Journal of Scientific Exploration, Vol. 29, No. 4, pp. 672–677, 2015 0892-3310/15

BOOK REVIEW

Observer Effect: The Quantum Mystery Demystified by Massimiliano Sassoli de Bianchi. Italy: Adea Edizioni, 2013. 94 pp. $9.58 (e-book). ISBN 978-8897144397.

Quantum mechanics has been a source of interesting analogies for the study of psychical phenomena or consciousness itself. Some thinkers have taken it beyond an analogy, aiming to explain consciousness and psi with quantum physics or to explain certain aspects of quantum mechanics with consciousness (especially the so-called "observer effect" related to the "measurement problem"). Is it a given that consciousness and quantum physics are connected? In his book, *Observer Effect: The Quantum Mystery Demystified* (available as a Kindle ebook on Amazon and iBookstore), physicist Massimiliano Sassoli de Bianchi makes an important educational contribution to both fields. Though the book requires some lay-level background in quantum physics, in his characteristic lucid, engaging, and conversational style, the author breaks down prejudices regarding what an observational process is or is not, on the basis of simple, yet profound, analogies and metaphors.

In quantum physics, a measurement can be described as an experimental situation in which a physical entity undergoes a non-deterministic and irreversible change, which some describe as the collapse of the wave function or reduction of the state vector. What does that mean? It suggests that even if we know all the initial conditions of the entity, that is its state before the measurement, we cannot predict with certainty what its final state will be, that is the state at the completion of the measurement process. The best we can do is to attach probabilities to the different possible final states, by means of a rule of correspondence, called the Born rule.

Solving the (quantum) measurement problem is about explaining what goes on, "behind the scenes," when a system is subjected to a measurement context. What produces such an abrupt change in the entity's state? Is this process truly non-deterministic and irreversible and, if so, why? Why is the Born rule so successful in determining the probabilities of the different possible outcomes? It is generally believed that convincing answers to the above questions are yet to be found. Many believe that these answers cannot be found. Consciousness has been proposed as a solution to the problem, though evidence for this is still lacking, and consciousness itself is quite a

riddle of its own—with many concluding it does not exist as such or that it is also an insurmountable enigma. However, due to the impression that some have of quantum mechanics as a complete theory, some are quite convinced of von Neumann's psychophysical interpretation. The book summarizes and points to other scientific interpretations that point to logical and mathematical problems that put into question the completeness of quantum mechanics and the inevitability of the von Neumann interpretation that "the observer or consciousness collapses the wave function."

Perhaps the behavior of quantum physics is truly strange and counter-intuitive and necessarily a product of consciousness. However, one of the problematic conclusions that one might derive from quantum mechanics is that no phenomenon exists before observation. In other words, reality does not exist in the absence of observation. Albert Einstein was, famously, no fan of this measurement problem or observer effect, quipping that the moon continued to exist, undisturbed, even when nobody was watching it! So does our observation create our own reality? Is Schrödinger's cat dead, alive, both, or neither? How can such a sophisticated theory be unable to address such basic questions regarding the moon or a cat? Common sense would say that the moon is there whether you look at it or not and that a cat is either dead or alive, though you may or may not observe it. A theory that cannot explain this is incomplete, is it not?

This book takes Einstein's famous metaphor seriously (and somewhat literally) and shows that we can gain considerable insight into quantum mechanics by performing cleverly designed experiments with everyday classical objects, such as rubber bands, hydraulic presses, and apples, which are described by the author in such a way as to demonstrate that the origin of quantum probabilities can be explained without recourse to psychophysical effects, or to effects that would only be present in the sub-atomic layer of our reality. In other words, the book will show lay and specialist readers alike that the strange properties associated with the observer effect are, surprisingly, not specific to nano-scale systems, as in general the quantum behavior of a macroscopic system can be understood not only as being a consequence of its internal coherence, but also of the way one can decide to actively experiment with it, by means of specific protocols. In other terms, one can show that macroscopic systems can exhibit a quantum (or quantum-like) behavior as a consequence of the fact that one is not conceiving observations (measurements) only as processes of pure discovery, but also as processes of creation, that is processes through which one can create, in an unpredictable manner, the very quantities one is measuring.

