be viewed as emerging due to investigating smaller time and distance scales where *objects* are less tangible, increasing recognition of subjectivity in *objective* science, and acknowledging the implications of radical theory change.

> "Theories can be very different and yet share all kinds of structure. The task of providing an adequate theory of approximate truth that fits the history of science and directly addresses the problem of ontological continuity has hitherto defeated realists, but a much more tractable problem is to display the structural commonalities between different theories. Hence, a form of realism that is committed only to the structure of theories might not be undermined by theory change (Ladyman, 2009, pp. 6-7)."

Two major varieties of structural realism have emerged: ontic and epistemic. Philosophers of physics seem to be pursuing more the ontic variety (Ladyman, 1998), emphasized here. The views draw from a long history of conceptual analyses by prominent scholars in analytic philosophy and philosophy of science. They also can be viewed as due to lack of familiarity with the ancient Vedic holistic account and its relevance to key issues in modern science and philosophy of science.

4.1 Epistemic Structural Realism (ESR)

Epistemic structural realism emphasizes the aspect of scientific theories that describe relations between unobservables, and is agnostic about their objective nature as ontologically real. One view emphasizes Worrall's (1989) 'minimal' approach of weakening our commitment to standard scientific realism by associating continuity of scientific theories only with relations and not entities themselves. Another emphasizes principles to gain structural knowledge, exemplified in Russell's (1927) epistemic principles that 1) we only have direct experience of our own percepts; 2) different effects have different causes; and 3) percepts are related in the same logical structural relations as the relations between their causes (Psillos, 2001; Ladyman, 2009).

Consistent with this view, Unger (2001) argues that "our knowledge of the world is purely structural and that qualia are the non-structural components of reality (Ladyman, 2009, p.9)." Another consistent example, from Maxwell (1962; 1970a; 1970b; 1972), is that we can know about unobservable entities by formal descriptions of their structural properties such as "...variables, connectives, quantifiers and predicate terms.... (Ladyman, 2009, p.9)."

However, critics state that structural realism is supposed to help with the problem of discontinuity with respect to ontologically real entities as reflected in theory change. But its epistemic arguments (and also purely semantic arguments less prominent now and not reviewed here), do not help much with this problem, according to Ladyman (2009).

4.2 Ontic Structural Realism (OSR)

French and Ladyman's (2003a; Ladyman, 2009) view of *ontic structural realism* was introduced with the added intent to address individuality and identity in quantum particles, spacetime points, and entanglement, as well as the role of models and idealizations in physics. It can be viewed as carrying forward the age-old debate of substance versus form, now in terms of substance versus structure.

> "A crude statement of ESR is the claim that all we know is the structure of the relations between things and not the things themselves, and a corresponding crude statement of OSR is the claim that there are no 'things' and that structure is all there is... (Ladyman, 2009, p. 12)."

In OSR, it is argued that contemporary physics tells us: "...the nature of space, time, and matter are not compatible with standard metaphysical views about the ontological relationship between individuals, intrinsic

properties and relations (Ladyman, 2009, p. 13)." We will briefly overview versions of OSR as attempts to make this assertion more precise. The versions are perspectives on whether objects or entities have ontological existence apart from relational structures, and whether ontological or relational structures are primary.

Later we will consider the conditional nature of the above argument in an expanded developmental framework of stages of scientific knowledge. Given the intent of this paper to take a new look at the ancient Vedic developmental account without being too long, descriptions of the versions of OSR are quite brief.

According to Ladyman (2009), versions of OSR cover the range from 1) eliminativism—there are no individuals (no separate objects); 2) relational structures are not accounted for entirely by their intrinsic properties; 3) individuals don't have intrinsic properties; 4) individuals have no irreducible intrinsic properties; 5) individuality and diversity of objects depend ontologically on relational structures; to 6) objects don't exist without anything else existing, but relational structures do. And finally, a version holds that 7) 'individual objects' are just constructs with only a heuristic role.

To give a bit more detail on some of these versions, French and Ladyman argue there are ways to understand the idea of relations without being grounded on objects; that is, "relations without *relata* (Ladyman, 2009, p.14)." One example given is a universal, in which a relation is made of formal properties (such as 'larger than') with no reference to instantiation. Another example is: "The relata of a given relation always turn out to be relational structures themselves on further analysis (Ladyman, 2009, p.14)." But OSR doesn't require going quite as far as accepting relations without relata; rather, relata are not to be considered individual objects apart from relations.

> "French and Krause (2006) argue that quantum particles and spacetime points are not individuals but that they are objects in a minimal sense, and they develop a non-classical logic according to which such non-individual objects can be the values of first-order variables, but ones for which the law of identity, 'for all x, x is identical to x', does not hold (but neither does 'x is not identical to x'). There is no unanimity about the difference between individuals, objects and entities…but one neutral way of putting the issue is to ask whether there are only individual objects in the logical sense of object as the value of a first-order variable, or whether there are individuals in some more substantive sense (for example, being subject to laws of identity, or being substances) (Ladyman, 2009, p. 14)."

As to the notion that all relational structures are not completely accounted for by intrinsic properties of their relata, an example is quantum entangled states as relational states that don't depend on non-relational properties of their relata. And OSR advocates such as Esfeld (2004) and French and Ladyman (2003a, b) note that, "Some relations are at least ontologically on a par with individuals so that either relations are ontologically primary or neither is ontologically primary or secondary (Ladyman, 2009, p. 15)," a form of 'moderate structural realism' (Esfeld and Lam, 2008).

> "Ladyman and Ross (2007), Saunders (2006) and Stachel (2006) argue that facts about the identity and diversity of fermions are not intrinsic [and] obtain only in virtue of the relations into which they enter. On this view the individuality of quantum particles is ontologically on a par with, or secondary to the relational structure of which they are parts. Stachel (2006) calls this 'contextual individuality' and he extends this to spacetime points (Ladyman, 2009, p. 17)."

Classically, objects were attributed spatiotemporal separation and a fundamental *thisness* that contributed to our sense they are *individual* objects or entities. In quantum field theories, individuality is less prominent in light of superposition, interdependence, and nonlocality. However, 'no individuals' would mean *no individual observers* either, a conclusion adherents of OSR might be quite reluctant to defend (illustrative of how ingrained the objectification of knowledge is in science). The quote below has inklings of a developmental framework to address the important issue of individuality (especially Poincaré), examined much deeper in the last section of this paper:

> "French (1999) and French and Ladyman (2003a) maintain that individuals have only a heuristic role. Poincaré similarly argued that "the gross matter which is furnished us by our sensations was but a crutch for our infirmity" (1898, 41). Ladyman and Ross

> (2007) argue that objects are pragmatic devices used by agents to orient themselves in regions of spacetime, and to construct approximate representations of the world (Ladyman, 2009, p. 18)."

In the context of quantum holism, Ladyman (2009, p. 19) again emphasizes relational factors as contributing to individuality, rather than the properties defining objects-in-themselves:

> "Leitgeb and Ladyman (2008) note that in the case of mathematical structures there is nothing to rule out the possibility that the identity and diversity of objects in a structure is a primitive feature of the structure as a whole that is not accounted for by any other facts about it."

At this juncture, we might conclude that structural realism supports scientific realism in the more modest sense that relational structures maintain across theory change even if theoretical descriptions and explanations of purported *real* objects or entities don't maintain. Still, rational commitment to science is deserved—with perhaps less hubris in our assertions about *reality*.

The history of science, however, reflects a strong legacy of striving for *accuracy* of theories and their experimental tests. This reflects a deep belief that theories should properly *represent* the *real* world as the outer criterion with which to judge the theories. OSR can be viewed as the pursuit of accuracy via increasingly refined thinking about the precise evidence nature gives us. This refinement is advancing beyond classical views of material nature—such as beyond the Aristotelian material-point concept. Notions of substance are being replaced with more abstract relational structures. Concepts such as the individuality of objects or entities are losing ground as we attempt to come to grips with subtler, less concrete levels of matter, energy, and information.

These changes also can be understood, however, in terms of refining our notion of substance while still retaining the notion of individuality. This will be discussed later in terms of a fundamental recasting of how we conceive spacetime, consistent with recognition that space is not empty and thus can be viewed as being some object or 'thing.' It emphasizes the spacetime field as a *medium* with limitations that define its properties at different levels. This view will be helpful in bridging ontology in scientific realism with the Vedic developmental model of *levels of reality*. It points to different limiting properties of spacetime that distinguish different ontological levels (Boyer, 2008; 2010). In other words, the challenge to scientific realism may not be to realism but to build better conceptualizations and descriptions of subtler *levels of reality,* associated with levels of spacetime.

5. Other contributions

Continuing to draw upon Ladyman's (2009) survey of structural realism, we now will consider work from related fields that support versions of OSR.

5.1 Group theory

Group theory describes structure in terms of symmetry, and transformations that leave aspects of structure unchanged. It applies the principle of invariance through change from a mathematical perspective, as a more abstract way of accounting for structural continuity.

> "The feature which suggests reality is always some kind of invariance of a structure independent of the aspect, the projection (p. 149).... I think the idea of invariant is the clue to a relational concept of reality, not only in physics but in every aspect of the world (Born, 1953, p. 144).
>
> "What sort of thing is it that I know? The answer is *structure*. To be quite precise it is structure of the kind defined and investigated in the mathematical theory of groups (Eddington, 1939, 147)."

Invariant features of a group *hypostatize* or stabilize a structure as an objective state. Unobservable particles are sets of qualities invariant under transformations (Ladyman, 2009); it is the invariant structural features that contribute to the sense of objectivity and continuity.

> "For example, one of the most fundamental distinctions between kinds of particles is that between fermions and bosons. This was described group theoretically by Weyl and Wigner in terms of the group of permutations.... The central point of philosophical relevance here is that the mathematical idea of invariance is taken by Weyl to characterise the notion of objectivity. It is this that liberates physics from the parochial confines of a particular coordinate system. For Weyl appearances are open only to intuition (in the Kantian

> sense of subjective perception) and therefore agreement is obtained by giving objective status only to those relations that are invariant under particular transformations (Ladyman, 2009, p.19)"

5.2 Quantum field and general relativity theories

A related view drawing from Immanuel Kant is applied by Auyang (1995) to address objectivity in quantum field theory. In this view also, it is the invariant structure across transformations that gives observations *objectivity*. Also drawing from Kant, Ryckman (2005) calls OSR 'transcendent structuralism' (Ladyman, 2009). Kant's meaning of 'transcendent' will be considered later.

