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Quantum Enigma: Physics Encounters Consciousness. Bruce Rosenblum and Fred Kuttner. New York: Oxford University Press, 2006, 211 pages, $29.95 hardcover.

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Bruce Rosenblum and Fred Kuttner are self-described "conventional, even practical" (p. 11) physics professors at the University of California, Santa Cruz. Together they have written *Quantum Enigma: Physics Encounters Consciousness*, a book which explores the physics taboos of consciousness and entanglement. The book's first sentence is, "This is a controversial book" (p. 3). The authors quickly point out that while quantum theory has never been wrong in its predictions, there is a "corner" in the theory that is hard to accept: that we actually create our physical reality when we observe it. This is what physicists call the "measurement problem" (p. 10). Physicists have kept this "skeleton in the closet . . . because it is a bit embarrassing" and addressing it is tantamount to admitting that consciousness is intricately tied to the existence of our reality (p. 85). Rosenblum and Kuttner write, "Quantum theory is at the base of every natural science . . . [it is] about the here and now and even encounters the essence of our humanity, our consciousness" (pp. 11–12). Most scientists want to steer clear of the quantum enigma because it begins to sound mystical, rather than scientific.

The authors use parables to illustrate the enigma. In the first parable, a physicist visits the fictional village Neg Ahne Poc, high in the mountains, where a *Rhob*, that is, a shaman (a tribute to Niels Bohr), claims that he can illustrate the quantum phenomenon using large objects. The *Rhob* proceeds to conduct two experiments for the physicist. There are two huts and a couple, a man and a woman. The *Rhob* places a hood over the physicist's head, so that the physicist cannot see the preparations. The first experiment consists of asking the physicist which hut the couple occupies. No matter which hut the physicist selects, the couple is there. Then the *Rhob* changes the experiment. In the new experiment, the *Rhob* asks the physicist in which hut is the woman and in which is the man. When the physicist responds, he is always correct. The authors describe the experiment using little stick figures to indicate who is speaking in the dialogue. This parable is easy to follow and illustrates the enigma quite well. The story ends when the *Rhob* tells the physicist, "whichever question

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At the time of compostition of this review, a new release of the book was published. Although this second publication did include some changes and additions, the publisher did not refer to this work as a new edition. Requests for reprints should be sent to Judith Glick–Smith, 2915 Brookwater Drive, Cumming, Georgia 30041. Email: judy@mentorfactorinc.com

you *choose* to ask is always appropriately answered" (p. 19). The beauty of illustrating the enigma at the macro level is that it is easier for the non-physicists to understand.

In the second parable, a physicist demonstrates quantum phenomenon to a group of people using small objects. She uses marbles and paired boxes for illustration. The results are the same as in Neg Ahne Poc. No matter what question the group of people asks, the answer is always correct. In this second story, the marbles are adhered to a screen as the boxes are opened. The pattern is different depending on whether the boxes are opened consecutively or at the same time (pp. 88–98).

Rosenblum and Kuttner describe and illustrate the quantum enigma before addressing the history and its implications. They discuss the universal law of motion as postulated first by Aristotle, then by Copernicus, and then by Galileo. Galileo realized that, to refute Aristotle's scientific claims, he would need "proof." He began to create experiments to prove that he was right and Aristotle was wrong. This set the stage that has existed to this day where, *"The only criterion for judgment in science is experimental demonstration"* (p. 27). Within this context, the authors differentiate between "law" (as in Newton's laws) and "theory" (as in quantum theory), as follows:

> Though "theory" is, at times, used in science for a speculative idea, it does not necessarily imply uncertainty. Quantum *theory* is, as far as is known, completely correct. Newton's *laws* are an approximation. (p. 28)

The authors cover Newton and "All the Rest of Classical Physics" in two very concise, but necessary, chapters. They describe Newton's legacy as including (1) determinism, which disputed the idea of free will and consciousness within the physical realm, (2) objective reality, (3) separability, and (4) reductionism. These ideas permeated all the sciences, including social sciences and psychology, until the early nineteenth century, when Thomas Young discovered the concept of "interference" and "provided the convincing demonstration that light was a wave" (p. 40), which is central to explaining the enigma.

Rosenblum and Kuttner bring the reader forward through the discoveries of electromagnetic force, the first and second laws of thermodynamics, the idea of "dark energy," and Einstein's theory of relativity. Finally, they introduce us to quantum mechanics. The authors are careful to tell us that quantum physics does not replace classical physics in "the way the sun-centered solar system replaced the earlier view with the Earth as the cosmic center" (p. 51). However, they note that if you look closely enough at any science, you will eventually see quantum physics. This is not in dispute. What is in dispute is the interpretation — the "deeper meaning" — of quantum mechanics (p. 52).