The approach employed is known as the hidden-measurement interpretation of quantum mechanics, which was developed in the 1980s

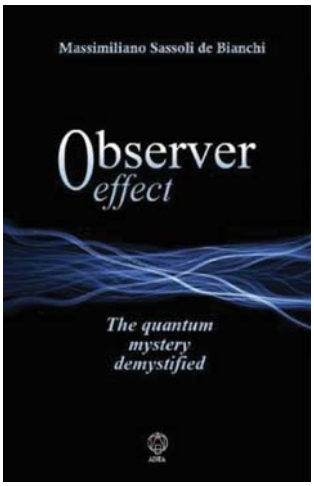
by Belgian physicist Diederik Aerts, and received more recently a comprehensive formulation thanks to Aerts' collaboration with the book's author (see for instance their open access foundational article "The extended Bloch representation of quantum mechanics and the hidden-measurement solution to the measurement problem" [Aerts & deBianchi 2014]).

Contrary to what has been done in the past, in the face of perplexity instead of deriving a formal mathematical structure ("lower your arms, shut up and calculate!") and then trying (unsuccessfully) to understand physical interpretations, the approach taken by Sassoli de Bianchi (which is that of the Geneva–Brussels school on the foundations of physics, of which Aerts is one of the founders) is to try first to identify what the relevant physical concepts are, defining and clarifying them on an operational basis, and then to use them to build a mathematical theory, hopefully with more meaningful and intelligible conceptual and mathematical language.

The book describes Aerts' creation—discovery view, which is able to describe the different entities that comprise our reality—both macroscopic and nano-scale. As we said, the quirky quantum conundrum, under this approach, is elucidated by showing that macroscopic entities can also incorporate the same sort of strangeness as the microscopic ones. Consequently, seemingly simple and conventional objects can be used to offer satisfactory answers to the aforementioned fundamental questions posed by the measurement problem.

The book also reveals an alternative—in a sense deeper—mystery of quantum mechanics: the non-spatial nature of microscopic entities, rather than the role of the observer-consciousness. In *Observer Effect*, Sassoli de Bianchi makes the case that quantum physics seems counter-intuitive because we have tried to understand it within our three-dimensional Euclidean space. He argues effectively for a different interpretation: that reality is not limited to our perceived space–time. The phenomena we observe during quantum measurements appear strange because we may be interacting with a reality that does not entirely fit in this ordinary spatiotemporal theater. A larger view of the physical reality opens up, where measurement apparatuses interact with non-spatial entities through hidden interactions, to create the properties we observe.

Typically, you would expect someone dismissive of psi phenomena to be the kind of author who would argue that the observer effect may have nothing to do with an observer. You might also expect that this de-coupling of both subjects would be used by the author as a way to dismiss psi phenomena or non-reductionist consciousness studies. This is what makes the book *Observer Effect: The Quantum Mystery Demystified* particularly interesting. The author is both a physicist and a consciousness



scholar, practitioner of psi or consciousness practices, open to both a "multidimensional" or "multi-material" physical world and a "multidimensional" world of consciousness, without necessarily conflating the two.

The take-away from the book, for me, is that just as reductionist materialism might not explain consciousness, consciousness may also be excluded as a *sine qua non* concept for modeling quantum phenomena. A solution is revealed that dismisses the need for consciousness–physics interaction without dismissing the possibility that consciousness can affect biophysical systems in other circumstances (e.g., psychokinetic effects, DMILs, engineering anomalies, REG-related phenomena, firing of neurons or mutation of DNA, etc.). If even the foundations of physics, where physical entities increasingly look more like concepts than objects (see Aerts' conceptuality interpretation of quantum mechanics), are not likely to be limited to Euclidean space (which obviously includes our body and its brain), why insist that consciousness cannot possibly exist beyond our limited, perceived material reality? This does not mean that any other consciousness realities, if they exist, correspond to the multiple dimensions raised by this interpretation of quantum physics. Their relationship or lack thereof would remain a new and even more complex mystery.

This provocative work exposes that we may *not* find in quantum mechanics the long-sought-after bridge between the worlds of consciousness and material reality. We might, instead, find a much more fascinating and expansive physical world. If consciousness or observation is not necessarily behind the measurement problem, quantum physics may not have sufficient explanatory power to explain the brain–consciousness link or phenomena such as psychokinesis, beyond the power of metaphor. Some double-slit interference experiments have aimed to test the possible role of the experimenter's mind in the collapse of the quantum wave function. However, Sassoli de Bianchi emphasizes that quantum mechanics neither rules out psi nor does it require a psychophysical explanation of physics. The book renews the need for the search for alternative, more convincing, and comprehensive models for consciousness.

