QUANTUM MECHANICS AND CONSCIOUSNESS: FACT AND FICTION

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Abstract: This article was written in response to a request from an editor of *American Vedantist*. It is shown that the idea that consciousness is essential to understanding quantum mechanics arises from logical fallacies. This may be welcome news to those who share the author's annoyance at consciousness being dragged into discussions of physics, but beware: The same fallacies may underlie the reader's own way of making sense of quantum mechanics. The article ends up embracing a Vedantic world view, for two reasons. For one, such a world view seems to the author to be the most sensible alternative to a materialistic one. For another, quantum mechanics is inconsistent with a materialistic world view but makes perfect sense within a Vedantic framework of thought.

Ever since its formulation three quarters of a century ago, quantum mechanics (QM) stands accused of applying a double standard to measurements: While as physical processes measurements are governed by the Schrödinger equation, as constituents of a "classical domain" they exist in an anterior logical relationship to QM and are governed instead by the so-called projection postulate. Some physicists have taken this to mean that QM is inconsistent. Others have felt that QM is incomplete: It does not tell us when a physical system evolves in a deterministic fashion as dictated by the Schrödinger equation, and when it changes unpredictably in conformity with the projection postulate.

Those who have come closer to understanding the real import of QM have realized that QM spells *the end of mathematical realism*: The mathematical symbols employed by QM cannot be interpreted as mirroring (representing, describing) the physical world. The mathematical formalism of QM provides us with probability measures; it serves to assign probabilities to the possible outcomes of possible measurements. That's all there is to it. The rest is metaphysics. This is OK since physics without metaphysics would not be physics—it would be pure mathematics, without any connection to the physical world. The problem is to find the right metaphysics, which at the very least ought to be free from logical fallacies.

Since the mathematical symbol known as the "state vector" or the "wave function" is nothing but a probability measure, the so-called "measurement problem" is spurious. No unpredictable transition from one physical state of affairs to another occurs, so none needs to be explained. What changes unpredictably is a probability measure, and this for reasons that are obvious rather than mysterious. Probabilities are assigned to possible events on the basis of relevant facts. They depend (i) on the time t of the events to which they are assigned and (ii) on the facts on which they are based. They can therefore change in two ways: in a deterministic manner as functions of t, and unpredictably with every new relevant fact. The successful completion of a measurement is the relevant fact *par excellence*. If the outcome of the measurement is unpredictable, as it generally is, it has to be included among the relevant facts on which probability assignments must subsequently be based. The outcome being unpredictable, the basis of relevant facts changes unpredictably as a matter of course, and so do the probabilities that we assign on this basis. No mystery there.

Unfortunately it is never hard to invent new pseudo-problems. Let $p\,(R,t)$ stand for the probability of finding an alpha particle inside a region R at a time t. While few would think of this probability as something that exists inside the region R, many succumb to the temptation of thinking of it as something that exists at the time t. The idea is that the possibility of finding the alpha inside R exists at all times, so the probability associated with this possibility also exists at all times and changes as a function of time.[1] Yet the possibility that something happens at the time t is not something that exists at the time t, anymore than the possibility of finding the alpha in R is something that one can find inside R. And the same holds true of the probabilities associated with these possibilities. Probabilities are not things that subsist and change; the time on which quantum-mechanical probabilities depend is the time of the measurement to the possible results of which they are assigned. To think of possibilities or probabilities as if they possessed an

actuality of their own, different from the actuality of facts, is to commit a category mistake. Some physicists commit it rather bluntly; they call their reified possibilities "propensities"[2] or "potentialities"[3, 4] and believe what happens during a measurement is that one of these acquires the status of a fact while the others lose their semi-actuality and cease to exist. Others commit it implicitly as when they hope or attempt to "understand how it is that probabilities become facts".[5]

This too is a pseudo-problem. Saying in common language that a possibility becomes a fact is the same as saying that something that is possible—something that *can* be a fact—actually *is* a fact. How can that be a problem? This non-problem becomes a pseudo-problem if one forgets that there is only one kind of actuality and misconstrues the common-language "existence" of a possibility as a second kind of actuality. It seems hard to believe that there are physicists—and quite a few—who still try to explain the transition from this pseudo-actuality to bona fide actuality, but there you are.