The authors begin their recounting of the discovery and evolution of quantum mechanics by discussing the various contributors to the field: Max Planck, Albert Einstein, Niels Bohr, Louis de Broglie, Werner Heisenberg, and Erwin Schrödinger. Rosenblum and Kuttner use an entire chapter to describe the applications for quantum mechanics in today's world, which accounts for one-third of our economy. They do this to provide grounding to the "far-out stuff" they have talked about in previous chapters (p. 81). Here the authors describe three very significant applications: the laser; the transistor ("the most important invention of the twentieth century"); and magnetic resonance imaging [MRI] (pp. 82–84). They also touch on two future technologies, quantum dots and quantum computers, which are looming on the horizon (p. 85).

At the beginning of the discussion concerning "skeletons in the closet," Rosenblum and Kuttner state:

> In his book *Dreams of a Final Theory*, Nobel Laureate Steven Weinberg [1993] writes, "The one part of today's physics that seems to me likely to survive unchanged in a final theory is quantum mechanics." We share Weinberg's intuition about the ultimate correctness of quantum mechanics. (p. 87)

The chairman of Max Planck's physics department made a similar statement in 1875: "Physics, he said, was just about complete: 'All the important discoveries have already been made'" (p. 53). While quantum mechanics appears to be "ultimately correct," as the authors suggest, if we continue to create as we observe, doesn't it stand to reason that this "correctness" might eventually give way to other more "correct" truths? Rosenblum and Kuttner agree with this idea, which is supported by John Bell, who believed that quantum mechanics is "not the whole story . . . [and] 'that the new way of seeing things will involve an imaginative leap that will astonish us'" (p. 87).

I found the chapters describing the intricacies of physics hard-pressed, but I think that I was simply ready for the book to get to the point. While covering familiar concepts, the information focused on the areas where these concepts fed into the quantum enigma. If the reader is new to these concepts, these explanations provide an excellent basis for understanding. The authors succinctly described three foundational ideas that came out of the Copenhagen interpretation: probability interpretation of the wavefunction, the Heisenberg uncertainty principle, and complementarity, which confronts the "spooky aspect of observation: the instantaneous collapse of an object's wavefunction everywhere by an observation anywhere" (pp. 102–107). The summary at the end of this chapter is excellent.

And, of course, we cannot forget the Gedankenexperiment which involves Schrödinger's cat. Rosenblum and Kuttner spin the story in a new way. The story illustrates the idea that until we observe an event, all possible outcomes exist simultaneously, that is, the cat is both dead and alive. But as the authors point out, the cat itself has consciousness. If that is the case the wavefunction can be collapsed by the cat, before "we" observe the cat and collapse the wavefunction ourselves. The authors tell the story of Eugene Wigner creating another version of the cat story using humans (sans cyanide). "Going even further, he speculated that human conscious awareness might actually 'reach out' — in some unexplained way — and change the physical state of a system" (p. 120).

Rosenblum and Kuttner also discuss the distinguished paper written by Einstein, Podolsky, and Rosen [EPR], which "did not claim that quantum theory was wrong, just that it was incomplete . . . . EPR would show that you could, in fact, know a property of an object without observing it. That property, they argued, was therefore not observer created. The property was a physical reality that the 'incomplete' quantum theory did not include" (p. 128). Niels Bohr countered with a paper that refuted EPR by declaring quantum theory complete. Einstein was disappointed when other physicists didn't reject Bohr's arguments in favor of his own.

Quantum Enigma: Physics Encounters Consciousness includes a wonderful, detailed description of Bell's theorem and its relationship to the enigma. "Our world does not have both reality and separability — one, perhaps, but not both. And we immediately admit to not truly understanding what the world being unreal or having a universal connectedness would imply" (p. 143). The authors encourage the reading of the sec-

tion in the book entitled "Derivation of Bell's Inequality" because of its profound impact, but they tell you that it isn't necessary to understanding the enigma. Describing the quantum enigma is problematic because there are so many interpretations. The authors concisely explain all the interpretations: Copenhagen; extreme Copenhagen; decoherence and consistent histories; many worlds; transactional; David Bohm; Ghirardi, Rimini, and Weber (GRW); Ithaca; and quantum logic.