Ladyman (2009, p.20) mentions other contributions in quantum field theory that further argue against individual objects of substance existing apart from structural relations, by virtue of the concept of a *field*. For example, he quotes Cassirer:

> "The field is not a 'thing,' it is a system of effects (*Wirkungen*), and from this system no individual element can be isolated and retained as permanent, as being 'identical with itself' through the course of time. The individual electron no longer has any substantiality… (1936, p. 178)."

Similar arguments have been made with respect to gauge field theories and gauge symmetry groups. For example, Lyre (2004) argues for an interpretation of gauge theories:

> "…according to which the fundamental objects are ontologically secondary to structure because the objects of a theory are members of equivalence classes under symmetry transformations and no further individuation of objects is possible (Ladyman, 2009, p. 20)."

Also, Kantorovich (2003) proposes that strong force symmetries and 'grand unification' symmetries are ontologically prior to particles affected by them (Ladyman, 2009). Moreover, there is concern that the existence of localizable particles is in conflict with a relativistic quantum field theory (Ladyman, 2009). And another layer of concern about the problem of individuality is:

> "…whether fields themselves are individuals, or whether they are properties of spacetime points. In the latter case the problem becomes whether the spacetime points are individuals. This last question is bound up with the debate about substantivalism in the foundations of General Relativity (pp. 20-21)."

Whether the notion of individuality in the theory of general relativity supports relations (relationism) or substance (substantivalism) is an additional concern (Ladyman, 2009, p. 21-22):

> "The main problem for the latter [substantivalism] is the general covariance of the field equations of General Relativity…. In other words, since the points of spacetime are entirely indiscernible one from another, it makes no difference if we swap their properties around so long as the overall structure remains the same. This is made more apparent by the so-called 'hole argument' which shows that if diffeomorphic models [described by Ladyman as infinitely differentiable, one-one and onto mapping of the model to itself] are regarded as physically distinct then there is a breakdown of determinism. Substantivalists cannot just bite the bullet and accept this since, as John Earman and John Norton (1987) argue, the question of determinism ought to be settled on empirical/physical grounds and not a priori ones.
>
> There have been a variety of responses to this problem. Lewis (1986) and Carol Brighouse (1994) suggest accepting haecceitism [thisness] about spacetime points, but argue that it should not worry us that haecceitistic determinism, that is determinism with respect to which points end up with which metrical properties, fails….
>
> Robert DiSalle (1994) suggests that the correct response to the hole argument is that the structure of spacetime be accepted as existent despite its failure to supervene on the reality of spacetime points. A similar view has been proposed by Carl Hoefer, who argues that the problems for spacetime substantivalism turn on the "ascription of primitive identity to space-time points" (1996, 11). Hence, it seems that the insistence on interpreting spacetime in terms of ontology of underlying entities and their properties is what causes the problems for realism about spacetime. This is a restatement of the position developed by Stein (1968)… according to which spacetime is neither a substance, not a set of relations between substances, but a structure in its own right."

Ladyman (2009) summarizes the views of DiSalle (1994) that the 'hole argument' is best responded to by accepting the existence of

the structure of spacetime even if it doesn't completely reduce to (supervene on) the existence of spacetime points. To further this approach:

> "Oliver Pooley (2007) argues that eliminativism about individual spacetime points can be avoided without any tension with General Relativity.... His sophisticated substantivalism allows that spacetime points be individuated relationally and not independently of the metric field. This means embracing contextual individuality grounded in relational structure (pp. 21-22)."

However, another way to address these concerns is that the 'genuine failure of determinism' applies only to classical *local* determinism in *local* relativistic spacetime. Neither local determinism nor local relativistic spacetime accounts for nonlocality and interdependence, such as in quantum entanglement. Whether objects or relations are *real* and whether individuality maintains across theory change don't get to the significance of the evidence for nonlocality and interdependence. Rather, the evidence strongly argues against physicalism as we have known it; and it has revolutionary implications for our conceptions of spacetime, determinism and causality, the dividing line between objective and subjective, and where the subject fits in the picture.

In this new quantum field context, spacetime can be viewed as a field or *thing* in that it is not empty and not just relational. But subtler concepts of *thingness or thisness* are needed. Again, this translates into different mediums of spacetime, with different causal dynamics. The particle interaction causal model in local relativistic spacetime needs to be supplemented by a *nonlocal causal wave* model in a nonphysical, nonlocal, interdependent texture of spacetime, discussed later in the Vedic model as *levels of reality* associated with levels of spacetime (Boyer, 2008; 2010; 2012a).

5.3 Criticisms of OSR

One criticism of structural realism is that it isn't distinct enough to avoid collapsing into standard realism. According to Psillos (1995), distinctions between form or structure, and content or the nature of the world of objects, may be better placed on a continuum (Ladyman, 2009). Another criticism is that, like ESR, OSR doesn't help much with the problem of theory change because it doesn't adequately discriminate what parts of theories we should or shouldn't commit to ontologically (Papineau, 1996; Stanford, 2003). And it may be that mathematical structures don't maintain across theory change either (Chakravartty, 2004; Stanford, 2003). But Post (1971) claims that, even in major theory change, empirically established parts of the old theories are not lost but become conditional aspects of the more comprehensive new theories.

A third criticism is that although physics tells us that certain aspects of individual objects may be unknowable, it doesn't logically necessitate accepting that they are not ontologically real, as some versions of OSR assert. Quanta may have primitive thisness, even if some properties are unknowable.

More abstractly, at least some notion of objects is basic to the mathematics of set theory (i.e., as a 'set of objects') (Ladyman, 2009). A 'set' can be viewed as a thing or object. Also, a number has meaning with respect to its relations to other numbers, but also carries some sense of thisness in terms of discreteness and individuality. And a collection of unrelated things can be attributed to be a set or object for some purposes. If structural relations in the collection make them interdependent as a system, this might give the collection or set an even stronger sense of thisness (Scharf, 2013). From these perspectives, both objects and relations are partially defined by context, while also both have degrees of thisness and reality—though not to the same degree as their instantiation in some tangible, countable entity or object (such as in one apple, or also an individual observer).

In defense of OSR, alternatives have the same problem of not adequately articulating what is real. We shouldn't be obliged to define what is real about unobservables using the same criteria as with macroscopic observables (McMullin, 1990). And minimal notions of objects are consistent with a structuralist view. Again, the view doesn't require eliminating the notion of objects, but rather not committing to their descriptions as ontologically real objects with individuality (Ladyman, 2009).

Another criticism of structural realism, noted earlier, is that our view of causality is based on individual objects, and may mean loss of ability to account for causality if we

discard the notion. In further defense of OSR, Ladyman and Ross (2007) point out that:

> "[S]cience describes the objective modal structure of the world, where the latter is ontologically fundamental, in the sense of not supervening on the intrinsic properties of a set of individuals.... [C]ausal structure is the pragmatically essential proxy for it in the special sciences (but not necessarily in fundamental physics) (Ladyman, 2009, p. 24)."

Thus structural realism may apply only to fundamental physics or mathematics. It may not be able to account for causality, or for the maintaining of theoretical commitments across theory change, in other sciences such as biology. In other words, on more concrete tangible levels of nature the notion of independent objects is needed, but perhaps not at the less tangible quantum level.

Taking this issue further, the final criticism discussed here is that structural realism may eliminate the distinction between mathematical and physical—another angle on the '*mathematization*' of science noted earlier. In the structuralist view, mathematical formalisms may replace ontology in physics. Some would say that physics is *really* about mathematics after all. Moreover, matter and energy are now understood in terms of *information*, which emphasizes relations rather than substance.

A recent informal poll of 33 quantum theorists (Schlosshauer, Kofler, & Zeilinger, 2013) could be viewed as support that relational structures and not descriptions of quantum 'objects' are the basis for continuity in scientific theories. The poll results suggest that, although the quantitative aspects of quantum theory have led to many successful practical applications, even after a hundred years there is still little consensus about what quantum theory means and what if anything is *real* about quanta.

> "For example, votes were roughly split evenly between those who believe that, in some cases, "physical objects have their properties well defined prior to and independent of measurement" and those who believe that they never do.... Perhaps the most striking implication of the poll is that, while quantum theory is one of the most successful and quantitatively accurate theories in science, interpreting it is as fraught now as it was at the outset. 'Nothing has really changed, even though we have seen some pretty radical new developments happening in quantum physics, from quantum information theory to experiments that demonstrate quantum phenomena for ever-larger objects, says [Maximilian] Schlosshauer (Ball, 2013)."

However, alternatively it could be viewed that the practical applications of quantum theory support the ontological existence of *quantum reality*. The difficulty of establishing consistent understanding of the meaning of quantum theory may be a result of thinking patterns engrained in the conceptual limitations of the classical ontology of physical realism. Substantive progress to resolve dilemmas presented to us by quantum theory may require expanding our ontology beyond the physical level to include quantum waves as *real,* and even minds with thoughts and feelings as *real*. If we stubbornly persist in asking seemingly reasonable ontological questions about where mathematical structures actually exist, it might be hard to avoid the conclusion that they are at least in our subjective minds. This suggests that *objective* science "...starting from 'an external or prior point of view...seems to tell us that nature needs to be entirely re-conceived (Van Fraasen, 2006, pp. 292-293)." Re-conceiving nature might then involve the recognition that matter and energy are based (supervene) on an abstract, nonphysical information field that includes *real* mind. Ladyman (2009, p.24) notes:

> "The essence of van Fraassen's objection here is that the difference between mathematical (uninstantiated/abstract) structure and physical (instantiated/concrete) structure cannot itself be explained in purely structural terms (Ladyman, 2009, p. 25).
>
> "There are two versions of mathematical structuralism: a realist view according to which mathematical structures exist independently of their concrete instantiations; and an eliminativist position according to which statements about mathematical structures are disguised generalisations about their instantiations that exemplify them (Shapiro, 1997, pp.149–50; Ladyman, 2009, p. 26)."

At this new juncture, we might be concerned that we have backed ourselves against the wall with respect to physical ontology, all along progressing toward the idealist view that even physical *reality* is not *objective*. Alternatively, perhaps we are

impelled to expand our ontology to a *real* nonphysical field with *objective* and *subjective* aspects characterized by both individuality and interdependence.

Interestingly, this directly brings us back to Platonic scientific realism that grounds even universal mathematical forms as *real objective* phenomena existing independent of the subjective observer. We again can go through an analysis of what is *real*, but this time having almost talked ourselves out of the notion of *objective physical reality,* and consequently *objective* science. Are we eliminating scientific realism in terms of the physical, only to deal with the same issues in mathematical realism? Are nonphysical mathematical structures *real*, independent of observers, as Plato believed? Embedded in this question is the long-standing mind-body problem, and whether minds are *real* apart from the physical. As noted in the Introduction (p. 1), such questions shout out with changing views of *reality* from concrete matter to intangible quantum waves to abstract information fields.

