



Comment

How to conciliate Popper with Cartesius
Comment on: “Consciousness in the universe. A review of the ‘Orch
OR’ theory” by S. Hameroff and R. Penrose

Samanta Pino, Ernesto Di Mauro *

Dipartimento di Biologia e Biotechnologie “Charles Darwin”, “Sapienza” Università di Roma, P.le Aldo Moro, 5, Rome 00185, Italy

Received 3 September 2013; accepted 4 September 2013

Available online 10 September 2013

Communicated by L. Perlovsky

Keywords: Consciousness; Quantum mechanics; Evolution

Hameroff and Penrose review evidence that coherent quantum processes evolve in defined biological structures terminating according to a specific scheme of objective reduction of the quantum state [1]. Both the specific scheme of objective reduction of the quantum state and the biological implications of these processes were proposed since several years by Hameroff and Penrose [2], and under the name of Diósi–Penrose theory [3]. How progress in physics, cosmology, quantum biology and neurosciences fits with these proposals?

From the point of view of the history and philosophy of science this vision is almost as far-reaching as the *theory-of-everything*, with the added relevance of putting us human beings in the centre of the Humean scene at a cosmological level, loading us with an intrinsically central role.

Reading this review leaves the Observer between two foci. The first is: “I” must absolutely contribute to the solidification of this major discovery. The other is best summarized by Faraday’s aphorism: “it is always better to have an obscure and distorted vision of the facts than to have none” [4]. It is reassuring that Hameroff and Penrose dub their work as Theory, not as Interpretation. The interpretation of a phenomenon based on a slippery, not completely solidified ground is like an equation whose solution is reached through imaginary numbers. The word imaginary might seem particularly appropriate in a context dealing with consciousness.

In the systematization through quantum physics of the collective phenomena embedded in the word consciousness a positive facet is that each of the two terms of the problem may help to solve the other, as in an open equation. Does quantum physics provide a sufficiently solidified ground? As far as consciousness is concerned one is tempted to leave the question partially open, bringing into the discussion the apparently unrelated comment that goes under the label of Weinberg’s nightmare.

DOI of original article: <http://dx.doi.org/10.1016/j.plrev.2013.08.002>.

* Corresponding author. Tel.: +390649912880; fax: +39064440812.

E-mail addresses: samantapino78@libero.it (S. Pino), ernesto.dimauro@uniroma1.it (E. Di Mauro).

The quest for the Higgs boson has apparently led to a most relevant finding. After the first well-deserved celebrations and triumphalism one consideration has taken the scene: the finding opens more problems than it solves. Luckily so. Steven Weinberg, Nobel laureate for theoretical work on elementary particles, defined as a nightmare the possibility that a Higgs boson was discovered that totally fulfilled its duties as laid out by the standard model, and did nothing more. This would have tightly prevented any clue to a more comprehensive theory, leaving unsolved the major problems concerning our present vision of the profound structure of nature. The fact that the decays for the new boson do not match exactly the predictions of the standard model about the rates at which the Higgs should decay into the five predicted particles, leaves open the quest for the evidence for super-symmetry (the candidate theory-of-everything), as opposed to an always possible non-symmetric new physics. The particle's spin, which is a *quantum* property (as correctly stressed by the Authors in Section 3.3), has not been identified, yet. Thus, the quantic piece of the mosaic is missing, and the door to the understanding of dark matter of gravity, and to the verification of the extra Higgses of super-symmetry is still open. As, again, correctly stressed by the Authors, the DP version of OR is a *gravitational* proposal.

This justifies the question: What is the role of quantum physics in the quest for next level of understanding? May quantum states be considered in this new light as a definitively plowed field? Which does not mean of course that one has to ask again the question by Einstein, Podolsky and Rosen: “Can quantum-mechanical description of physical reality be considered complete?” [5]. The question met sufficient positive answers. However: can we really use its tools to understand consciousness, something that we cannot look at from outside, something that we will never be able to observe innocently and independently? And, if so, can we find a Popperian way for its falsification?

A second positive facet of Hameroff and Penrose quest is that their systematization (let's call it by its name Orch OR Theory) forces us to think from inside about the concept of reality, whose definition is as slippery as the definition of life itself [6]. In both instances, consciousness and life, we are inner Observers, we are Cats in the Box. This is mostly relevant when dealing with consciousness, a category that is the navel of any other category (Cartesius' *cogito ergo sum* and Parmenides' *the same is to understand and to be*). Is it possible, as in the Paul Dirac's words, to get out of “. . . the pure fictions of the mind and pastimes for thinkers dedicated to logics?” [7]. Here a severe Popperian approach becomes indispensable. With Sections 5.7 “Orch OR criticisms and responses” and 5.8 “Testable predictions of Orch OR – current status”, Hameroff and Penrose do their best in this direction. Does the invoked *non-computability* trespass the limit of this approach? No doubt that this text poses profound questions.

The third facet, possibly even more positive, is that this essay helps us in the quest of the real meaning of the categories of Interpretation and Definition.

On the negative side, and maybe here we are too radical, Hameroff and Penrose theory proposes an explanation by quantum physics of an intricately unapproachable phenomenon, of an *unknown*. To do this they feel comforted by the lack of different alternative explanations, possibly overinterpreting the possibilities and the role of quantum physics. However, this might after all not be that negative, potentially opening an experimental field to falsifiable verification.

The road from physics to mental phenomena has already been frequented, notoriously by Pauli and Jung and, under the influence of Pauli, by Heisenberg.