The last three chapters address the concepts of consciousness and free will. Rosenblum and Kuttner write, "Our concern is with the consciousness central to the quantum enigma — the awareness that appears to affect physical phenomena" (p. 168). In addition, without free will, there is no quantum enigma. The idea that we create our reality goes back thousands of years in Vedic philosophy. The discussion about consciousness and free will even explores the idea of God-consciousness being the observer. According to the authors, observation is the "hard problem" of both consciousness and of quantum mechanics. Physicists are exploring the possibilities of the "neural correlates of consciousness" and have been looking for an "awareness neuron" (pp. 172–173). The authors explore the opposing views of various scientists. They contrast Donald Hoffman's view that consciousness is all there is with Nicholas Humphrey's idea that human consciousness is a "conjuring trick, designed to fool us into thinking we are in the presence of an inexplicable mystery" (p. 176). Rosenblum and Kuttner also explore the idea of whether we can eventually build a conscious computer and what that could mean.

In bringing together the two concepts of consciousness and the quantum enigma, the authors state:

> Consciousness and the quantum enigma are not just two mysteries; they are *the* two mysteries: the first, our physical demonstration of the quantum enigma, faces us with a fundamental mystery of the objective world "out there"; the second, conscious awareness, faces us with the fundamental mystery of the subjective mental world "in here." Quantum mechanics appears to connect the two. (p. 179)

In showing the linkage between these two ideas, Rosenblum and Kuttner describe the "von Neumann chain," which states that only a conscious observer can collapse a wavefunction, and as long as there are conscious observers that process can go on indefinitely (p. 180). This leads the discussion to the idea of entanglement: the collapse of a wavefunction from a superstate to an observable reality. Entanglement "travels infinitely fast . . . . Awareness can travel no faster than the speed of light" (p. 182). The authors use another box-pair parable to make the case for what they believe to be the only objective evidence for consciousness. This parable's conclusion is that "Your conscious choice created the particular situation of the marble in its box pair. The condition of the marble would have been different had you made a different choice." However, Rosenblum and Kuttner are quick to add that objective evidence is not proof (pp. 185–186).

The authors speak about the idea that human observers are limited by their experience of space and time. There are actually two enigmas: (1) the observer-created reality, and (2) nature's randomness (p. 187). Rosenblum and Kuttner use analogies and parables to make a compelling case for the importance of consciousness in quantum mechanics. They discuss the ideas of Roger Penrose, who has developed a potential physical mechanism for measuring consciousness. Penrose "calls this process 'objective reduction,' abbreviated OR. He notes the appropriateness of the OR acronym — it brings about the 'or' situation" (p. 190).

In *Quantum Enigma: Physics Encounters Consciousness*, the authors speculate whether the quantum enigma is actually just in our heads; so they pose questions about paraphenomena, such as extra-sensory perception (ESP), precognition, and psychokinesis. Finally, Rosenblum and Kuttner address the issue of the quantum enigma at the macro level by discussing the scientific discoveries of black holes, dark energy, and the Big Bang. They remain neutral in their reporting of specific ideas or theories stating that more work is necessary. They encourage readers to come to their own conclusions and to remain tentative until more research has been completed (p. 202).

The information in this book is well presented, thought-provoking, and is logically organized, although the writing style often appears patchy, and the illustrations could have been better presented. The illustrations appear to have been hand-drawn, which makes them often more distracting than helpful. These illustrations would be more effective if they were larger, professionally drawn, and included call-outs.

While it is important for books like this one to provide a history of the evolution of physics, I found myself wanting to skip sections, but didn't. My recommendation is to read everything as all sections are important in understanding what comes thereafter.

Quantum Enigma: Physics Encounters Consciousness is a pivotal book because it shines the light squarely on "the skeleton in the closet." Rosenblum and Kuttner realize that physicists must pursue solid research to legitimize the exploration in this corner of physics. The authors caution readers about movies like "What the #$*! Do We (K)now?" (a.k.a., "What the Bleep Do We Know?"). This particular movie adequately explains some of the concepts of quantum mechanics in a way the lay person can understand; however, when the movie attempts to connect "spiritual revelation" to quantum mechanics, it "slides far down the slippery slope" (p. 155). Rosenblum and Kuttner contend,

> The antidote for sensationalistic, misleading treatments of the implications of quantum mechanics would be for the physics discipline to be more open to some discussion of the quantum enigma in introductory physics courses, for example. We should not try to keep our skeleton in the closet. (p. 155)

The authors were particularly annoyed with the film for its attempt to make a "quantum connection with the channeling of a 35,000-year-old Atlantis god named Ramtha and other such nonsense" (p. 155). I wonder, 100 years from now, if the link between quantum mechanics and consciousness will be accepted as common knowledge. Will we discover that consciousness extends beyond the physical and that the idea of channeling is not so far-fetched? Only time and, of course, continued experimentation will tell.

References

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