Still another angle on these issues is to accept that the concept of *structure* has meaning in terms of both substance and form. The term is commonly used as a noun, somewhat implying a *substance*; and also as a verb as in *to structure,* emphasizing relations or *form*. The substance/form distinction may have different connotations at different phenomenal levels of nature or *levels of reality*.

For example, eddies in water have form; but the substance is the water. Eddies don't appear separate from water, but water appears without eddies. Similar relationships seem to hold for molecules/particles, particles/quanta, and possibly fundamental quantum fields and the unified field, but with increasing abstraction. At each level, some *thing* has relationships with other things and with itself. At deeper levels, *thingness* or *thisness* is more abstract. Individuality appears to decrease and interdependence to increase, somewhat like on a continuum but even more like *levels* with different defining or limiting features from concrete to abstract, tangible to intangible. In other words, there are subtler, less tangible forms of substance and structure than physical matter.

The unified field can be described both in terms of singularity and infinity of superposed waves. We might say it is formless, but also of perfect order, while at the same time the most substantive infinite, eternal, omnipresent and only *container* of everything. It is both infinitely unified which may evoke more a sense of substantive structure or wholeness, and infinitely diversified which may evoke more a sense of relational structure or parts. We need to recast our thinking to a holistic model in which the physical and the mental are *real* parts within the unified field.

Changing views of scientific realism are due to increasingly abstract notions of substance and form with progress in the development of scientific knowledge. This doesn't take away from science as we have known it, but rather extends it. How we imagined, explained, and modeled objects or entities and processes or functions in nature has advanced. The older tangible, independent, local view is an inadequate framework for describing the new empirical *realities* of interdependence and nonlocality. We will now consider ontology and epistemology in this expanded holistic framework.

And this leads directly to the Vedic developmental account of *levels of reality* associated with different *states of consciousness*. In this account, at surface levels of understanding and experience, object and subject are independent; at deeper levels they are more interdependent; and most fundamentally, no *thing* is independent because all things are ultimately unified in the unified field. These levels of nature relate to the primary locus of experience in different states of consciousness.

Concerns reviewed here about scientific realism stem from either/or contrasts of the discriminative intellect, exemplified in the earlier discussions of substance *or* structure, ontologically 'real' substance *or* just relations, as well as the contrast of reductive parts devoid of holism *or* holism devoid of parts. The Vedic Darshana recognize wholeness and parts *at the same time*. Transcending the finest functioning of the discriminative intellect is said to be required for this integration from '*or*' to '*and*.' It is held to be the essential means of gaining knowledge in the Darshana of Yoga (Maharishi, 1967). It concerns how much our ability has developed to experience *levels of reality* as individually existing, including ourselves, and also unified at the same time—that is, *and* rather than just

or; part *and* whole, diversity *and* unity, individual *and* universal, *and* beyond both.

In this final and more extended section of the paper, we will first briefly review modern scientific epistemology which resulted in the inadequate physicalist view that generated many of the concerns in scientific realism. Next we will overview ontological *levels of reality* in Sāṁkhya, and then the 'developmental epistemology' of Yoga (Scharf, 2012). We will end with a brief consideration of the Darshana of Vedanta and the related concepts of *Maya* and *ultimate reality*.

6. Vedic developmental account

Throughout western civilization, the basic means to gain knowledge have been recognized to be reason and experience. The objective scientific method integrates deductive and inductive reasoning based on experience. However, the classical objective approach of not including the subjective observer is becoming recognized as fundamentally fragmented—and as having been inadequate all along. Classical science tacitly assumed subjective logical consistency within and across observers as core to the *objective* scientific method, without explicitly acknowledging this foundational consistency and addressing its implications for the *reality* of matter, mind, and consciousness.

To protect against unreliable subjectivity in reason and ordinary sensory experience, the *objective* scientific method relies on consensual validation or public agreement. But it is important to recognize that consensus is based on the level of functioning of those who contribute to it. The entire enterprise of *objective* science is based primarily on reason and experience in the ordinary waking state of consciousness. This state is the phenomenological basis for the independence of observed (object) and observer (subject). This duality is tacitly imposed on nature in the ordinary waking state. In the expanded developmental framework of the six Vedic *Darshana* (sometimes called the six systems of Indian philosophy), contemporary ontic and epistemic views in scientific realism can be understood to center around the phenomenal experience of object-subject duality. In other words, the perspectives have been stuck in this issue because experiences are stuck in the ordinary waking state.

The Darshana of *Sāṁkhya* emphasizes ontology and phenomenal levels of nature; and the Darshana of *Yoga* emphasizes epistemology and systematic means to validate knowledge through direct experience. According to Maharishi Mahesh Yogi's re-clarification of the developmental sequence in the six Darshana, the direct first-person subjective experiential approach in Yoga is a necessary complement to the indirect third-person objective experimental approach in modern science (1967, 1963).

As noted in 4.2, OSR argues that contemporary physics tells us: *"...the nature of space, time, and matter are not compatible with standard metaphysical views about the ontological relationship between individuals, intrinsic properties and relations* (Ladyman, 2009, p. 13)." In the Vedic developmental account as introduced here, this incompatibly is the expected product of reductive perspectives and the experiential duality that characterizes the ordinary waking state. The stage of development and limitations of phenomenal experience in this state run through virtually the entire history of analytic philosophy, philosophy of science, and modern science generally.

The word *Veda* can be translated as 'total knowledge' (Maharishi Vedic University, Introduction, 1994). The closest concept in modern science seems to be the unified field. The Vedic account begins with complete holism or unity. Wholeness is the basis of the parts, and the parts sequentially emerge from it. Eternity is the basis of time, and infinity is the basis of space.

This holistic perspective is a fundamentally different orientation toward nature from the common reductive perspective in modern science. In this holistic perspective, subjective minds and the objective universe we observe with them emerge from the same source and the same laws of nature. Thus a natural correspondence between object and subject is expected, and not at all miraculous.

The holistic perspective is suggestive of means to reconcile emerging epistemic views of the nature of space, time, and matter with standard views of ontology, which as noted earlier OSR argues are incompatible. The argument for incompatibility is due to not recognizing different *levels of reality* in different *states of consciousness*. Standard views of ontology generally correspond with

ordinary waking experiences, while the apparently incompatible epistemic views of spacetime and matter now emerging reflect progress to deeper ontological *levels of reality*. This is becoming clearer with cutting edge theories that include ontologically *real* levels of nature beyond the physical, discussed now.

6.1 Three-level models

Modern physics progressed as an *objectified* reductive investigation, doing its best to avoid the unreliability of subjectivity. This led to a model with one ontological level: the causally closed *objective* physical universe, sometimes called *materialistic monism* or *physicalist realism*. It is increasingly recognized that mind and consciousness are not accounted for anywhere in this universe. Recently unified field theories have been developing, which can be viewed as an additional level. But quantum theory required consideration of how to get from quantum wave functions in *imaginary* mathematical space to *real* physical space; and for the first time this brought subjective mind and consciousness directly into the picture. It is revealing that a two-level ontology (the physical and the unified field) doesn't account for mind and consciousness either.

Mathematician and physicist David Bohm (1980) posited what has been called the *neorealist* interpretation of quantum theory, which extends monism and realism. In this model, there is our familiar ordinary physical level, *explicate order,* characterized by local particle interaction causality, and a subtler nonlocal nonphysical level, *implicate order,* characterized by nonlocality and interdependence. This model is consistent with physical and nonphysical Platonic forms of scientific realism. However, Bohm's model is not psychophysical parallelism or dualism. The more concrete local explicate order is part of, permeated by, and causally interacts with the subtler nonlocal implicate order. And importantly, both exist in an ultimate *universal plenum*, or *super-implicate order* (Bohm, 1980; Bohm & Hiley, 1993; Boyer, 2012a). Thus it is a non-dual or monistic model with three levels: explicate (gross), implicate (subtle), and super-implicate (transcendent) orders.

Bohm and Hiley's (1993) neorealist interpretation of quantum theory has correspondence with a recent three-level model by mathematician and cosmologist Roger Penrose (2005), which draws from Platonism. Discussing mathematical forms associated with an objective *Platonic realm*, he states:

> "I am aware that there will still be many readers who find difficulty with assigning any kind of actual existence to mathematical structures. Let me make the request of such readers that they merely broaden their notion of what the term 'existence' can mean to them. The mathematical forms of Plato's world clearly do not have the same kind of existence as do ordinary physical objects such as tables and chairs... Objective mathematical notions must be thought of as timeless entities and are not to be regarded as being conjured into existence at the moment that they are first humanly perceived... Those designs were already 'in existence' since the beginning of time, in the potential timeless sense that they would necessarily be revealed precisely in the form that we perceive them today, no matter at what time or in what location some perceiving being might have chosen to examine them... Thus, mathematical existence is different from physical existence but also from an existence that is assigned by our mental perceptions. Yet there is a deep and mysterious connection with each of those other two forms of existence: the physical and the mental... 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. 17-23)."

Another model with three levels has been outlined by physicist Henry Stapp (2000, 2007). In analyzing quantum wave function collapse, three levels are used to explain how *real* objective and *real* subjective experiential levels might interact. In a broad interpretation of orthodox quantum theory, Stapp (2000, p. 213) states that consciousness is needed in 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."
>
> [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...."

The three levels in this model are physical *reality*, experiential *reality*, and all-possibility Hilbert space. The concept of all-possibility Hilbert space used in Stapp's model is placed similarly to the universal plenum (super-implicate order) in Bohm and Hiley's model, which also is placed similarly to Penrose's model of the 'Platonic realm.'

These three-level models also have some correspondence with the three-level model by unified field theorist John Hagelin (1987). This model is an abstract mathematical *Lagrangian* formulation. In very compact form, the Lagrangian contains two terms. The first term, denoted as Φ, is described as a classical conception of a static space and time translation invariant field—a non-changing field of *existence*. The second term represents *dynamic order* or change, denoted as Π. This term represents the inherent capability of the field to generate orderly change in the field. This formulation also relates the unified field to Hilbert space, a complex vector space of infinite dimensions as an infinite collection of points comprising all quantum mechanical states.