Another name for this pseudo-problem is the "emergence of classicality". QM is a tool for assigning probabilities to possibilities. It assigns probabilities on the basis of facts, and it assigns them on the assumption that exactly one possibility (no matter which) becomes a fact, in the innocuous common-language sense of "becoming a fact". Since QM *presupposes* facts from beginning to end (from the "preparation" of a physical system to a measurement on the system), it cannot possibly account for the existence of facts. So what accounts for the existence of facts—the emergence of "classicality"?

Counter-question: What *could* account for the existence of facts? The existence of facts is not something that can be accounted for, any more than we can give an answer to the question of why there is anything at all, rather than nothing. As integral Vedantists we may hold that Brahman or Maya (the creative power of Brahman) accounts for the existence of facts, but then we stand before the mystery of the existence of Brahman, and there we are left dumbfounded. The fallacy that the existence of facts can and ought to be explained, arises when one thinks of the possibilities to which QM refers, and of the probabilities it assigns to them, as if they constituted a self-existent matrix from which facts arise. A silly category mistake, but there you are.

To recap, by mistaking the wave function—a probability measure—for an actual state of affairs one creates one pseudo-problem (How is it that this actual state of affairs changes unpredictably during a measurement?) and by mistaking possibilities for actualities one creates another pseudo-problem (How is it that certain possibilities acquire the extra actuality that turns them into facts?). Since the early days of QM consciousness has been invoked as a filler for either or both of these alleged explanatory gaps [6, 7, 8, 9, 10, 11, 12, 13], for two reasons. The first is that quantum physicists habitually speak of "observations" when they mean measurements and of "observables" when they mean measurable quantities. This has created the impression, and promptly called forth the claim, that consciousness is essential to understanding QM.

The second reason is that QM concerns probability assignments, and in the deterministic world of classical physics probabilities are always *subjective*: We resort to probability assignments as and when we are *ignorant* of the precise initial conditions that determine the subsequent behavior of a physical system. Quantum-mechanical probabilities, however, come in two varieties: subjective *and objective*: The latter variety has nothing to do with ignorance; there is nothing for us to be ignorant of. The probability associated with a particular result of a measurement is subjective if it is assigned on the basis of an incomplete set of relevant facts, such as when the measurement is actually made but we are as yet ignorant of its result. Probabilities associated with the possible results of unperformed measurements are objective just in case all relevant facts are taken into account.[14]

There is, accordingly, a need to distinguish between performed measurements and their actual results on the one hand, and unperformed measurements and their possible results on the other. But this has nothing to do with the fact that the results of performed measurements are usually *known* to someone. The difference between performed and unperformed measurements is not that the results of the latter are not known or perceived. The difference is that unperformed measurements are not performed!

The bottom line, so far, is that *there isn't any problem that could be solved by dragging consciousness into discussions of QM.* The questions that consciousness is supposed to answer are pseudo-questions.

What about the converse? If consciousness does not help us understand QM, maybe QM can help us understand consciousness? (The underlying idea here is what philosopher David Chalmers has called the "law of minimization of mystery": "consciousness is mysterious and quantum mechanics is mysterious, so maybe the two mysteries have a common source"[15]). The mystery of consciousness is essentially the question of how it relates to the material world—how anything material can be conscious, and how anything can be conscious of the material world. What seems obvious to me is that as long as no-one has any clear idea about what QM is trying to tell us about the material world, it would be premature, if not outright foolish, to turn to QM for answers to these profound and fascinating questions.

Beginning with Fritjof Capra's popularization of the idea that physicists and Eastern mystics have something common to talk about, these questions—as well as the equally profound and fascinating problem of making sense of QM—have been obfuscated by concoctions of mysticism and QM dished out by numerous woolly mas-

ters. Among these *The Self-Aware Universe* by Goswami et al.[16] presents a worst-case scenario, not least because of the truths it contains—and makes a mockery of by buttressing them with absurdities, fallacies, and *non sequiturs*.[17] "To hitch a religious philosophy to contemporary science" may not be, as Bernstein maintains, "a sure route to obsolescence".[18] But to hitch it to a travesty of QM certainly is.

I am not opposed to the notion that physicists and mystics have something common to talk about. Yet they cannot do so profitably unless they cease to be muddle-headed about their respective domains. It seems to me that in the end physics will of its own accord converge with a spiritual philosophy that strictly holds its ground if both remain faithful to their principles. The words of the German poet Schiller are pertinent here: "Enmity be between you! Too soon it is for alliance. / Search along separate paths, for that is how truth comes to light."

