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ARTICLE

Comment on Schlick

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The problem of natural philosophy raised by quantum mechanics can be characterised with two pairs of statements that have featured in Schlick's discussion but without Schlick having highlighted, let alone resolved, the contradiction that seems present between the propositions of each pair:

(1a) The uncertainty relations do not represent merely subjective limits to possible observations, in the sense that there should be real features of a physical system that are unobservable. Rather, an atomic system *has* no simultaneously sharp position and momentum.

(1b) Nevertheless, the replacement of a state description of a system, which is to be performed based on a measurement – say of a wave function that is 'spread out' over the whole of space – through another one – say a wave function with exact specification of position –, cannot be understood as specifying a real physical process in space in which a wave extended over the whole of space 'shrinks' to a wave packet concentrated within a small range of positions. (A notion which, apart from other physical absurdities, would include the assumption of processes propagating superluminally.)

Similarly the contrast in the other pair of claims:

(2a) The intuitive conceptions of classical physics prove inadequate to the task of a fully quantum mechanical description of a physical system.

(2b) Nevertheless, according to Bohr's correspondence principle, also in quantum mechanics every single step from an observation to how it is put to use in the physical formalism, and vice versa from a formula derived in the formalism to the corresponding prediction of an observation, can and must be interpreted entirely using the classical-intuitive conceptions.

The seamless reconciliation of the respective (a) and (b) is possible only by supposing that the quantum mechanical state description of a physical system – as opposed to the

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state description in classical physics – does not pretend to characterise the physical system uniquely and adequately, but only relative to the context of observation then present, and that it changes with the latter.

Thereby however, as shown by more detailed considerations, the opposition disappears that Schlick claims between the limitations of knowledge demonstrated by Kant in his doctrine of transcendental idealism and the limits of natural description that quantum mechanics forces us to recognise – at least insofar as one takes into account the corrections brought by Fries and Nelson to the formulation and justification of this doctrine. It becomes equally manifest that quantum mechanics has in truth not brought about the alleged refutation of the a priori principles of natural philosophy postulated by Kant, in particular of the law of causality. Rather, quantum mechanics revises the usual version of the principle of causality only insofar as it separates it from the assumption often conjoined with it that physics must lead to a unique adequate description of nature. It otherwise upholds the presupposition of seamless causal connections. (To justify these claims, I can here merely refer to my essay 'Die naturphilosophischen Grundlagen der Quantenmechanik' ('The natural-philosophical foundations of quantum mechanics'), *Abhandlungen der Fries'schen Schule*, vol. VI, issue 2, Sections 9, 12, 16–18.)