This unified theory includes concepts of the knower or observer and the process of knowing—not just the known. The *knower* 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 unchanged. It is likened to the uninvolved *observer* of all transformations that, through its dynamic orderliness associated with the discriminative role in evolving the quantum mechanical system, determines the physical manifestations of the system. 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 the stable quantum mechanical *states* themselves. This model can be viewed as a more abstract view of substance and form, as *existence* and *dynamic order*.

6.2 The Vedic 3-in-1 model

A completely holistic 3-in-1 model runs through Vedic literature. In contemporary terms, it can be interpreted as including 1) the ordinary finite, local physical level of classical physics; 2) the subtle finite, nonlocal, nonphysical level including mind that is beginning to be identified in some aspects of quantum physics; and 3) the transcendent source of everything in unified field physics. Within the unified field are the other two levels—the Vedic 3-in-1 ontology.

The reductive approach in modern science analyzes things to their most fundamental parts, exemplified in quantum field theory as 'infinity' of superposed quantum wave potentials. In the related inflationary big bang cosmological theory, the ultimate reductive endpoint is literally *nothing*. But *nothing* means no substance, no form, no structure, and no potential to do or be anything (such as to fluctuate randomly as gravitational and Higgs fields that purportedly initiated the big bang). This theory needs to explain how *everything* comes out of *nothing*—which seems quite *illogical* and inadequate as the bottom-line of all of science.

The holistic approach, such as in unified field theory, can be viewed as just the opposite. The ultimate essence of nature is the undifferentiated singularity of the unified field, oneness beyond parts—unity without diversity. In this case at least, the need is to answer the *logical* question of how phenomenal parts emerge from wholeness. This question is extensively addressed in the Veda.

The Vedic account further emphasizes holism and reductivism at the same time, not just one or the other. In this completely holistic model, *everything* doesn't come from *nothing*. All levels of nature are phenomenal limitations of the infinite eternal unified field, which cannot be 'banged out of.' It may seem like nothing if it is nonphysical and completely abstract; but every object, structure, event, or process remains in it (not empty). It can be described as 'nothingness,' especially in the sense of phenomenally transcendent to all relative finite phenomena; but not *literally nothing*.

As the source and container of everything, the unified field can be described as the infinite (space) and eternal (time) that transcends finite levels of spacetime. No *thing* could exist outside of it. From the perspective of the unified field, within itself are the subtle phenomenal level of finite nonlocal relativistic spacetime and our familiar, ordinary gross level of local relativistic spacetime. The subtle level of nonlocal, nonphysical spacetime phenomenally manifests first, within the unified field. This level includes the subjective mental level and the subtle objective level. This level is a limited field or medium in the sense that it is finite spacetime; but it is closest and most similar to the infinite eternal unified field, so it has the least limitations. It is nonlocal, highly interdependent, and nonphysical. From within it, the distinction of subject and object emerges. It permeates and causally guides the more limited local field or medium of physical spacetime. This grosser local level is our familiar relativistic spacetime field delimited by physical Planck-size quanta, relativistic gravity, and the speed of light. In this holistic understanding, these three fields are concentric levels of spacetime.

Is the unified field a substance, reductive or supervening on anything else, *objective*, ontologically *real,* causally interacting? If it is to be identified as a substance, it would be the ultimate substance, or beyond the distinction of substance and form. It would be the first cause, self-determined or uncaused, or beyond the notion of cause. All levels and all structures in the manifest universe ultimately reduce to and supervene on it. It is infinitely self-interacting; there is nothing else outside of it with which it could possibly interact. It could be identified as *objective* in the sense that it phenomenally is apart from any individual observer, but also it is the basis of all individual subjective observers—the source of objectivity and subjectivity, prior to and permeating both.

The unified field can be said to be ontologically *real* in the ultimate sense, with everything existing as phenomenally appearing to be outside of it in dualistic states of consciousness and simultaneously within it and nothing other than it in the state of unity consciousness. It would be the only infinite eternal *reality*: all other *levels of reality* would be non-eternal, finite phenomenal *realities* in it. It could be characterized as beyond time and space or, for purposes of explaining the diversity of nature, as the *eternal* basis of time and the *infinite* basis of space—always everywhere.

In ordinary waking state experience, typically the physical is the only *real* level—concrete, local, tangible, and *objectified*, with discrete individual objects predominating ordinary sensory experience. In this state, consistent with materialistic monism or physical realism, there is no other *real* level. This is associated with physical scientific realism, and the view that mind and consciousness are epiphenomena that entirely depend (supervene) on and are reducible to the physical brain/body.

In the completely holistic Vedic model, what is more or less *real* is basically the opposite of experience in the ordinary waking state. The ordinary gross local physical level is the least *real*, the subtle nonlocal nonphysical level is eventually experienced as much more *real*, and the unified field is ultimately experienced as the *only reality*. In the Sāṁkhya model of *levels of reality*, each level has universal and individual aspects. Individual minds and individual objects of sense—subjects and objects—emerge due to increasing phenomenal limitations within the unified field.

The unified whole is not merely a collection that depends on its parts; rather, the parts depend on the whole. The whole also is not an emergent epiphenomenon that becomes 'more than the sum of the parts.' The whole is prior to all the parts, and the parts supervene on it. Scientific progress toward this view of unified field theory is summarized in this quote of Maharishi (1963):

> "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.... Everything in the universe is of a relative order, but the truth is that eternal Being, the ultimate life principle of unmanifested nature, is expressing itself in different forms and maintaining the status quo of all that exists. The absolute and relative existence are the two aspects of eternal Being; It is both absolute and relative." (pp. 32-33)

The three-level ontological models described above also have some correspondence with the philosophical concepts of realism, idealism, and transcendentalism. Historically, *objective* science focused only on the gross physical level as *real*. In the 20th Century, theories emerged of an underlying unified field and, in the past few decades, of a subtle nonlocal field of information space (and 'quantum mind'). Explanatory gaps remain between physical matter and information space, as well as between information space and the transcendent unified field. These explanatory gaps relate to experiential gaps between body, mind, and consciousness extensively addressed in the practical 'developmental epistemology' of the Vedic Darshana of Yoga (Scharf, 2012).

The monumental insights of Bohr, Heisenberg, Wigner, and Neumann about the necessity of including consciousness and the observer in orthodox quantum theory reflect an important stage of progress. Alternatives to orthodox quantum theory—such as 'many-worlds' and 'objective reduction' interpretations—attempted to take the observer back out in order to retain an *objective* physics. In the march to more abstract understanding of the essence of nature, the recent theories of an information field more fundamental than matter/energy are also trying to retain *objectivity* by using the concept of information without any subjective meaning or semantic content (Shannon & Weaver 1949). These attempts to remain *objective* can help clarify the dividing line between objective and subjective, and ultimately the nature of consciousness itself. The current stage of understanding reflected in these cutting edge scientific theories makes Sāṁkhya particularly relevant and timely.

Sāṁkhya enumerates in further detail the 3-in-1 ontology with respect to the relationships between matter, mind, and consciousness. Discussions about the nature of consciousness frequently involve the mind-body problem. In Sāṁkhya, the mind-body problem can be viewed as conflating mind and consciousness. It is better addressed in terms of how gross physical and subtle nonphysical levels of nature link up (Boyer, 2012a). In this sense, the mind-body problem has little to do with consciousness—neither of them being conscious *as such*. In Sāṁkhya, all phenomena including the gross physical brain/body, matter, energy, information, and the subtler nonphysical mind with its levels of sensing, reasoning, feeling, and intuiting can be viewed as not conscious.

The Sāṁkhya perspective of consciousness itself as separate from matter and mind can be used to clarify structuralist views noted earlier that are drawn from Kant, such as by Auyang (1995). Kant's 'transcendental idealism' and 'transcendental realism' (Kant, 1781 [trans. Pluhar, 1996]) attempted to address the debate between realism (mind-independence) and idealism (mind-dependence):

> "I understand by the transcendental idealism of all appearances the doctrine that they are all together to be regarded as mere representations and not things in themselves, and accordingly that time and space are only sensible forms of our intuition, but not determinations given for themselves or conditions of objects as things in themselves. To this idealism is opposed transcendental realism, which regards space and time as something given in themselves (independent of our sensibility) (Kant, CPR, A 369)."

Kant seems to have agreed with idealism that *noumenal* objects-in-themselves cannot be known directly in that they are transcendent to phenomenal experiences. Phenomenal objects are mind-dependent and thus *real* in the sense that they are associated with what is knowable by the mind. But for Kant objects are not mind-dependent in the same sense as idealism: they are not just ideas

in the individual's mind. Phenomenal objects are known not only by sensory perception, but also by natural *a priori* processes as automatic cognitive functions, which he associated with *intuition*. It is in this sense that Auyang uses Kant's approach to support quantum theory as *objective*. Invariant structures across transformations that are *a priori* aspects of cognitions give observations their *objective* content.

Auyang (1995) builds further on the case for objectivity in quantum theory by arguing against *non-conceptual experiences*, which she also views as consistent with Kant. Certain conceptions (such as space and time) are automatically involved in phenomenal perception; and the process of experiencing also has the *experiencer* or *subject* automatically embedded in it. On this experiential basis, Auyang (1995) argues that the notion of an observation does not need the notion of a *subject*. The cognitive functions that give meaning to phenomenal experience automatically include the observer as *subject* (similar to statements by physicist Henry Stapp, 2000, and many others). Subjectivity in the sense of a separately identifiable *subject* is unnecessary; so in this sense, quantum theory can retain its status as *objective*. This fits Kant's self-introspection as reflected in this quote:

> "If I remove the thinking subject, the whole material world must at once vanish because it is nothing but a phenomenal appearance in the sensibility of ourselves as a subject, and a manner or species of representation (Kant, CPR, A383)."

Kant asserts that there is no experience of *subject* without thoughts. Auyang applies this assertion to the dividing line between objective and subjective (1995). In this view, the object and the process of observing are automatically included in cognitions, and the subjective observer cannot be experienced separate from them. The separate concept of *subject* is not a part of ordinary phenomenal experience, and in this sense the phenomenal world of experience can be said to be *objective*. But this implies that the direct experience of the *subject* apart from mental activity isn't possible. From the Vedic developmental view, this 'direct experience' is the core of Yogic practice, the experience of consciousness itself, or pure consciousness.

There seems to be an important difference in use of the term 'transcendent' in Kant versus the Vedic account. At least in the quote above, Kant refers to the outward direction of some object (noumenon) of sense as existing outside the mind (objects-in-themselves). This is in the opposite direction of the Vedic account of going deeper into the mind and transcending all mental activity to the ground state of the mind, consciousness itself. In both cases, transcendence means to go beyond. But Kant seems to mean beyond the mind in the external noumenal world.

