

## **Comment on Roger Paul, “Relative State or It-from-Bit:...”, *Science and Christian Belief* XVII, 2005.**

Lydia Jaeger; *Science and Christian Belief* XIX, 2007, p. 81-3

Interpretations of quantum mechanics are a difficult chapter in current physics and an on-going field of research. I was therefore pleased to see *Science and Christian Belief* taking up the question of their potential theological consequences. Without entering the general discussion on the subject, I would just like to mention one particular point: it is somewhat misleading, especially for readers without expert knowledge in quantum mechanics, to present Hugh Everett's and John Wheeler's interpretations on the same footing. Whereas Everett's relative state interpretation is certainly metaphysically extravagant, it is compatible with standard quantum mechanics ; in fact, it is the most straightforward realist interpretation of the formalism<sup>1</sup>. Therefore it makes sense to inquire about the theological implications of this interpretation.

The situation is very different with Wheeler's idea of it-from-bit and his conception of the universe as self-excited circuit. Although Wheeler as a physicist has made significant contributions to both quantum mechanics and cosmology, his metaphysical use of quantum mechanics, in order to explain the creation of reality, is misguided, as it relies on several confused arguments, of which I want to point out three:

### *(1) The idea that observation creates reality*

Wheeler considers that all reality emerges from observation:

Each query of equipment plus reply of chance inescapably do build a new bit of what we call “reality”. Then for the building of all of law, “reality” and substance [...] what choice do we have but to say that in some way, yet to be discovered, they all must be built upon the statistics of billions upon billions of such acts of observer-participancy<sup>2</sup> ?

But his conclusion relies on a misleading interpretation of the quantum measurement process. A measurement does not fix a beforehand undetermined (or even non-existing) reality; it simply objectify a certain set of observables. For example, in the case of the two-path thought experiment, depicted in *Figure 1* of Paul's article (p. 169), there is no reason to think that the photon is more real after the measurement. Depending on the experimental upset, one or another set of observables (either the paths taken or the superposition of the

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<sup>1</sup> Peter MITTELSTAEDT, *The interpretation of quantum mechanics and the measurement process*, Cambridge, C.U.P., 1998, p. 14-18.

<sup>2</sup> “Beyond the black hole”, in *Some strangeness in the proportion : a centennial symposium to celebrate the achievements of Albert Einstein*, ed. H. WOOLF, Reading (MA), Addison-Wesley, 1980, p. 359.

paths) has now definitive values. But in virtue of Heisenberg's uncertainty principle, this necessarily implies that other observables have now indeterminate values. The measurement has therefore not enhanced "reality"; only different parameters are now fixed compared to the situation before the experiment. Thus quantum mechanics does not warrant Wheeler's conclusion that "reality consists of a few iron posts of observation"<sup>3</sup>.

### *(2) Delayed-choice experiments and backward causation*

It is convenient (as Paul himself does) to discuss Wheeler's delayed-choice interpretation of quantum experiments, by using once again the two-path thought experiment. Depending on the experimental set-up, one observes or not an interference pattern. One might therefore be tempted to describe the outcome of the experiment as either measuring the path that the photon has taken or as measuring the superposition of both paths. But such a representation relies on a classical picture. In fact, quantum mechanics forbids even to *think* that the photon has taken one rather than the other path, before measuring the corresponding observable. Einstein and Bohr had already discussed similar experimental set-ups, in their early debates on the probabilistic character of quantum mechanics. In the 1960s, the formulation of the Bell's inequalities (experimentally confirmed in the 1990s) showed definitively that it is contrary to quantum theory to consider that the photon has taken one specific path, out of the two possible, before measuring it. Thus one cannot read quantum probabilities as stemming from our ignorance; the path of the photon is *objectively* undetermined before the measurement. Thus, there is no place for backward causation in quantum mechanics, against Wheeler's rhetorics concerning delayed-choice.

### *(3) The role of consciousness*

As Wheeler himself points out, consciousness is not an integral part of the measurement process (as Paul points out, p. 167 f). The objectification is brought about by the interaction of the quantum system with the macroscopic measurement instrument. Even if the way this objectification comes about is one of the (most would say unsolved) puzzles of quantum mechanics, one should not look towards consciousness as a potential solution of the problem: There is no reason to think that the pointer of the measurement instrument is not already in a definitive position, before the scientist looks at it. The fact that a human being (or perhaps a computer) becomes "conscious" of the objectified result is no essential part of the measurement process.

Wheeler seems, however, to forget his own warning, not to confuse observation with registration of a measurement result, when he develops his conception of observer-

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<sup>3</sup> J. WHEELER, quoted by PAUL, p. 172.

participancy and the universe as self-excited universe. In this context, he speculates about the strategic role of consciousness in giving rise to reality (cf. PAUL, p. 172 f). He even tries to explain the fact that our universe is hospitable to life, by the idea that consciousness might be necessary in bringing about reality, via quantum measurements :

If an anthropic principle, *why* an anthropic principle ? Envisage as Carter does 'an ensemble of universes' in only a very small fraction of which life and consciousness are possible ? Or ask as we do now if no universe at all could come into being unless it were guaranteed to produce life, consciousness and observership somewhere and for some little length of time in its history-to-be<sup>4</sup> ?

But even if his interpretation of the quantum measurement process, as giving rise to reality, was correct, the additional step he takes here would be totally unwarranted. The objectification is brought about by the interaction with macroscopic measurement instruments, not by (human or other forms of) consciousness. Thus at the very best, his idiosyncratic solution to the measurement problem would allow to speculate about the necessary existence of macroscopic objects. But such a conclusion is still a far cry from anything resembling an anthropic principle.

Given these very serious conceptual problems in Wheeler's conception of the universe as self-excited circuit, I consider it misleading to inquire about theological implications of his "interpretation" of quantum mechanics, as Wheeler's metaphysical extrapolations have no basis in quantum mechanics. In fact, parts of his construction (as delayed choice) are even contrary to standard quantum mechanics, that is to today's best available scientific knowledge. But there is another kind of theological question which might be interesting to ask with regard to Wheeler's proposal: Why does such an excellent scientist, as has been Wheeler, get himself into deep conceptual muddle, when he tries to use science, in order to explain the origin of reality? I have argued elsewhere that Wheeler's proposal of the universe as self-excited circuit mimics creation *ex nihilo*, without being able to provide an immanent grounding of reality as *ersatz* for the Creator which he refuses<sup>5</sup>. Such a conclusion reveals us something about the religious nature of human beings and about the improper use of science. But this kind of critical evaluation of Wheeler's proposal uses a quite different methodology than does an inquiry about the theological implications of Wheeler's conception, as if it was true - where we know that it is not.

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<sup>4</sup> "Genesis and ownership", in *Foundational problems in the special sciences*, ed. R. BUTTS, J. HINTIKKA, Dordrecht, Reidel, 1977, p. 21 ; cf. p. 5. Cf. Charles W. MISNER, Kip S. THORNE, J.A. WHEELER, *Gravitation*, San Francisco, Freeman, 1973, p. 1217.

<sup>5</sup> L. JAEGER, "La volonté de tout expliquer : John Wheeler et l'univers comme 'circuit auto-excité'", 2006, submitted *Archives de philosophie*.