"That which thinks not by the mind [or, that which one thinks not with the mind], that by which the mind is thought, know that to be the Brahman and not this which men follow after here," the Kena Upanishad [19] admonishes us. There is a consciousness beyond mind, and Goswami is absolutely right when he asserts that consciousness transcends both matter and mind. But to refer to this transcendent consciousness as "quantum mind" is ludicrous (as ludicrous as Zohar and Marshall's "quantum self"[20, 21] and Chopra's "quantum healing"[22, 23]), and so is his supporting tale: Perception consists of the collapse of a possibility wave in the presence of awareness. The subject consciousness of the experience arises with the chosen brain state both of which exist only as possibility until the collapse. The observer forces the many possibilities into a single, manifested actuality by the very act of observation. The brain is a measuring instrument which collapses the infinite and eternal quantum mind into concreteness as manifested through individual experience. The universe exists as formless potentia in myriad possible branches in the transcendent domain. And so on *ad nauseam*. As one reviewer remarked, "he sounds like Madame Blavatsky with a hangover".[24]

Now that we have disposed of the pseudo-problems and of some of their gratuitous answers (answers that do not involve consciousness have also been given), we are ready to address a real problem. How can a particle go through two slits without going through a particular slit and without being divided into parts that go through different slits? For this is what happens in a two-slit experiment whenever nothing indicates the slit taken by a particle. This problem arises from a mismatch between space and the way we tend to think about space. Ask yourself how you think about the empty regions L and R inside the two slits. No doubt you will consider them different, separate, distinct. This is why the behavior of particles in two-slit experiments baffles us. If a particle goes through both slits without going through a particular slit then the distinctness of L and R implies that the particle has two parts, one that goes through L and another that goes through R. Since, in fact, the particle does not get divided by its passage through the slits, L and R cannot be distinct. That's what baffles us.

But think again. How are L and R different? You may say, well, they are in different places. So where are these different places? If you contemplate this question long enough, you will realize that you are poised either for a tautology or for an infinite regress. Either: L is where L is. Or: L is inside another region L', which is inside another region L'', and so on *ad infinitum*. The root of the problem is that we keep switching between two inconsistent modes of thinking. If we ask about the position of L, we treat L as a *thing* to which a position—a *property*—can be attributed. If we answer that L is in L, we treat L both as an object with a position and as the position of an object. If we reply that L is in L', we treat L' as a property of L. If we then ask about the position of L', we switch back to thinking of L' as a thing to which properties can be attributed.

The problem has an easy solution: Stop thinking about regions of space as if they were *things*. The regions L and R are *properties* that may or may not be possessed. L (that is, the property of being inside L) is possessed just in case there is a thing T inside L. Saying (A) "T is inside L" seems to be different from saying (B) "T has the property L" because proposition (A) seems to imply that L is a *thing* that contains T. But, in fact, L is not a thing, and (A) says exactly what (B) is saying. Much the same applies to (numerically exact) positions: We tend to think of them as points, and we tend to think of these points as things to which positions can be attributed. In reality they do not *have* positions, they *are* positions, and positions are not *things* but *properties* that may or may not be possessed by things. As such they do not exist (in the material world) unless there are material objects to which they can be attributed.

Back to our particle. At the time it went through the slits it wasn't inside L, it wasn't inside R, and it didn't consist of two parts, one inside L and one inside R. As long as you assume that space is a thing that has parts—and once you start thinking that way you end up thinking that any finite region of space has infinitely many distinct parts,—you just can't make sense of this. But it is wrong to conceive of space as a thing that has parts because it is logically inconsistent to think of properties as if they were things. The behavior of particles in two-slit experiments forces us to acknowledge a fallacy we have been committing with impunity because the world of classical physics was consistent with it.

So space is not a thing that has parts but a set of positions. If we take into account that all positions are *relative* positions,[25] we arrive at the conclusion that *space is the totality of relative positions that exist between mate-*

rial objects. (Another word for "relative position" is *spatial relation.*) QM further takes into account that a position measurement can never distinguish between more than a finite number of finite regions, so that only finite regions are available as attributes. Attributable positions are always finite regions such as L and R. If a particle goes through both slits, neither L nor R is attributable to it, nor does it have parts to which the regions L and R are separately attributable. What *is* attributable to the particle is the region $L+R$ that is "made up of" L and R.