The interaction is not limited to a three decades-long Jung–Pauli epistolary and the reciprocal influences have been profound [8]. In the joint Pauli–Jung volume *Naturklärung und Psyche* (Rascher, Zürich, 1952), the essay by Pauli goes under the title “Der Einfluss archetypischer Vorstellungen auf die Bildung naturwissenschaftlicher Theorien bei Kepler”, the influence of archetypal images in the formation of scientific theories by Kepler, which clearly not only indicates history-of-science relevant facts but also testifies the strongly felt need to develop a common epistemological vision in order to solve multifactorial problems, quests open at both ends. The founding role of Pauli's work in quantum physics does not need to be recalled and the effects of his quantum vision in the development of Jung's vision of the human mind (archetypes included) have been well explored. The title of the essay by Jung in their co-authored volume “Synchronizität als ein Prinzip akausaler Zusammenhänge” (Synchronicity as a Principle of Acausal Connections) could not indicate more clearly the influence of Pauli's quantumism on Jung's perception of reality, and the interplay of the two great minds. Before them, the self-referentiality of the Euclidean approach to human consciousness has been narrated by Lewis Carroll in his “Through the looking-glass”.

This told, solid scientific evidence (microtubules and the rest) is not yet completely convincing and one is left with the desire to contribute to the whole intellectual construction in order, precisely, not to leave it in its present state of fascinating intellectual construction. Anyhow, certain parts of the mosaic are particularly appealing: the fact for instance that anesthetic gas exerts their effects on consciousness, and that actual evidence from genomics and

proteomics point to anesthetic action in microtubules (Section 3.3). With Faraday, it is always better to have a partial vision of the facts rather than having none.

Some could, at the contrary, be fully convinced of the existence and function of objective reductions of the quantum states occurring in and orchestrated by biological structures. Of these, microtubules would represent the most efficient and evolutionary winning example, consciousness being the most visible of its non-epiphenomenal phenotypes. As a novel suggestion relative to their previous studies, “beat frequencies” are introduced by Hameroff and Penrose as a possible source of the observed electro-encephalographic (EEG) correlates of consciousness.

Introducing quantum physics into the realm of biology entails another major positive aspect: room is made for Darwinism and Chance-and-Necessity reasoning. Biological structures as microtubules evolved (well within Darwinian logics) which occurred to cause objective reduction of the quantum state. Once Darwin enters the scene, everything becomes possible. Our mind provides the a posteriori verification. For a deeper look at this concept, the reader is referred to the elaboration of the terms “Ereignis” and “Ereignen” by Martin Heidegger [9].

The basic Hameroff and Penrose assumption would in this case objectively become of paramount importance. H. Reichenbach’s *The philosophical foundations of quantum mechanics* [10] should then be rewritten as *The philosophical “implications” of quantum mechanics*.

The Hameroff–Penrose form of orchestrated objective reduction is related to the fundamentals of quantum mechanics and space–time geometry. Hence the connection between the basic structure of the Universe and biomolecular processes. Relating these effects to neurons might appear an unjustified self-inflicted limitation and, in this perspective, the general conclusion should not be avoided: consciousness is a property and a manifestation of life [1], life is universal in principle. Thus, consciousness is in principle universal [11].

A note of caution: Roger Penrose himself recently said: “I don’t see why we should take quantum mechanics as sacrosanct. I think there’s going to be something else which replaces it” [12]. These words, if they can be considered as not being out-of-context, find their explanation in the incompleteness of quantum theory. The awareness of this incompleteness is at the very basis of the Orch OR Theory (Section 4.1) and is reappearing throughout this mind-boggling essay.

References

- [1] Hameroff SR, Penrose R. Consciousness in the universe. A review of the ‘Orch OR’ theory. *Phys Life Rev* 2014;11(1):39–78 [in this issue].
- [2] Hameroff SR, Penrose R. Conscious events as orchestrated spacetime selections. *J Conscious Stud* 1996:36–53.
- [3] Penrose R, Hameroff SR. Consciousness in the Universe: neuroscience, quantum space time geometry and Orch OR theory. *J Cosmol* 2011;14; Diósi L. A universal master equation for the gravitational violation of quantum mechanics. *Phys Lett A* 1987;120(8):377–81; Diósi L. Models for universal reduction of macroscopic quantum fluctuations. *Phys Rev A* 1989;40:1165–74.
- [4] Faraday M. On the conservation of force. *Proc R Soc* 1857;2:352.
- [5] Einstein A, Podolsky B, Rosen N. Can quantum-mechanical description of physical reality be considered complete? *Phys Rev* 1935;47:777–80.
- [6] Trifonov EN. Vocabulary of definitions of life suggests a definition. *J Biomol Struct Dyn* 2011;29:259–66.
- [7] Dirac P. Quantized singularities in the electromagnetic field. *Proc R Soc* 1931;133:60–70.
- [8] Peat D. Synchronicity: the bridge between science and matter. New York: Bantam Books, Random House, Inc.; 1987; Lindorff D. Pauli and Jung: the meeting of two great minds. Wheaton, IL: Quest Books; 2004; Miller AI. Deciphering the cosmic number: the strange friendship of Wolfgang Pauli and Carl Jung. New York: WW Norton & Company; 2009; Tagliagambe S, Malinconico A. Pauli e Jung. Un confronto su materia e psiche. Cortina R, editor. Milano; 2011.
- [9] Heidegger M. Holzwege. Frankfurt am Main: Vittorio Klostermann GmbH; 1950.
- [10] Reichenbach H. The philosophical foundations of quantum mechanics. Berkeley and Los Angeles: University of California Press; 1944.
- [11] Pino S, Di Mauro E. Gaia universalis in “Consciousness and the Universe: quantum physics, evolution, brain & mind” by R. Penrose, S. Hameroff, H.P. Stapp, D. Chopra, XIV. Consciousness and the Universe. *J Cosmol* 2011;14:1251–9.
- [12] Grossman L. Fireworks erupt over quantum nonsense. *New Sci* 2012;2883:13.