Reply to Lawden

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The quantum theory of measurement has become relevant for parapsychology by virtue of the claim, made by numerous authors, that it implies a kind of psychokinetic interaction between the consciousness of the observer and the objects under observation (see, for example, Lawden, 1980, 1981; Mattuck, 1982; Walker, 1981). A recent note by the present author disputed this claim by attempting to show that a purely objectivistic view of quantum measurements is possible (Villars, 1982). The axioms of quantum theory were interpreted as distinguishing two different kinds of physical interaction; *ordinary physical interactions*, which do not involve the so-called 'reductions of state vectors', and *interactions with observing apparatus*, which do involve such 'reductions'. It was claimed that this interpretation yields a purely objectivistic view of measurements which does not require, in any special role, the consciousness of the observer. D.F. Lawden has criticised this interpretation (Lawden, 1983). The following remarks attempt to answer his main criticisms:

(i) Lawden claims that the proposed interpretation does not provide "a principle for distinguishing an observing instrument from the general class of physical systems". However, the following explicit definition of an observing instrument was given: "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" (p. 402). Thus, if an object can be used to obtain numbers which can be interpreted as the eigenvalues of an operator of the formal theory, then the object is an observing instrument. This is a logical definition rather than a physical definition. However, far from saying, as Lawden claims, that there are "no characteristics of observing instruments which suggest that they should be treated differently from any other assembly of atoms", it was stated explicitly that, "Any particular observing apparatus will have certain particular characteristics by virtue of which we recognise it as an observing apparatus" (p. 402). What *was* denied was that it is necessary for the consistency of the objectivistic point of view that we be able to specify distinguishing physical characteristics shared by all observing apparatuses. Even if we could identify distinguishing physical characteristics common to all currently known forms of apparatus (which itself seems unlikely), there would be no guarantee that new types of apparatus could not be invented which work according to completely different physical principles. The objectivistic point of view only requires that we be able to decide in any particular case whether or not an object is an observing instrument, not that we be able to give a general physical characterisation of observing instruments.

(ii) Lawden claims that the proposed interpretation attributes "unique powers" to observing instruments, in particular, "the power, via an unknown channel of interaction with other physical systems, to reduce their state vectors". However, the suggestion that the reduction of state vectors during an observation is caused by the apparatus was not made in the proposals. It was only claimed that observation interactions obey special laws. No explanation was offered of why this is so, or of how the reductions of state vectors occur. An extended physical theory capable of explaining the reductions of state vectors could as easily attribute these events to a special power of the objects under observation, i.e. microphysical objects in general, which they manifest only during interaction with an observing apparatus. However, it is also quite possible that an extended physical theory capable of explaining these events will never be devised. Observing instruments must have special properties by virtue of which we recognise them as such, but need not necessarily possess special powers.

(iii) Since it was not claimed that observing instruments possess unique powers, there is nothing "discontinuous" or "miraculous" about the assembly of a collection of parts into a working instrument. What makes an object an observing instrument are just those properties by virtue of which it is capable of distinguishing the eigenstates of some particular quantum observable. In any particular case, there will generally be no difficulty in identifying those properties and in explaining how the apparatus acquires them in the process of construction.

(iv) Contrary to what Lawden claims, no new interaction is introduced by the proposed interpretations. Nobody doubts that observation interactions occur. These interactions are merely interpreted as being a special class of interactions. Thus, the reductions of state vectors which occur during observations are not the result of an "unknown channel of interaction", but rather, are a feature of the observation interaction itself.

(v) The proposed interpretation was not intended to constitute a "resolution of the intractable problem of the reduction of the state vector", but only to present an objectivistic interpretation of measurements to counter the subjectivistic one advocated by Lawden. Quantum theory as it stands, leaving aside the speculative proposals for its extension proposed by Lawden and others, offers no explanation of the reduction of state vectors, which it merely postulates in its axioms. A theory cannot explain what it postulates in its axioms, and postulates which appear strange to one generation may present no difficulties to another. An Aristotelian must have found Newton's laws of motion strange and counterintuitive, whereas they present no intuitive difficulties today. The postulate, in the special theory of relativity, of the constancy of the speed of light in vacuo is counterintuitive, but few would suggest dispensing with this postulate for that reason. In essence, the proposed interpretation suggests that we simply accept the dualism of two kinds of physical process in quantum

theory, i.e. ordinary physical interactions and observation interactions. The postulate of the reduction of state vectors during observation interactions is to be regarded as an axiom of equal status to the postulate of the Schrödinger equation.

(vi) Lawden states: "I would expect any fundamental physical theory to treat all physical entities impartially, whether they be atoms, heavenly bodies, observing instruments or conscious beings". It is the claim of the proposed interpretation that the discovery of the indivisible quantum of action and the consequent unavoidable and irreducible interaction between the observed object and the observing apparatus has lead quantum theory to draw a "logical distinction" (Bohr, 1963) between observing instruments and ordinary physical objects which seems likely to remain a permanent feature of fundamental physical theory.

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