Made up of L and R? Doesn't this imply that L and R are distinct parts of $L+R$? It does not, for $L+R$ is a property rather than a thing that has parts. It is possible that $L+R$ is attributable to a particle while neither L nor R is attributable to anything. In this case the distinction we make between "The particle went through L" and "The particle went through R" is a distinction that Nature does not make; it corresponds to nothing in the material world; it exists solely in our heads.

Thus our spontaneous, untaught way of thinking about space—as a thing that has parts—is wrong. And so is the way in which students of physics, to this very day, are being taught to think about space, namely as a manifold of intrinsically distinct point individuals. It involves the same fallacy, namely to think of conceptually distinct properties as if they were intrinsically distinct things. And if these students stumble over the behavior of particles in two-slit experiments, they are warned not to waste their time wondering. "Do not keep saying to yourself, if you can possibly avoid it, 'But how can it be like that?' because you will go 'down the drain' into a blind alley from which nobody has yet escaped. Nobody knows how it can be like that."[26] Nobody knows because everybody has been taught the wrong way of thinking about space.

This sorry state of affairs warrants an inquiry into its neurophysiological and psychological roots. You probably know that a certain area of the retina (known as the blind spot) lacks light-sensitive cells. You don't see an object if its optical image falls on this area. If the object is a black cross on white paper, you only see a white area, and if the paper is red, you see a red area instead. No visual information reaches your brain from this area, yet sometimes it looks white and sometimes it looks red. Here is why: The brain analyses the data it receives from both eyes by detecting *contrasts.* It "sees" the edges of more or less homogeneously colored and evenly lit regions, where all but the most gradual variations in brightness and/or color occur. These regions themselves are not (directly) seen but are *filled in* on the basis of changes in brightness and color occurring across their boundaries. The region containing the blind spot is uniformly filled in just like any other contrast-free region.

The way in which the brain processes visual information guarantees that the result—the phenomenal world—is a world of objects that are bounded by surfaces. The *phenomenal* world—the world as we perceive it—therefore conforms to the "cookie cutter paradigm"[27, 28] (CCP) according to which the world's synchronic multiplicity rests on surfaces that carve up space in the manner of three-dimensional cookie cutters. The parts of any material object—including the world as a whole—are defined by the parts of the space it "occupies", and the parts of space are defined by delimiting and separating surfaces. This seems self-evident because this is how we perceive the world because this is how the brain analyses visual information.

We are prone to think that the mind works as it does because the brain works as it does, but in any spiritual conception of the world it must be the other way round. To understand why the brain works as it does we need to know why the mind works as it does.

There is, we said, a consciousness beyond mind. For the most detailed account of this consciousness and its relation to both matter and mind—as well as the most solidly founded on experience—we turn to Sri Aurobindo. In the Aurobindonian scheme of things, the world is an evolving manifestation of Brahman. Mind (*manas*) is the highest creative principle hitherto evolved but not by any means the highest. The original creative principle and dynamic link between Brahman and the world is supermind (*vijnana*). The creative action of the supermind is primarily qualitative and infinite and only secondarily quantitative and finite. Mind is the agent of this secondary action—limiting, defining, dividing, individualizing. Here is how Sri Aurobindo describes the characteristic action of mind, or *mental* consciousness:

> Mind in its essence is a consciousness which measures, limits, *cuts out* forms of things from the indivisible whole and contains them *as if each were a separate integer.* Even with what exists only as obvious parts and fractions, mind establishes this fiction of its ordinary commerce that they are *things with which it can deal separately* and not merely as aspects of a whole... It is this essential characteristic of Mind which conditions the workings of all its operative powers, whether conception, perception, sensation or the dealings of creative thought. It conceives, perceives, senses things *as if rigidly cut out from a background or a mass* and employs them as fixed units...[29]

This characteristic action of mental consciousness is the real reason why the phenomenal world conforms to the CCP, and why we find it so hard *not* to think of space itself as a thing that has parts. As long as we take the parts of matter to be defined by the parts of space, the parts of space are logically prior to the parts of matter; hence they exist independently of matter; hence space is a thing that has parts. Moreover, since it is in the nature of mind to deal with parts as if they were things that ex-

ist by themselves, rather than by virtue of some process of division or differentiation, space would be infinitely divided if it did conform to the mental outlook. The idea that *all* (conceivable) parts of space exist by themselves inevitably leads to the contemporary physicist's conception of space as a manifold of intrinsically distinct point individuals.