Kant does further distinguish *negative* and *positive* noumena. Negative noumena relate to objects-in-themselves beyond sensory phenomena (sensible entities), in the outer world. Positive noumena relate to non-sensory objects (intelligible entities) similar to Platonic forms outside the mind and thus transcendental to intuitive, cognitive, and sensory perceptual process in the mind. But both negative and positive noumena are outside the mind, and there is no direct access to them within the mind.

> "Doubtless, indeed, there are intelligible entities corresponding to the sensible entities; there may also be intelligible entities to which our sensible faculty of intuition has no relation whatsoever; but our concepts of understanding, being mere forms of thought for our sensible intuition, could not in the least apply to them (Kant, CPR, B309/B30 P2677 (NKS)."

In the Vedic account, 'transcendental' is with respect to the underlying inner ground state of consciousness itself that is directly accessed *deeper inside the mind*, beyond all sensory, cognitive, and intuitive functions. This Vedic sense of 'transcendental' doesn't appear in Kant's analysis, and he seems to argue against even its possibility. It is not surprising that his method of self-introspection to examine these issues would not include 'direct experience' of consciousness itself. Self-introspection is a reflective, representational mode of knowing with object-subject duality. It is a type of ordinary thinking, from which the Yogic process of transcending begins. If for Kant there is no experience of *subject* separate from mental activity, then he would not be referring to transcendence in the Vedic sense of deeper to the inner ground state of the mind beyond all mental activity.

The notion of 'transcendental' is from the perspective of *individual* phenomenal experience. Kant's 'transcendental' idealism vs. realism recognizes that one has access only to phenomenal experience, not the presumed objects of sense that are transcendent in the sense of outside and beyond one's experience, which supports idealism. On the other hand, Kant's use of 'transcendental' supports realism in the sense that he believes there is something existent beyond phenomenal experience. With respect to the *subject*, however, Kant seems to experience his 'conscious self' only in combination with sensory, cognitive, and intuitive individual mental activity. There seems to be no direct experience of pure consciousness deeper inside as the innermost essence of the self or *subject*.

In the Vedic account, transcendence refers to going deeper inside to the pure subjectivity of consciousness itself. The ultimate basis of individual phenomenal experience is consciousness itself. Subjective mental activity emerges from consciousness itself, and the objective world and objects of sense emerge from that. In other words, Kant's self-introspections seemed to remain within the ordinary waking state of consciousness. He did not describe consciousness itself as the universal value of the individual self, the universal Self. That 'direct experience' is identified in Vedic literature as *turiya*, the fourth state of consciousness in addition to waking, dreaming, and sleeping.

In subtle ways, similar conceptual limitations are reflected in contemporary theories that miss a deeper understanding of holism. One example is unified field theories that envision the unified field as inherently dynamic but not inherently orderly as a sentient field of consciousness. Another example is Einstein's apparent inability to come to a more integrated, holistic model in order to resolve his question whether objects or relations are primary in general relativity.

> "[T]he most significant implication of the [relativity] theory seems not generally appreciated.... The spacetime gravitational field can be viewed as an ethereal substance or *matterstuff*. This is the essential point of the finding in relativity theory that space and time are not a separate background.... All matter is built of the relativistic spacetime gravitational field—like an ocean of water with icebergs in it made of water (Boyer, 2012a, p. 8-9)."

In the Vedic understanding of holism, gross physical nature supervenes on the relativistic spacetime gravitational field; in turn, this gross field supervenes on the subtle nonphysical field, which in turn supervenes on the unified field—the completely holistic 3-in-1 Vedic model. From the individual waking state perspective, consciousness itself, the universal Self, is transcendent in terms of being deeper *inside,* underlying all individual mental activity. Parts are underlain by the wholeness.

These points serve as a prelude for discussing where to place the dividing line between objective and subjective in the continuing effort to avoid subjectivity in *objective* science. It can be related to the distinction in Sāṁkhya between consciousness itself (*Purusha*) and *objective* Nature (Prakriti). This is the phenomenal distinction between the unified field as *pure subjectivity*, and all else including mind as unconscious—and thus in a sense *objective*. In this view, the objective/subjective dividing line is between finite manifest Nature (matter and mind combined) as *objective* and the infinite unmanifest unified field as *pure subjectivity*. Using this dividing line, consciousness can be excluded from quantum theory in a similar way as Purusha (consciousness itself) is phenomenally separate from Prakriti (Nature). This distinction is helpful as a developmental stage toward getting out of crude physicalism that attributes consciousness to be just in the brain, or just in the mind.

A more traditional placement of the objective/subjective dividing line is between the objects of sense and the senses. In this placement, *levels of reality* outside the senses as the objects of sense are *objective*, and the deeper inner levels of mind are *subjective*. Consciousness itself is *pure subjectivity*. This delineation more closely corresponds to the holistic 3-in-1 Vedic ontology (Maharishi, 1967).

Sāṁkhya is an important step toward clarifying what consciousness is. It enumerates in considerable detail a model of levels of mind that is the direction of progress in psychology over the past 150 years (Boyer, 2012a, b). Its role is to clarify consciousness as unmixed with mind and body, leading to direct empirical validation of consciousness itself beyond ordinary waking through regular practice in the Darshana of Yoga. The 'union' through Yoga is the union of individual self

with universal Self in 'direct experience.' When eventually consciousness itself is the natural, spontaneous background of wakefulness along with waking, dreaming, and sleeping, it is identified as the first state of enlightenment in the Vedic developmental model.

But Sāṁkhya and Yoga fit into the larger developmental context of the other Darshana. Appreciation of consciousness as separate from mind and matter in Sāṁkhya, and direct experience of it in Yoga, are the experiential bases for progress to ultimate unity in *Vedanta*—the 'end of the Veda.' Without understanding the developmental sequence of states of consciousness that Maharishi has re-clarified in the six Darshana, the understanding and corresponding phenomenal experiences of object/subject, objective/subjective are muddled. This would be expected from an epistemic approach that remains within the experiential limitations of object/subject duality in the ordinary waking state.

6.3 Observed (objective), process of observing (subjective) and observer (transcendent)

The holistic Vedic 3-in-1 model further has correspondence with the distinctions of observed, process of observing, and observer. The *observed* can refer to the objects in the theorized outer *objective* world, also called the *known*. But knowledge as *that which is known* seems to reside in the process of observing and observer rather than the observed or known. The markings in a book, for example, are knowledge by virtue of the symbolic value attributed to them. The knowledge isn't in the book, but in the conscious mind that attributes meaning to the markings in the book.

The intact sensory system produces consistent sensations that at least appear to be elicited by and represent the outer independent objects we sense. It is a common assumption of naïve realism, and to some degree also standard scientific realism, that the properties of objects are present in the objects themselves. The sensory system is highly consistent within and across most human observers. This part of the process of knowing is described as automatic sensory input into the mind of properties in outside objects such as elements, chemical compounds, wavelengths, and vibratory forms. Higher-order top-down cognitive and affective processes then attribute further qualitative meaning to the objects. These qualitative meanings seem to vary more than sensations due to their association with the paradigm or worldview and developmental state of the observer or knower.

The sense of *objective reality* is thus contributed to by the consistency within an observer of ordinary sensory experience and reasoning—the basic components of *intra-subjective* consistency and means of gaining knowledge. A key additional contribution is consistency across observers, or *inter-subjective* agreement. The relatively high consistency both within and between subjective observers with similar worldviews can be understood to support realism.

But for other human observers with quite different cultural histories and worldviews, the book might be experienced as just very thin sheets of wood to serve as good kindling. To non-human observers such as an elephant or ant, the book might be simply an object to walk on or eat. It may not be a distinct object at all for observers such as amoebae or bacteria. Certain properties of the object remain the same; but its *objective reality* as a book with useful information in it does not maintain.

In realism, it seems quite reasonable that objects exist independent at least of any particular individual observer. Like-minded observers seem to agree on many of their properties. It also seems quite reasonable that some qualities depend on the observer's perspective, more in line with idealism. They don't independently inhere in the object, but are products of the contextual interaction of object and observer. But like-minded observers seem to agree on many of these qualities too.

For the most part, objective and subjective levels match up to a high degree across like-minded individuals. The objective physical realist perspective of objects existing independent of observers and the subjective idealist perspective of structures as depending on the observer both have considerable support. Another way of saying this is that orderly principles or universal laws of nature governing both outer objective and inner subjective seem to be present. This strongly suggests both realism and idealism have relative validity. In this view, scientific realism should not be undermined, even if theoretical

descriptions change as our understanding of substance and form progresses.

> "A diamond will cut a piece of glass, no matter what cultural words or concepts we use for "diamond," "cut," and "glass," and no amount of cultural constructivism will change that simple objective fact.... So it is one thing to point out the partial but crucial role that interpretation plays in our perception of the world.... But to go to extremes and deny any moment of objective truth at all (and any form of correspondence theory or serviceable representation) is simply to render the discussion unintelligible (Wilber, 1998, pp.121-123)."

In the Vedic developmental account, belief in the *observer* as an individual is typical of the ordinary waking state of consciousness. The independence of objects is directly related to identifying oneself as an independent individual self. But if there are no individuals as argued in some versions of structural realism noted earlier, then there would be no individual observers either. This seems quite contrary to ordinary daily life, and likely unacceptable to most individuals who believe in OSR.

6.4 Epistemic levels of subjectivity

Sāṁkhya enumerates levels of subjectivity from sensations to thoughts, intellectual discriminations, and deeper intuitive feelings—similar to Kant as discussed earlier (but again, Kant's self-introspections seemed to exclude the underlying 'direct experience' of consciousness itself). The basic means to gain knowledge that include ordinary sensory experience and reason interact with deeper intuitive-like presuppositions. These fundamental presuppositions nowhere present themselves to the senses. They are sometimes asserted to be proven by logical reasoning in the form of mathematical proofs, as argued in the following quotes of Penrose (2005):

> "But what is mathematical proof? A proof, in mathematics, is an impeccable argument, using only the methods of pure logical reasoning, which enables one to infer the validity of a given mathematical assertion from the pre-established validity of other mathematical assertions, or from some particular primitive assertions—the *axioms*—whose validity is taken to be self-evident.... [W]e must be careful...whether to trust the 'axioms' as being, in any sense, actually *true*.... But what does 'true' mean, in this context?... Plato made it clear that the mathematical propositions—the things that could be regarded as unassailably true—referred not to actual physical objects...' He envisaged that these ideal entities inhabited a different world, distinct from the physical world. Today, we might refer to this world as the *Platonic world of mathematical forms*.... In mathematics, we find a far greater robustness than can be located in any particular mind.... Nevertheless, one might still take the alternative view that the mathematical world has no independent existence, and consists merely of certain ideas...found to be totally trustworthy and are agreed by all....
>
> Do we mean...'agreed by those who are in their right minds', or 'agreed by all those who have a Ph.D. in mathematics'...and who have a right to venture an 'authoritative' opinion? There seems to be a danger of circularity here; for to judge whether or not someone is 'in his or her right mind' requires some external standard. So also does the meaning of 'authoritative', unless some standard of an unscientific nature such as 'majority opinion' were to be adopted (and it should be made clear that majority opinion, no matter how important it may be for democratic government, should in no way be used as the criterion for scientific acceptability).... Platonic existence, as I see it, refers to the existence of an objective external standard that is not dependent upon our individual opinions nor upon our particular culture.... To my way of thinking, Platonic existence is simply a matter of objectivity and, accordingly, should certainly not be viewed as something 'mystical' or 'unscientific'... (pp. 110-115)."

