Quantum Enigma: Physics Encounters Consciousness
Review of Bruce Rosenblum's and Fred Kuttner's

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Quantum Enigma: Physics Encounters Consciousness
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In contrast to other books popularizing quantum mechanics, the importance and significance of this book is that it both explicitly discusses the connections between quantum mechanics and consciousness, and is used as course material for liberal arts students at the authors' university (UC Santa Cruz) and perhaps elsewhere. Teaching with humor and sometimes in parables, the authors skillfully expose some of the enigmas of quantum mechanics with emphasis on their connections to consciousness. Chiefly, these enigmas are: (1) the measurement problem which involves observer created reality and the randomness of nature, and (2) quantum entanglement, experimentally verified through violations of Bell's inequality, which suggests inseparability or non-locality at the microscopic levels. Rosenblum and Kuttner also succinctly summarize nine interpretations of quantum physics and point out in no uncertain terms that every interpretation encounters consciousness (pp. 158–69).

Quantum physics was born over 80 years ago, and sadly, as the authors tell us, instead of embracing such encounters and exploring the mystery of consciousness, the majority of physicists have been avoiding the consciousness issue like the plague (pp. 155–57). As they explain, this situation is understandable to some degree, given that physicists conceive of themselves as working in the so-called *hard sciences*. In contrast, consciousness does not enter quantum physics through the deterministic and unitary Schrodinger equation, but apparently operates from outside space-time through free will. Further, as the authors justifiably imply, the field of consciousness studies is infested with self-appointed authorities, pseudo-scientists, and "snake oil" promoters who give the field a bad reputation and scare physicists away.

Indeed, in many fields of the mainstream sciences today, the study, and even the mere mention of consciousness, are still taboo, and the physicists' version of a theory of everything does not include consciousness. The irony is if we cannot understand ourselves, and refuse to do so, we cannot hope to fundamentally understand the world surrounding us. Clearly, one cannot call one's theory a theory of everything if everything is not included. But should the reasoning be that in order to fundamentally understand the external world we need also (or we must first) understand how consciousness works?

In my view, there are no legitimate excuses for physicists and other scientists not exploring the mystery of consciousness and its connections to quantum physics. Rosenblum and Kuttner are highly commended for exposing the skeleton in the physicists' closet to the students and the public.

Although the authors clearly point out the connection between quantum physics and consciousness reflected in the measurement problem, they do not offer their own solutions to the problem. They do agree, however, with Bell's view that even though quantum mechanics is so far correct on everything it predicts, it is incomplete, and will be " superseded in an imaginative jump that will astonish us" (p. 88). Like the authors, I full-heartedly agree with Bell's view based on the findings of my own research with my collaborator.

Reading the book and reflecting on my own research, I get the impression that there is, indeed, an interactive quantum reality centered on consciousness, as some may have suggested before and as some experiments seem to have shown. The interaction between consciousness and reality, however, seems to be a chicken-and-the-egg problem. That is, is quantum reality (the "chicken") product of and influenced by consciousness (the "egg"), or is consciousness produced and influenced by quantum reality? As is well-known, searching for a first cause often invokes these kinds of perplexing questions. In their book, the authors have amply answered the first question in the affirmative. Similarly, Planck had concluded long ago that "I regard consciousness as fundamental. I regard matter as derivative from consciousness. We cannot get behind consciousness. Everything that we talk about, everything that we regard as existing, postulates consciousness" (1931).

To make connections to the actual brain, the authors discuss Stapp's (1993, pp. 195-196) theory. I applaud Stapp's heroic efforts in the face of various criticisms. The question, however, of how consciousness influences the brain and through what quantum entities therein is far from settled. To say the least, Stapp's theory needs to be mapped to the correct quantum entities being influenced by consciousness in the brain. In our theory, the quantum entities are the nuclear or electron spins in neural membranes and proteins, or both (Hu & Wu, 2002). The only way to get the correct mapping is to put various models to experimental tests, which so far are few between.

On the other hand, since a conscious human observer is made of quantum entities, the second and reverse question (is consciousness produced and influenced by quantum reality?) should also be asked, answered, and reconciled with the first question. To answer this question, the authors discuss the Penrose-Hameroff model, observing that the model proposes a specific mechanism in the brain, based on non-computability, quantum gravity, and tubulins in microtubules (pp. 194–95). Penrose's arguments for the non-computability of conscious process are quite impressive and strong; but only experiments can tell whether his bold speculation of quantum gravity being the objective cause of wave function collapse (OR) makes any sense. Even if the experiments were successful, it is still a far cry from proving tubulins in microtubules are involved in consciousness, as Hameroff suggests.

Several people feel that Hameroff's idea is misguided and that Penrose got on the wrong OR boat, so to speak, not only because neural electrochemical activities occur in and around neural membranes, but also because the simple, tubular, and uniform structures of microtubules make them unlikely to be the carriers of information related to consciousness. (See Hu & Wu, 2002) experimental demonstration that gravity is likely the manifestation of quantum entanglement. Thus, in my opinion, the role of gravity in consciousness is more likely to achieve binding and wave function collapse is associated with disentanglement.