The characteristic action of mental consciousness is also the reason why we are by nature materialists, for the essence of materialism is the idea that *multiplicity is fundamental*. Mind deals with parts, in both perception and conception, "as if each were a separate integer". The essential function of the concept of "matter" is to betoken the separate existence of each part.

It will be illuminating to contrast two misconceptions arising from the mind's way of dealing with the world with what QM has to say—if we allow it to say what it has to say and do not force it into a conceptual framework that renders it incomprehensible. The first is that if there are ultimate parts—that is, if things are ultimately made of partless parts—then these have the form of a point. If the physical world were created along the lines laid down by the CCP, the shapes of things would be bounding surfaces, and matter would be an extended stuff bounded by surfaces. A material object would have as many parts as the space it occupies, and an object without parts—a particle like the electron—would be a bit of stuff with the form of a point.

The second misconception is that things are re-identifiable. Let me illustrate this with another experiment, a two-particle collision. Initially we have two incoming particles, one heading northward and one heading southward, and after the collision we have, per assumption, two outgoing particles, one heading eastward and one heading westward. Here re-identifiability means that each outgoing particle is identifiable with one of the incoming particles: The outgoing particle heading eastward is identical with either the incoming particle heading southward or the incoming particle heading northward. This is implied by the separate matter tokens that the mind places into things in order to account for their separate existences.

Now let's hear what QM has to say. QM, recall, forces us to conceive of space in the only logically consistent way, as the totality of spatial relations existing between material objects. Let's distinguish between the external spatial relations of an object and its internal spatial relations. (The *external* spatial relations of an object O are those between O and objects that have no parts in common with O. The *internal* spatial relations of O are those between O's own constituent parts.) The *position* of O, properly conceived, is any of O's external spatial relations. The *form* of O, properly conceived, consists of the spatial relations between its parts. By this definition, an object that lacks parts, and therefore lacks internal spatial relations, *also lacks a form*.

To convince yourself that the ultimate constituents of matter are *formless* rather than pointlike, try to imagine a single pointlike object. As you imagine a pointlike object, you also imagine a spatial expanse in which this object is situated. You cannot imagine a point without imagining a space that surrounds or contains it. A point is a form, and the existence of a form implies the existence of space. But you are asked to imagine a *single* pointlike object—not any other thing, nor any of this object's relations to other things. So you must not imagine its external spatial relations. And since a pointlike object lacks parts and therefore lacks internal spatial relations, your mental picture must not contain *any* spatial relations. But space is a set of spatial relations, so your mental picture must not contain space. And since the existence of a form implies the existence of space, your mental picture must not contain any form. The upshot is that the existence of a pointlike form is inconsistent with the proper way of thinking about space—as a set of spatial relations.

If you find it hard to conceive of electrons as formless objects, join the club. But keep in mind that no-one has ever seen an electron. By looking at the traces it has left one can see *where* it has been but one cannot see its *form*. Experiments can only establish the absence of evidence of internal spatial relations, which by itself is consistent with either a pointlike form or no form at all. So on the principle of theoretical parsimony alone (Occam's razor) we should consider it pointless to attribute to an electron the form of a point.

And what does QM have to say about our collision experiment? It tells us in unmistakable terms that if the particles are of the same type and their spins (if they have) are not antiparallel, then the outgoing particle heading eastward is *neither the same as nor different from either of the incoming particles*. In this case the distinction between "E is identical with N" and "E is identical with S" (where E stands for the outgoing particle heading eastward and N and S stand for the incoming particles) is another distinction that Nature does not make; it corresponds to nothing in the material world; it exists solely in our heads. In other words, the particles are *not re-identifiable*.

Now recall that re-identifiability is implied by the separate matter tokens that the mind places into things in order to account for their separate existences. What QM tells us here is that *there are no separate matter tokens*. Consequently, if we consider particles of the same type, and if we consider them in themselves, out of relation to each other, we must consider them identical not just in the weak sense of exact similarity but *in the strong sense of numerical identity*. (Identical twins are genetically identical in the weak sense; they have exactly similar genes. The evening star and the morning star are identical in the strong sense; they are one and the same planet.)

This strong identity is not confined to particles of the same type. The properties by which particles can be distinguished are either relational (like positions) or dynamic (characteristic of their interactions, like charges) or comparative (like mass ratios—the mass of a single particle has no physical significance). Hence if we consider the fundamental particles of matter in themselves, out of relation to each other, we must not consider them many. In themselves they lack distinguishing characteristics. The nonexistence of separate matter tokens therefore implies that in themselves they are one and the same thing.