But if access to mathematical forms is via logical reasoning in the mind rather than sensing them as objects outside the mind, then must they be only outside the mind? Perhaps these mathematical structures, or Platonic forms, also exist deeper in our minds. The deepest structures of our individual minds may contain the same laws of nature that structure logical reasoning and the entire objective universe; and we may have inherent potential to tap into them deeper inside, as Penrose ponders:

> "Nature is potentially present within all of us, and is revealed in our very faculties of conscious comprehension and sensitivity, at whatever level they may be operating (Penrose, 1994, p. 420)."

'Whatever level they may be operating' is the operative point in this paper. The inner sense of what is accurate, *true*, or *real* relies on

feelings deeper than sensation, thinking, and logical reasoning. It involves a *felt sense* or intuition about how the world is structured that has inherent meaning to us.

There are levels of mathematical structures—whole numbers, integers, rational numbers, real numbers including irrational numbers, imaginary numbers, complex numbers (Hagelin, 2012). And mathematical logic extends into more abstract conceptions of pre-geometry or meta-mathematics, underpinned by axioms, undefined quantities; principles of simplicity, elegance, symmetry, and belief in the comprehensibility and inevitability of laws of nature. But none of these concepts are verifiable alone by the senses or by logical proofs we sometimes end up attributing to be *self-evident*.

Gödel's incompleteness theorem showed that mathematical systems complex enough to include simple arithmetic can be consistent or complete, but not both (Boyer, 2008). This suggests that a deeper inner level of intuitive *feelings* underlies logical consistency expressed in mathematical proofs. These intuitive feelings are further underlain by a sense of *knowingness*, a sense that *I* know who *I am*, a sense that *I am the knower,* a direct sense that *I am*, that *I exist,* and more fundamentally (apparently missed by Kant and many others), *consciousness itself*. The bottom line of our ability to gain knowledge is not the senses—they cannot reveal subtler mind and intellect. In turn, mind and intellect cannot reveal consciousness itself that is transcendent to even the subtlest intuitions.

These subtler levels of the inner sense of rightness or self-evident truth can of course have distortions and biases. Systematic subjective means that naturally allow the mind to transcend and disembed from these levels are said to develop their clarity. Transcendence goes beyond the intellectual discrimination of logical and illogical to the simultaneous coexistence of opposites, beyond all dualities or pairs of opposites. With regular transcending, *objective reality* and *subjective reality* are said to become increasingly consistent. Without transcending the conceptual limitations, clarity at the deepest levels may progress only marginally in an entire life-span. These inner levels of individual subjectivity may remain an un-illumined 'black box,' with little or no 'direct experience' of consciousness itself as the ever-present underlying, transcendent ground state of the mind.

In this Vedic developmental account, there is a deep correspondence between ontological levels of nature and levels of subjective experience of what *reality* is—the primary locus of experience. Sensory experience is not of atoms or elementary particles, though the macroscopic sensory system is sensitive enough to sense their effects. The macroscopic sensing system matches gross matter, the macroscopic physical domain. When such gross experiences predominate in daily life and there are no or only fleeting subtler experiences, the ordinary belief is that the local physical domain is the only ontologically *real* domain. This is the common result of the lack of full development and refinement of the mind—which is precisely what the systematic means to gain knowledge of the Vedic Darshana of Yoga is designed to alleviate.

> "The concept of objectivity free from all subjectivity is like saying we could have a *mind-independent mind*—an experience without an experiencer.... Rather, to be objective more fundamentally means to minimize distortion and increase orderliness in our subjective minds, as well as in our measurement devices and procedures.... Further it would hardly seem possible to know about or function in an objective world if subjective minds were not at least relatively orderly, stable, reliable, and consistent—both intra-subjectively and inter-subjectively (Boyer, 2008, p. 14)."

The ontologically richer models emerging in quantum physics that include nonlocality and interdependence are increasingly difficult to validate with even our most advanced experimental tools. There is also growing recognition that it is in part due to limitations of the outer indirect, third-person scientific method. This has led to the current stage in modern science of sometimes wildly speculative mathematical models not grounded in empiricism, and the difficulty of discriminating between them. It calls for a reconsideration of scientific epistemology to incorporate systematic means in order to develop the ability to investigate *real* levels of nature beyond the physical.

> "To prove a theory you carry out an experiment according to the operational instructions, left by those who have made the experiment before you. In spiritual

search the chain of experiments one has to make is called Yoga (Nisargadatta Maharaj, 1973, p. 367)."

6.5 Yoga as a developmental epistemology

Many factors influence our ability to reason and experience. In the same way that a measuring device can malfunction, physiological and psychological processes can malfunction due to fatigue, stress, disease, or other disorderly influences. Our daily lifestyles affect how our bodies and minds function, adding stress that reduces coherent functioning or refinement that increases it. These factors have major effects on reliability, consistency, and accuracy of knowledge within and across individuals.

Even many of the most respected scientific authorities have not acknowledged the relevance of their own subjective state. This is exemplified in the comprehensive survey by Ladyman (2009) cited extensively in this paper that did not mention the topic (see also Schlosshauer, 2011). The subjective state of the scientist can no longer be ignored in *objective* science. The level of functioning of mind and body—most fundamentally the *state of consciousness*—shapes the reasoning and empirical experiences on which scientific consensus is built. Ordinary waking is characterized by an experiential gap between outer objective and inner subjective—object-subject independence. Full appreciation of holism in nature requires further development (Maharishi, 1963).

It is quite challenging even to envision nonlocal *quantum mind* as permeating the local physical brain, given ingrained reductivism and lack of direct experience of subtle nonlocal and transcendent levels. Ordinarily it feels like our mind is behind our eyes, in the brain somewhere, as a localized 'screen of the mind.' Experiences of subtler, nonlocal levels become increasingly *real* as a natural result of research in the *inner laboratory* of the mind that refines sensory perceptual processes. In higher stages, this 'screen' is refined to include much subtler, inherently more enlivened essences of sensory objects, and our inner sense of self is the background observer of the 'screen.' The 'screen' presents subtle as well as gross objects to the individual self. Eventually the self is experienced as an unbounded nonlocal observer or *witness* of all individual experience.

In ordinary waking, phenomenal experience of subject-object independence is commonly associated with the sense that the objective outer world is more *real*—more substantial, reliable, and consistent—than inner subjectivity. This is held to be a product of the discriminative property of the intellect without sufficient refinement and grounding in unity. In Vedic terms, it is sometimes called *Pragya aparadha*, the 'mistake of the intellect.' In the experiential duality of ordinary waking:

> "You are taking duality so much for granted, that you do not even notice it.... Truth...is nearer than the mind and the body, nearer than the sense 'I am'.... You have objectified truth and insist on your standard proofs and tests, which apply only to things and thoughts.... Your true being is...completely free from all self-identification with whatever it may be, gross, subtle, or transcendental (Nisargadatta Maharaj, 1973, pp. 368-371)."

6.6 Systematic subjective means to gain knowledge

Yoga refers to practical means to transcend the object-subject duality of intellect in order to 'yoke' or unify the individual self with the universal Self. Although the process of transcending is effortless, it is quite subtle and not widely understood or experienced in either secular or non-secular traditions.

Modern science has progressed far beyond directly observable and indirectly measurable physical levels. This places more emphasis on logical reasoning in formulating and evaluating scientific theories. But like sensory experience, reasoning still involves active mentation (As with Kant, consciousness and thinking are conflated). Thinking about matter, energy, nothing, the unified field, God or Godhead, as well as introspection, self-reflection, or being mindful of some object of experience, tends to keep the thinker in the subject-object duality of the ordinary waking state. This is a fundamentally fragmented experience of the world, overshadowing the underlying unity.

In the 20th Century, materialistic and existential views that life is meaningless became widespread—entirely disconnected from the underlying unity of life. Maharishi

points out that this occurs when only the indirect, object-based, third-person *objective* approach is used and the knower remains within the subject-object duality of ordinary waking. The underlying unity is hidden by ordinary thinking that does not transcend the duality. As Maharishi (1967, p. 444) points out:

"Transcending thought is infinitely more valuable than thinking."

Empirical validation of unity is the purpose of Yoga. Although some scientists have spent time on both development of intellectual understanding and also transcendence of the intellect, many who haven't doubt that experiences beyond the discriminative intellect to non-dual unity are possible.

> "Those whose hearts and minds are not cultured, whose vision concentrates on the gross, only see the surface value of life. They only find qualities of matter and energy.... They do not enjoy almighty Being in Its innocent, never changing status of fullness and abundance of everything that lies beyond the obvious phase of forms and phenomena of matter and energy, and of mind and individual.... Pure Being is of transcendental nature because of Its status as the essential constituent of the universe. It is finer than the finest in creation; because of Its nature, It is not exposed to the senses which primarily are formed to give only the experience of the perception of the mind, because the mind is connected for the most part with the senses (Maharishi, 1963, pp. 24-25)."

Maharishi's crucial contribution is in reviving and systematizing the effortless subjective means to gain knowledge in Yoga, as the Transcendental Meditation® technique. It is an effortless process of the mind naturally settling to its least excited ground state—like a local wave settling back into the unbounded ocean. Over the past 40 years it has been researched extensively, with 600 or more studies on its results now published, about 400 in refereed journals (Orme-Johnson (2010), Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi Programme (1977-90), Dillbeck MC. (2011), Eppley, Abrams & Shear (1989), Barnes, Treiber & Davis (2001), Rosenthal (2011).