The authors also discuss in their book the philosophy of Chalmers, who classified the problems of consciousness into "easy" and "hard problems" (pp. 176–77). Classification in itself,

however, will only redefine the problems, not provide any solutions. As the authors point out (pp. 179–80), the real messages from Chalmers (1996) are that (i) reductive explanations of consciousness in terms of physical processes do not hold, and (ii) conscious experiences are as primary as mass, charge, and spacetime. Thus, theses messages entail new psychophysical principles, which treat information as having both a physical aspect and phenomenal aspect.

Admirably, Chalmers is a rare and clear-headed dualist, who irks materialists, and perhaps others, by his ideas. In my view, Chalmers' first point is only valid with respect to classical physical processes, but not quantum processes that are fundamentally psychophysical. With respect to the second point, I can agree that consciousness is primary, but I take it that experiences are contents, not entities. The authors point out that "[Chalmers' dual-aspect information] smacks of the situation in quantum mechanics, where the wave function also has two aspects," physical and informational (pp. 179–80). However, Chalmers (1996) seems to be skeptical about the connections of quantum mechanics and consciousness. This is inexplicable and rather unfortunate. The authors also discuss the views of materialists such as Crick, Dennett, and Koch, who are diametrically opposite to Chalmers (pp. 177–81).

The book raises deep and old philosophical questions surrounding consciousness. For example, it quotes Einstein's statement that "I like to think moon is there even if I am not looking at it"(p. 125) and mentions the old question, "If a tree falls in the forest with no one around to hear it fall, is there any sound?"(p. 175). To answer these fundamental questions, we need to reconcile the chicken/egg problem of consciousness and reality raised earlier.

I am inclined to believe: (i) Consciousness is both transcendent and immanent (here I borrow the notions from a certain philosophy of Hinduism).The transcendental aspect of consciousness produces and influences reality as the interactive output of consciousness, and, in turn, reality produces and influences the immanent aspect of consciousness as the interactive input to consciousness. (ii) Human consciousness is a limited or individualized version of this dual-aspect consciousness, such that we have limited free will and limited observation/experience, which is mostly classical at macroscopic levels but quantum at microscopic levels.

Possessing limited transcendental consciousness, we have the choice of what measurement to do in a quantum experiment, but not the ability to control the result of measurement. That is, the result appears to us, as random. On the other hand, at the macroscopic level, we also have the choice of what to do, but the outcome, depending on context, is sometimes certain and at other times uncertain. Further, possessing limited immanent consciousness, we can only observe the measurement result in a quantum experiment that we have conducted, and experience the macroscopic environment surrounding us as the classical world.

Applying this dual-aspect consciousness ontology, we would respond to Einstein with the answer that the moon would still be there, even if he were not looking at it, because it is produced/influenced by the (unlimited) transcendental consciousness and observed/experienced by the (unlimited) immanent consciousness. Similarly, the answer to the old question would be that there is still sound heard by the (unlimited) immanent consciousness. This latter answer is similar to the one given in the centuries-old limerick quoted in the book (p. 175). On a related matter, the authors point out that God is omnipotent but may not be omniscient (p. 176). To explain such a seeming defect of God, it may be said his omniscience lives within each of us as our human experiences and observations.

The authors do not discuss relativistic quantum mechanics in the book, such as the Dirac Equation, which combines quantum mechanics with relativity and describes fermions, such as electrons and quarks. Perhaps, this is because the book is written for non-specialists. The Dirac equation contains the "mysterious" quantum spin that forms the key basis of our spin-mediated

consciousness theory (Hu & Wu, 2002). In my opinion, this is the equation containing one of the major keys to a genuine science of consciousness, and therefore, may be called the "God Equation."

In closing, let me note that I gladly reviewed this book because of my appreciation for its scientific approach. Although I'm not a quantum physicist per se, I have been in the "trenches" of the scientific studies of consciousness for the past decade as a biophysicist, an outsider unencumbered by academic conformity and orthodoxy. I'm of the view that the state of consciousness studies is rapidly changing and the future is promising. Let us remind ourselves of the revised proverb: The [truth] is in the details. To eventually arrive at a genuine science of consciousness, we must build and experimentally test various concrete models of consciousness, which are connected to hard sciences. By both explicitly discussing the connections between quantum mechanics and consciousness and bravely using the book containing these discussions as course material for students, the authors show the readers, and teach the students, that such connections are real and tangible, not just pseudoscience or New Age mumbo-jumbo. In doing so, Rosenblum & Kuttner lead by example. I hope that other physicists and scientists in the academics will follow suit by breaking away from the invisible prison of conformity and orthodoxy, opening widely the physicists' closet containing their skeleton, and turning the same into golden opportunities for solving the mystery of consciousness.

I highly recommend this book.

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