We must accept that being one thing, or many things, or identical things, or different things does not, in reality, have the absolute meaning that it has for the mind. These are relative notions. Two particles can be one thing in one sense, two identical things in another sense, and two different things in yet another sense. Considered in themselves, all fundamental particles are one and the same thing X. Because of the spatial relations that exist between X and X, they are also many identical things. (A multiplicity of relations implies at least the appearance—Shankara might say the illusion—of a multiplicity of relata.) And to the extent that they possess distinguishing properties, they are also different things.

Then what is X? X is what every *existing* fundamental particle intrinsically is. But, as I have just pointed out, physics knows nothing of *intrinsic* properties; the scientifically knowable properties of particles are extrinsic [30] (relational, dynamic, or comparative). All we can say of an existing fundamental particle *in itself* is that *it exists*. Hence X is *existence pure and simple*. And since existence (*sat*) is one of the three principal characterizations (*sat-chit-ananda*) of Brahman, the identification X=Brahman seems justified.

For integral Vedantists the world is a manifestation of Brahman. QM tells us something about how this manifestation is effected. By entering into spatial relations with itself, formless Brahman acquires the aspect of a multiplicity of formless particles. Along with the particles, space and forms come into existence, for space is the totality of existing spatial relations (between Brahman and Brahman), and forms are particular sets of such relations.

Space contains—in the proper, set-theoretic sense of "containment"—the forms of all things that have forms. It does not contain material objects over and above their forms; *a fortiori* it does not contain the formless "constituents" of matter. Physical space exists *between* the fundamental particles. And since what exists at either end of each spatial relation is Brahman, spatial relations are *internal* to Brahman. QM tells us that the physical world is *both constituted by Brahman and suspended within Brahman*, if by "Brahman" we mean a pure existence which enters into spatial relations with itself. Note that the second aspect of Brahman, consciousness (*chit*), does *not* figure in the intersection of Vedanta and QM.

The world is differentiated both spacewise (spatial relations warrant distinctions between "here" and "there") and timewise (temporal relations warrant distinctions between "now" and "then"). The temporal differentiation is effected by *change*, for time and change are coimplicates: A timeless world cannot change, and a changeless world is temporally undifferentiated and therefore timeless. In my opinion, the quintessential message of QM is that there are limits to the world's spatial and temporal differentiation. The world is only finitely differentiated. This too conflicts with the CCP, for the latter implies that the world is infinitely differentiated spacewise (as we have seen) and therefore also timewise.[31] QM tells us how and to what extent the world is spatially and temporally differentiated. As long as our thinking adheres to the CCP and we assume, accordingly, that the world is infinitely differentiated to begin with, we cannot but fail to get its message.

In an infinitely differentiated world, spatial relations are determinate quantities; they possess definite values. In a finitely differentiated world, spatial relations are indeterminate quantities; they possess fuzzy values. The proper conceptualization of indefiniteness requires the use of statistical concepts, and this is why quantum mechanics is formally a statistical theory, concerned with probabilities. But why is the world only finitely differentiated? Why do spatial relations have fuzzy values? The answer is that, for all we know, this is the only consistent way to "fluff out matter"—to create material objects of finite size using a finite number of formless particles, or to manifest finite forms using a finite number of spatial relations. If you are Brahman, and you want to create spatially extended objects by entering into spatial relations with yourself, you have no choice but to let these relations have fuzzy values.

A possible way of giving quantum mechanics in a nutshell is to say that there are limits to the objective reality of mental distinctions. Recall Sri Aurobindo's characterization of mind. Mind is the agent of division, of differentiation. When it is employed by supermind, the original creative principle, mind is used judiciously. The mind's tendency to divide *ad infinitum* is checked. But when mind is separated in its self-awareness from its supramental parent and left to run wild, as it is in us, it not only divides *ad infinitum* but also fails to recognize itself as the instrument of the division. It takes the resulting multiplicity for the original truth or fact. That is why mental consciousness is inherently reductionistic, atomistic, and therefore materialistic.

According to quantum mechanics, the original truth or fact is unity, rather than multiplicity. Multiplicity is contingent and emergent. Quantum physics thus is the opposite of materialistic. There are, recall, no separate matter tokens. And since "matter" essentially connotes the existence of such tokens, *there is no matter*. There is a substance—exactly one—and this is Brahman. QM

describes a world that is created top-down, by a process of differentiation, rather than bottom-up, by a process of aggregation. In doing so it reveals that the creative principle to which the world owes its existence is supramental rather than mental, for supermind, characteristically, proceeds from the One to the Many by differentiation or particularization, while mind proceeds from the Many to at best a semblance of unity by aggregation.