In *trying* to still the mind, the typical experience is that it is fickle and shifts from one object of experience to another. Long traditions based on this experience hold that the mind must be controlled to be resolute and still. Numerous methods attempt to still the mind using either *contemplation*—reflective thinking about an object of attention—or *concentration*—effortful focus on an object. Contemplation has come to mean reflecting on concepts such as peace or the grace of God. Because the mind tends to wander, contemplation is frequently modified to include concentration in attempts to eliminate intrusive mental content that can distract the mind from being resolute and still—such as focusing on the breath or a visual or auditory stimulus. Maharishi has revived the systematic, integrated understanding and experience of how the mind settles down *effortlessly*, which many in long-standing traditional practices overlooked and have had difficulty appreciating.

The contrast between the silent transcendent state and active mental states is finally being documented in direct experimental comparisons. Some mental practices correlate with increased gamma synchrony, proposed as the best measurable neural correlate of consciousness (Hameroff, 2008; Stapp, 2007). This is consistent with the ordinary waking state understanding and experience of consciousness as *being aware of* some object of experience. But it is not correlated with reported transcendental consciousness, which typically involves peak alpha power indicative of restful alertness (Travis & Shear, 2010; Travis & Arenander, 2006; Dillbeck, 2011).

6.7 Vedanta and the simultaneity of individual/universal

To further articulate what science can tell us about *reality,* it is quite fortunate that modern science is at the doorstep of the ultimate unification in unified field theory. But unity is only in terms of theoretical understanding — intellectual wholeness — not yet *direct empirical validation* of unity. From the perspective of unity, neither the object nor observer has completely independent existence. Whether the focus is on independence or interdependence, objectivity or subjectivity, realism or idealism, individuality or universality, eventually we go beyond to unity—the purpose of Vedanta.

The six Darshana are each said to contain wholeness of knowledge, while

emphasizing a particular perspective. Some interpreters propound a particular one to the exclusion of the others, not emphasizing their sequential developmental contributions. For example, some interpretations of Sāṁkhya strongly *distinguish* Purusha (universal Self) from Prakriti (Nature). This distinction is important at a certain stage in clarifying consciousness itself as unmixed with mind and body. But it isn't that Purusha and Prakriti ultimately are separate in fundamental dualism. It is relative dualism at a stage of development. As noted earlier, this stage is particularly relevant to the current stage of modern science and philosophy of science, exemplified throughout this paper.

Understanding and direct experiential validation of ultimate unity is the purpose of the Darshana of Vedanta. In Vedanta, the infinite eternal unity is *real*—always existing and never changing. The finite relative world is always changing and never the same, and in this sense could be said to be *unreal*—or perhaps better identified as *phenomenal*. This relates to the concept of *Maya*, frequently interpreted that the world is illusory. The interpretation of the world as illusory has been a basis for many to reject the Vedic approach without deeper consideration. Maharishi has explained that the concept of Maya is more precisely described as neither *real* nor *unreal*.

The concept of Maya is sometimes associated with *measurable existence* and the view of nature as having parts that can be measured (Bhavasar & Boyer, 2010). For the purpose of providing explanations of the phenomenal world, it also is sometimes associated with Prakriti, Veda, process of manifestation, and story of creation (Hensley, 2012). In objective modern science, *reality* has been attributed only to things that can be measured in terms of the metrics of ordinary time and distance—though it is now extending into nonphysical fields in nonconventional, nonlocal spacetime. This subtler level is quite difficult to conceptualize how to measure, or even how to retain some form of individuality and substantiality as the basis for measurement. What has been left out is the developmental context, crucial to understand the concept of Maya as neither *real* nor *unreal*.

The upshot for scientific realism with respect to this Vedic developmental account is that the objective world is relatively *real* in the sense of phenomenally independent of *individual* observers (object/subject independence, realism), but also relatively *unreal* in the sense that it cannot be known independent of observers (object/subject dependence, idealism).

Because the world is ever-changing, relative, and finite, it could be said to be *unreal* compared to the *ultimate reality* that is non-changing, infinite, and eternal. But this is also a way of understanding that Maya is neither *real* nor *unreal,* as well as how Vedanta could be interpreted as suggesting that the world as Maya is illusory. In Vedanta, all phenomena are nothing other than the universal Self, and all objects and subjects emerge from and are wholly dependent (supervene) on the unified field or universal Self. That *ultimate reality* beyond gross, subtle, or transcendental is verifiable in 'direct experience (Maharishi, 1967).'

Individual consciousness is ultimately unified with universal consciousness in the universal Self—individual/universal, oneness/Oneness *at the same time*. In that sense, it can be said that we *can* "…stand outside of ourselves to behold the degree of fit that our representation might have with the world (see earlier quote of Varela, Thompson & Rosch, 1993, p. 161)." This is by virtue of being the ultimate source of individual subject *and* individual object, and experiencing in unity how they both phenomenally are distinguished and phenomenally emerge from that source. But it is neither outside ourselves nor the universe; rather, the individual self and the universe are both within it. The distinction of subjective and objective emerges in the phenomenal process of manifesting the finite universe within the infinite eternal unity. But the direct experience of unity is not known from the localized individual self. In Vedanta, all phenomenal experience by the localized individual self is also experienced as within and nothing other than the universal Self. That is so far beyond ordinary waking which attributes *self* only to the local physical brain/body that even the notion of nonlocal 'quantum mind' can be hard to conceive—without clear experiences of transcendental consciousness.

7. Summary and Conclusion

In the reductive physicalist or materialistic monist worldview associated with physical

scientific realism, objects or entities we sense directly or investigate indirectly should be attributed status as ontologically *real*. But science has progressed to smaller time and distance scales and unobservable objects, involving changes to and sometimes abandonment of accepted theories that attempt to describe unobservable objects. This has increased concern whether science can tell us about *reality*.

Quantum theories account for a wider range of phenomena than physical theories, adding more unobservables and further decreasing commitment to standard scientific realism. Structural realism weakens ontological and strengthens epistemic commitments, emphasizing mathematical structures as the basis of continuity across theory change. But further, it needs to address nonphysical *levels of reality* in which *real* mathematical structures are said to exist, as in Platonic scientific realism and some quantum field theories. This paper proposes that the path to resolve the major challenges to scientific realism is to extend it beyond *physical* realism.

In the Vedic developmental account, we are naturally impelled to understand nature—which eventually brings us back to our own nature. Progress is reflected in increasingly abstract understanding of matter, energy, information, mind, and consciousness. Concerns about scientific realism reflect this natural progress, which is now challenging the limits of current scientific ontology and epistemology.

Regular experience of the fourth state of transcendental consciousness fosters higher stages of development in which subtle and transcendent levels of nature become *real*. Epistemic stages correspond to phenomenal *levels of reality* and to ontologically *real* levels of nature from gross physical matter to subtle nonphysical mind to transcendent unity. In the gross level (physical scientific realism), objects are *real* and exist independent of each other and the observer. In the subtle nonphysical, objects are experienced as *hyper-real* and both independent as in *Platonic scientific realism* and interdependent with respect to each other and the observer in *quantum reality*.

Of particular importance is that in the Vedic account these same correspondences apply to the laws of nature. The laws of nature can be said to be objective and independent of individual subjectivity, within individual subjectivity, and to transcend both in the perfectly orderly infinite eternal unified field of natural law.

As a final additional point about how to validate the holistic Vedic 3-in-1 ontology as described here in terms of Maharishi's re-clarification of Vedic knowledge, the deep correspondence between relatively *real* objects and empirical experience of them by relatively *real* individual subjects leads to the Vedic principle of 'name and form equivalence' (*namarupa*). Both name and form are patterns of vibration of the unified field. In Vedic language, the name of an object is the same pattern of fluctuation as its form. At the most refined levels, the name of the form can be said to be so similar to the vibration of the form that the name elicits the form. This name and form equivalence eventually provides experiential validation of the detailed correspondence of objective and subjective *levels of reality* (Nader, 2000; 2012).

Again, in completely holistic Vedanta all objects and observers are nothing other than the universal Self. That *ultimate reality* is said to be directly verifiable in unity consciousness as the simultaneity of part/whole, reductivism/holism, individual/universal. It is expressed simply and fully in the Vedic statement:

"Aham Brahmasmi (Brihad-Aranyak Upanishad, 1.4.10)

I am totality (Inaugurating Maharishi Vedic University, 1996, p. 181)."

References

Alexander CN, Rainforth MV & Gelderloos P. Transcendental Meditation, self-actualization, and psychological health: a conceptual overview and statistical meta-analysis. Journal of Social Behavior and Personality 1991; 6 (5): 189-247.

Auyang S. How Is Quantum Field Theory Possible? Oxford: Oxford University Press. 1995.

Ball P. Experts Still Split About What Quantum Theory Means: Poll Reveals Diverse Views About Foundational Questions in Physics. Nature 2013. January 11, doi:10.1038.2013.12198.

Barnes VA, Treiber FA & Davis H. Impact of Transcendental Meditation on cardiovascular function at rest and during acute stress in adolescents with high normal blood pressure. Journal of Psychosomatic Research 2001; 51(4); D97-605.

Bhavasar SN & Boyer RW. Major progress linking modern science and Vedic science, Sambodhi, Vol. XXXII, 2009, Ahmedabad, India, 1-32.

Bohm D. Wholeness and the Implicate Order. London: Routledge & Kegan Paul. 1980.

Bohm D & Hiley BJ. The undivided universe. London: Routledge. 1993.

Born M. Physical reality. Philosophical Quarterly 1953; 3: 139–149.

Boyer RW. Bridge to Unity: Unified Field-Based Science and Spirituality. Malibu: Institute for Advanced Research. 2008.

Boyer RW. Think Outside the Bang: Beyond Quantum Theory and Hidden Dimensions to a Holistic Account of Consciousness, Mind and Matter. Malibu: Institute for Advanced Research. 2010.

Boyer RW. Linking Mind and Matter: A New Scientific Model That Unifies Nonlocal Mind and Local Matter. Malibu: Institute for Advanced Research. 2012a.

Boyer RW. Vedic Principles of Therapy. Malibu: Institute for Advanced Research. 2012b.

Cassirer E. Determinism and Indeterminism in Modern Physics. New Haven: Yale University Press. 1936 [1956].

Chakravartty A. Structuralism as a form of scientific realism. International Studies in Philosophy of Science 2004; 18: 151–171.

Dennett D. Darwin's Dangerous Idea: Evolutions and the Meanings of Life. Simon & Schuster, 1995.

