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Consciousness and Quantum Theory: A reply to Lawden and Walker

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In recent essays, D.F. Lawden and E.H. Walker have reiterated the view that, in quantum physical observations, it is the act of conscious observation of the observing apparatus by the observer that causes the reduction of the state vector that leads to the production of a definite experimental result (Lawden, 1980; Walker, 1981). According to this view, observing instruments that are not consciously observed do not register any definite result. The purpose of the present essay is to show that an alternative interpretation of quantum physical observations is possible which remains consistent with the traditional realist standpoint of science, according to which observing instruments register definite results irrespective of whether they are consciously observed or not. This alternative interpretation is presented in the six propositions below:

i) *The axioms of quantum theory distinguish two different kinds of physical interaction*. These are *ordinary physical interactions* and *interactions with an observing apparatus* (observation interactions).

ii) *Ordinary physical interactions are completely described by the law of continuous evolution of states (Schrödinger's law)*. This is given in Axiom 4 of the simplified presentation of the formalism given by M. Jammer (Jammer, 1974) and Rule 3 in the more rigorous account by B. d'Espagnat (d'Espagnat, 1976).

iii) *Observation interactions involve, in addition to continuous evolution of states, discontinuous changes of state governed by a purely probabilistic law*. This law is given in Axioms 2, 3 and 5 (Jammer, 1974) and Rules 4 to 10 (d'Espagnat, 1976). Thus, an observation interaction has two stages; continuous evolution of the joint state of object and apparatus in accordance with Schrödinger's law followed by discontinuous reduction of the resulting state. Here, the reduction of the state vector during an observation is regarded as a special feature of the physical interaction between object and apparatus which occurs only during interactions with an observing apparatus.

iv) *Schrödinger's law and the law governing the reduction of state vectors are independent axioms.* Hence, it is in no way possible to explain the reduction of state vectors during an observation in terms of the law of continuous evolution of states. In particular, any attempt to explain the reduction of state vectors in terms of a general theory of irreversible processes in observing instruments, such as is criticised by Walker (Walker, 1981, p. 36), is explicitly excluded here.

v) *It is always possible to distinguish an observing apparatus from ordinary physical objects.* A physical object is an observing apparatus if and only if it functions in a way that corresponds to an observable of the formal theory. Any particular observing apparatus will have certain particular characteristics by virtue of which we recognise it as an observing apparatus. This proposition is a necessary condition for the distinction between ordinary physical interactions and observation interactions to be unambiguous. However, it is *not* the case that the collapse of the state vector during an observation can be explained by applying the law of continuous evolution of states to the special case of an object having the particular characteristics which distinguish it as an apparatus (c.f. proposition iv). Furthermore, proposition v does not mean that we can identify general physical characteristics which distinguish observing apparatuses generically from ordinary physical objects. This may or may not be true. For the consistency of the present point of view, it is only necessary that, for any given physical object, or arrangement of physical objects, it be possible to decide whether or not it is an observing apparatus.

vi) *There is no theory of observations in quantum physics beyond that postulated in the axioms of the theory.* In particular, the theory gives no physical explanation of why reductions of state vectors only occur during observation interactions and not during all physical interactions generally. This is simply postulated as an axiom of the theory.

According to the view of quantum physical observations presented above, the reduction of the state vector is part of the physical interaction between object and apparatus and occurs quite objectively, whether or not the apparatus is consciously observed.

It is not the intention of the above argument to deny the relevance of quantum theory to the understanding of the paranormal. In another recent essay, Lawden mentions three aspects of quantum theory which seem most likely to contribute to our understanding of paranormal phenomena (Lawden, 1981). These are, the ability of consciousness to cause the reduction of state vectors during observations, quantum nonlocality, and the tunnel effect. If the possibility of a realist interpretation of observations is admitted, it becomes at least doubtful whether the role of consciousness in quantum physics is in any way essentially different from its role in classical physics. Nevertheless, the other aspects of quantum theory mentioned by Lawden remain relevant.

In particular, the novel property of nonlocality, by now well-established as a very general characteristic of microphysical objects, seems very likely eventually to provide the basis for an explanation of the paranormal.

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