Now that we know what QM is trying to tell us about matter, we can touch on the question of how consciousness relates to matter. QM has nothing to say on this subject, so we turn to (Sri Aurobindo's integral) Vedanta. Brahman is at once pure existence (*sat*) and pure consciousness (*chit*). We may characterize it either as an intrinsically indeterminate existence with the power to determine itself or as an intrinsically contentless consciousness with the power to give itself content. There is a supreme way of being, or of being conscious, to which these two characterizations are equally adequate. Up there there isn't any difference between Brahman qua existence and Brahman qua consciousness. The same is true at the other end of the great "Chain of Being", except that here existence is formless and consciousness lacks content. Each particle is Brahman, and therefore each particle is, indistinguishably, a pure existence and a pure consciousness. The question no longer is how anything material can be conscious. Instead we must ask how consciousness acquires content, or how undifferentiated consciousness=being differentiates into content-filled consciousness and form-determined being. In this way, as serveral panpsychists [32, 33, 34, 35, 36] have argued, the hard problem of consciousness [15] becomes solvable.

The bottom line: As long as you attempt to straitjacket QM into materialistic modes of thinking (which is what the woolly masters do as persistently as the next physicist), and it makes no sense. Place it into a Vedantic framework of thought, and it makes perfect sense. Let it speak for itself, and it takes you a long way toward a Vedantic conception of the world.

References and Notes

[1] This ideas appears to receive support from another frequently voiced misconception, according to which a property is actually possessed by a physical system if the probability of obtaining this property as the result of a measurement is one. On this view, $p\,(\mathrm{R}, t) = 1$ implies that the alpha is inside region R at the time t, and this suggests that the probability $p\,(\mathrm{R}, t)$ tells us something about what exists or obtains at the time t. But the notion that probability one is sufficient for the possession of a property q is manifestly false, for if q is not actually obtained as the result of a measurement, it is possible in general to perform a different measurement and obtain a result that is incompatible with the possession of q.

[2] Karl *R.* Popper, *Quantum Theory and the Schism in Physics* (Rowan & Littlefield, Totowa, NJ, 1982), edited by W.W. Bartley, III.

[3] Werner Heisenberg, *Physics and Philosophy* (Harper and Row, New York, 1958), Chap. 3.

[4] Abner Shimony, "Conceptual Foundations of Quantum Mechanics", in *The New Physics* (Cambridge University Press, Cambridge, 1989), edited by Paul Davies, pp. 373–95.

[5] Sam Treiman, *The Odd Quantum* (Princeton University Press, Princeton, NJ, 1999), p. 188. Dozens of similar phrases can be found in the literature.

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[18] Jeremy Bernstein, "A cosmic flow", American Scholar, Winter 1978/79, 6-8.

[19] Sri Aurobindo, *The Upanishads: Texts, Translations, and Commentaries* (Sri Aurobindo Ashram, Pondicherry, 1981), p. 102.

[20] Danah Zohar and I.N. Marshall, *Quantum Self: Human Nature and Consciousness Defined by the New Physics* (Quill, 1991).

[21] I do not deny the existence of a self radically different from the referent of folk believes about the self, but only that this has anything to do with QM.

[22] Deepak Chopra, *Quantum Healing: Exploring the Frontiers of Mind Body Medicine* (Bantam Books, 1990).

[23] By the same token, I do not deny possibilities of healing (both transitive and intransitive) that are beyond the ken of present-day medical science, but only that they have anything to do with QM.

[24] Kirkus Reviews (New York), March 1, 1993.

[25] To specify the position of an object, we must say where it is in relation to another object that serves as a reference point.

[26] Richard P. Feynman, *The Character of Physical Law* (MIT Press, Cambridge, MA, 1967), p. 129.

[27] Ulrich Mohrhoff, "Quantum mechanics and the cookie cutter paradigm", e-Print quant-ph/0009001.

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[29] Sri Aurobindo, *The Life Divine*, SABCL Vol. 18 (Sri Aurobindo Ashram, Pondicherry, 1970), p. 162; italics added.

[30] This use of "extrinsic" differs from the more specific use of the term in Refs. [14] and [27].

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