Dillbeck MC. Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi Programme: collected papers, Vol. 6. The Netherlands: Maharishi Vedic University Press. 2011.

DiSalle R. On dynamics, indiscernibility, and spacetime ontology. The British Journal for the Philosophy of Science 1994; 45: 265–287.

Eppley KR, Abrams AI & Shear J. Differential effects of relaxation techniques on trait anxiety: a meta-analysis. Journal of Clinical Psychology 1989; 45: 957-974.

Esfeld M. Quantum entanglement and a metaphysics of relations. Studies in History and Philosophy of Modern Physics 2004; 35: 601–617.

Esfeld M. and Lam V. Moderate structural realism about space-time. Synthese 2008; 160: 27–46.

Feyerabend P. Farewell to Reason. Verso. 1987.

French S. Models and mathematics in physics: The role of group theory. In J. Butterfield and C. Pagonis (eds.), From Physics to Philosophy, pp.187–207. Cambridge: Cambridge University Press. 1999.

French S and Krause D. Identity in Physics: A Historical, Philosophical and Formal Analysis. Oxford: Oxford University Press. 2006.

French S and Ladyman J. Remodeling structural realism: Quantum physics and the metaphysics of structure. Synthese 2003a; 136: 31–56.

French S and Ladyman J. Between platonism and phenomenalism: Reply to Cao. Synthese 2003b; 136: 73–78.

Hagelin J. Is Consciousness the Unified Field? A Field Theorist's Perspective. Modern Science and Vedic Science 1987; 1(1): 29-87.

Hagelin JS. The physics of flying. The Video Magazine, Vol. 7, Tape 1, N- 38, Maharishi University of Management.

Hameroff SR. The conscious pilot: Synchronized dendritic webs move through brain neurocomputational networks to mediate consciousness. April 11 plenary session, Toward a Science of Consciousness Conference 2008; April 8-12, Tucson, AZ.

Hensley P. Personal communication, January 27. Fairfield IA. 2012.

Herbert N. Quantum reality: beyond the new physics. New York: Anchor Books. 1985.

Inaugurating Maharishi Vedic University (1996). India: Age of Enlightenment Publications.

Kant I. (1781). Pluhar W. (trans.) (1996). Critique of Pure Reason. Indianapolis: Hackett XXVIII.
Kant I. A383
<en.widipedia.org/wiki/Idealism#Transcendental-idealism>
Kant I. A369
<en.widipedia.org/wiki/Critique_of_Pure_Reason>
Kant I. B309/B30 P2677 (NKS)
<en.wikipedia.org/wiki/Noumenon>

Kantorovich A. The priority of internal symmetries in particle physics. Studies in History and Philosophy of Modern Physics 2003; 34: 651–675.

Ladyman J. Structural Realism, 2009. pp.1-35.
http://www.plato.stanford.edu/entries/structural-realism/

Ladyman J and Ross D. (with Spurrett, D. and Collier, J.) Every Thing Must Go: Metaphysics Naturalised, Oxford: Oxford University Press. 2007.

Leitgeb H and Ladyman J. Discussion Note: Criteria of Identity and Structuralist Ontology. Philosophia Mathematica 2008; 16: 388–396.

Lyre H. Holism and structuralism in U(1) gauge theory. Studies in History and Philosophy of Modern Physics 2004; 35: 643–670.

Maharishi Mahesh Yogi. Science of Creative Intelligence: knowledge and experience. [Syllabus of videotaped course]. Los Angeles: MIU Press. 1972.

Maharishi Mahesh Yogi. Maharishi Mahesh Yogi on the Bhagavad-Gita: a new translation and commentary, chapters 1 to 6. London: Penguin Books. 1967.

Maharishi Mahesh Yogi. Science of being and art of living. Washington DC: Age of Enlightenment Publications. 1963.

Maharishi Vedic University: Introduction. Holland: Maharishi Vedic University Press. 1994.

Maxwell G. The ontological status of theoretical entities. In H. Feigl and G. Maxwell (eds.), Minnesota Studies in the Philosophy of Science 1962; 3: 3–14.

Maxwell G. Structural realism and the meaning of theoretical terms. In S. Winokur and M. Radner (eds.), Analyses of Theories and Methods of Physics and Psychology (Minnesota Studies in the Philosophy of Science: Volume 4), pp. 181–192. Minneapolis: University of Minnesota Press. 1970a.

Maxwell G. Theories, perception and structural realism. In R. Colodny (ed.), The Nature and Function of Scientific Theories (University of Pittsburgh Series in the Philosophy of Science: Volume 4), pp. 3–34. Pittsburgh: University of Pittsburgh Press. 1970b.

Maxwell G. Scientific methodology and the causal theory of perception.em> In H. Feigl, H. Sellars and K. Lehrer (eds.), New Readings in Philosophical Analysis, pp. 148–177. New York: Appleton-Century Crofts. 1972.

McMullin E. Comment: Duhem's middle way. Synthese 1990; 83: 421–430.
Nader T. Human physiology: expression of Veda and the Vedic literature. The Netherlands: Maharishi Vedic University. 2000.
Nader T. Ramayan in human physiology, discovery of the eternal Reality of the Ramayan in the structure and function of human physiology. 2012.
Nisargadatta Maharaj. I Am That. Durham, NC: Acorn Press. 1973.
Orme-Johnson DW. Medical care utilization and the Transcendental Meditation program. Psychosomatic Medicine 1987; 49: 493–507.
Orme-Johnson DW Autonomic stability and Transcendental Meditation. Psychosomatic Medicine 1973; 35(4): 341-349.
Papineau D. (ed.) Philosophy of Science. Oxford: Oxford University Press. 1996.
Penrose R. The road to reality: A complete guide to the laws of the universe. New York: Alfred A. Knopf. 2005.
Penrose R. Shadows of the mind: In search of the missing science of consciousness. New York: Oxford University Press. 1994.
Pooley O. Points, particles and structural realism. In Rickles D., French S. and Saatsi J. (eds.), Structural Foundations of Quantum Gravity, Oxford: Oxford University Press, 2006, pp.83–120.
Post HR. Correspondence, invariance and heuristics. Studies in History and Philosophy of Science, 2: 213–255. Reprinted in S. French and H. Kamminga, eds., 1993, Correspondence, Invariance and Heuristics: Essays in Honour Of Heinz Post, Boston Studies in the Philosophy of Science, Vol 148, pp.1–44. Dordrecht: Kluwer Academic Press. 1971 [1993].
Psillos S. Is structural realism the best of both worlds? Dialectica 1995; 49: 15–46.
Psillos S. Is structural realism possible? Philosophy of Science 2001; 68: S13–S24.
Putnam H. Mathematics, Matter and Method. Cambridge: Cambridge University Press. 1975.
Rosenthal NE. Transcendence: healing and transformation through Transcendental Meditation. New York: Tarcher/Penguin. 2011.
Russell B. The Analysis of Matter. London: Routledge Kegan Paul. 1927.
Ryckman T. The Reign of Relativity: Philosophy in Physics 1915–1925. Oxford: Oxford University Press. 2005.
Saunders S. Are quantum particles objects? Analysis 2006; 66: 52–63.
Scharf D. Personal communication, Fairfield IA. 2013.
Scharf P. Personal communication, Fairfield IA. 2012.
Schlosshauer M. (Ed.) Elegance and Enigma: The Quantum Interviews. Heidelberg: Springer-Verlag. 2011.
Schlosshauer M, Kofler J & Zeilinger A. A Snapshot of Foundational Attitudes Toward Quantum Mechanics, 2013. arXiv:1301.1069v1[quant-ph]6Jan2013.
Scientific research on Maharishi's Transcendental Meditation and TM-Sidhi Programme—collected papers, Vols. 1-5. (Various Eds.) Fairfield, IA: Maharishi University of Management Press. 1977-1990.
Shannon CE & Weaver W. The mathematical theory of communication. Urbana IL: University of Illinois Press. 1949.
Smolin L. The trouble with physics: The rise of string theory, the fall of a science, and what comes next. New York: Houghton Mifflin Co. 2006.
Stachel J. Structure, individuality and quantum gravity. In D. Rickles, S. French and J. Saatsi, Structural Foundations of Quantum Gravity, Oxford: Oxford University Press, pp. 53–82. 2006.
Stanford PK. No Refuge for Realism: Selective Confirmation and the History of Science. Philosophy of Science 2003a; 70: 913–925.
Stanford PK. Pyrrhic victories for scientific realism. Journal of Philosophy 2003b; 11: 551–572.
Stanford PK. Exceeding Our Grasp: Science, History and the Problem of Unconceived Alternatives. Oxford: Oxford University Press. 2006.
Stapp HP. The Hard Problem: A Quantum Perspective. In Shear, J. (Ed.). Explaining.
consciousness—The hard problem. Cambridge, MA: The MIT Press, pp.197-21. 2000.
Stapp HP. Mindful universe: Quantum mechanics and the participating observer. Berlin Heidelberg New York: Springer-Verlag. 2007.
Travis FT, Haaga DH, Hagelin JS, Tanner M, Arenander A, Nidich S, Gaylord-King C, Grosswald S, Rainforth M & Schneider RH. A self-referential default brain state: patterns of coherence, power, and eLORETA sources during eyes-closed rest and the Transcendental Meditation practice. Cognitive Processes 2009; 11 (1): 21-30.
Travis F & Arenander A. Cross-sectional and longitudinal study of effects of transcendental meditation practice on interhemispheric frontal asymmetry and frontal coherence. International Journal of Neuroscience 2006; 116; 1519-38.
Travis F & Shear J. Focused attention, open monitoring and automatic self-transcending: categories to organize meditations from Vedic, Buddhist and Chinese traditions. Consciousness and Cognition 2010; 19(4): 1110-1118.
Van Fraassen BC. Structure: Its shadow and substance. The British Journal for the Philosophy of Science 2006; 57: 275–307.
Van Fraassen BC. Structuralism(s) About Science: Some Common Problems. Proceedings of the Aristotelian Society, LXXXI: 2007; 45–61.
Varela FT, Thompson ET & Rosch E. The embodied mind: Cognitive science and human experience. Cambridge, MA: The MIT Press. 1993.
Wilber K. The marriage of sense and soul: Integrating science and religion. New York: Random House. 1998.
Woit P. Not even wrong: The failure of string theory and the search for unity in physical law. New York: Basic Books. 2006.
Worrall J. Structural realism: The best of both worlds? Dialectica, 43: 99–124. Reprinted in D. Papineau (ed.) The Philosophy of Science, pp. 139–165. Oxford: Oxford University Press. 1989.