To complement this reading, I recommend reading articles published by the author, which are mentioned in the bibliography of the book. Additionally, to further appreciate possible ramifications of the work, I recommend his

article “Quantum dice” (de Bianchi 2013), where the author argues that measurements on a single die can be performed so as to create typical quantum interference effects, and he also shows how to connect (entangle) two identical dice, to maximally violate Bell’s inequality. Bell’s inequality was designed to test whether or not the real world satisfies local realism. If confirmed, Bell’s inequality would show that quantum mechanics must violate either locality or another principle, realism, relating to the value of unmeasured quantities. The two principles are often referred to together as a single principle of local realism. Experimental tests of the Bell inequality, beginning in 1972, seem to show that quantum mechanics disobeys the inequality, and thus must violate either locality or realism, although critics have pointed out various possible “loopholes” in the experiments (consider however that a loophole-free Bell experiment has been reported this year, see Hensen et al. 2015).

Sassoli de Bianchi, echoing previous research by Aerts, is then able to show that the basic mechanism underlying the violation of Bell’s inequality is the *creation* (and not the discovery) of correlations, and that this mechanism can equally operate with microscopic and macroscopic entities. The fundamental difference is that the creation of correlations would be the result of ‘non-spatial connections’ when the entities are microscopic, whereas the connections are necessarily present in three-dimensional space when they are macroscopic.

By consulting the newest publications of the author, which he wrote in collaboration with Aerts, one can observe progress in the investigation of the nature of entanglement in physical systems by means of the hidden-measurement approach. Therefore, I can only hope that he will soon offer us an additional work on this crucial phenomenon, and at the same time pointing to the mystery it also hides, which again, according to the author, would be captured by the notion of “non-spatiality.”

Let me conclude by quoting a few suggesive words by Diederik Aerts:

> Reality is not contained within space. Space is a momentaneous crystallization of a theatre for reality where the motions and interactions of the macroscopic material and energetic entities take place. But other entities—like quantum entities for example—“take place” outside space, or—and this would be another way of saying the same thing—within a space that is not the three dimensional Euclidean space. (Aerts 1999:129–183)

Massimiliano Sassoli de Bianchi received a Ph.D. degree in physics from the Federal Institute of Technology in Lausanne (EPFL) in 1995, with a study on time-observables in quantum scattering theory. His research activities are focused on the foundations of physics, quantum theory, and

consciousness. He has written essays, popular science books, children's stories, and has published numerous research articles in international journals, both in physics and in the study of consciousness. He has been a repeat finalist for the IAC Global Award for Scientific Contribution to Consciousness Science. He is a life member of the American Physical Society and the American Association of Physics Teachers, as well as a full member of the Society for Scientific Exploration and the International Academy of Consciousness. He is currently the director of LAB (Laboratory of Basic Self-research), and the editor of the Italian-language journal *AutoRicerca* (www.massimilianosassolidebianchi.ch).

Nelson Abreu
nelson.abreu@iacworld.org

References Cited

Aerts, D. (1999). The Stuff the World Is Made of: Physics and Reality. In *Einstein Meets Magritte: An Interdisciplinary Reflection* edited by D. Aerts, J. Broekaert, and E. Mathijs, Dordrecht: Kluwer Academic.

Aerts, D., & de Bianchi, M. S. (2014). The extended Bloch representation of quantum mechanics and the hidden-measurement solution to the measurement problem. *Annals of Physics, 351*, 975–1025.

De Bianchi, M. S. (2015). Quantum dice. *Annals of Physics*, *336*, 56–75.

Hensen, B., Bernien, H., Dreau, A. E., Reiserer, A., Kalb, N., Blok, M. S., Ruitenberg, J., Vermeulen, R. F. L., Schouten, R. N., Abellan, C., Amaya, W., Pruneri, V., Mitchell, M. W., Markham, M., Twitchen, D. J., Elkouss, D., Wehner, S., Taminiau, T. H., & Hanson, R. (2015). Experimental loophole-free violation of a Bell inequality using entangled electron spins separated by 1.3 km. Xiv:1508.05949 [quant-ph]).