

ABSTRACTS FROM SYNTHESE

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QUANTUM LOGIC AND CLASSICAL LOGIC: THEIR RESPECTIVE ROLES

PATRICK HEELAN

The paper analyzes the claim made by Birkhoff and von Neumann, Finkelstein, Jauch, Putnam and others that quantum mechanics implies the use of a nonclassical 'quantum logic' (an orthocomplemented nondistributive lattice) on the level of factual sentences. It is shown that this claim is confused by the erroneous assumption that simple theoretical statements about the Hilbert space state vector of a system are logically equivalent to simple empirical statements about the outcome of Yes–No tests. It is shown that simple theoretical statements are equivalent to statements in a meta-context-language which assert the existence, not of events, but of constellations of invariant physical conditions within which events occur. The logic internal to the meta-context-language is a nonclassical logic; the logic of quantum event language is or could be classical. The existence of a quantum logic is shown to be related to the general context-dependent character of statements and this claim is illustrated by examples taken from outside the domain of physics.

QUANTUM MECHANICS AND CLASSICAL PROBABILITY THEORY

JOSEPH D. SNEED

The mathematical formalism of quantum mechanics, via its customary interpretation, leads to a density function for each observable. Using this formalism, there is also a natural way to calculate joint density functions for two observables. However, it has been known for some time that joint density functions, obtained in this way, may be incompatible with classical probability theory. More recently, Cohen has shown that there are density functions for non-commuting observables and functions of these observables, given by the quantum mechanical formalism, which have the following property. There is *no* joint density function (compatible with classical probability theory) from which *all* these density functions may be derived as marginal densities. A somewhat more general proof of this has been given by Nelson.

STATISTICAL EXPLANATION IN PHYSICS: THE COPENHAGEN INTERPRETATION

RICHARD SCHLEGEL

The statistical aspects of quantum explanation are intrinsic to quantum physics because individual quantum events are created in a nonpredictive way in the interactions associated with observation. The superposition principle that is essential in quantum theory is exemplified in the classic single-photon two-slit interference experiment. Recently Mandel and Pfliegor have done a similar experiment with two independently operated lasers. Interference is obtained even with only one photon in the apparatus at a given time. The result gives a further argument against "hidden variable" localization, and supports subjectivism on the level of individual quantum-scale events. Extension of this subjectivism to large-scale nonquantum phenomena is within the principles of quantum theory; counter arguments to such an extension are noted.

THE QUANTITATIVE EPISTEMOLOGICAL CONTENT OF BOHR'S CORRESPONDENCE PRINCIPLE

ARTHUR KOMAR

The basic dynamical quantities of classical mechanics, such as position, linear momentum, angular momentum and energy, obtain their fundamental epistemological content by means of their intimate relationship to the symmetries of the space–time manifold which is the arena of physics. The program of canonical quantization can be understood as a two stage process. The

first stage is Bohr's Correspondence Principle, whereby the basic dynamical quantities of the quantum theory are required to retain precisely the same relationship to the symmetries of the space-time manifold as do their classical counterparts, thereby preserving their epistemological, as well as measurement-theoretic, significance. Having so identified the basic dynamical variables, functions of these may now be used to identify the subtler symmetries of the proper canonical group. The second and determining stage of the quantization program requires the establishment of a correspondence between some of these subtler symmetries of the classical theory and related symmetries of the quantum theory, the relationship being determined by a common algebraic form for their defining functions.

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KNOWING THAT ONE KNOWS AND THE CLASSICAL DEFINITION OF KNOWLEDGE

RISTO HILPINEN

The notion of knowledge is traditionally defined in terms of three conditions: the condition of *belief* (*a* believes that *p*), the condition of *justification* (*a* is justified in believing that *p*), and the condition of *truth* (*p* is the case). If the condition of justification is interpreted as '*a* has adequate evidence that *p*,' it is possible to find a clear-cut counter-example to the principle that knowing implies knowing that one knows (the *KK-thesis*): *a* knows that *p* without knowing that he knows, if he fails to recognize the adequacy of his evidence.

This formulation of the classical definition has been criticized by Keith Lehrer (among others), who has argued that *a* knows that *p* only if his belief that *p* is based upon his (adequate) evidence, i.e. if *a* would appeal to this evidence to justify his belief. If the definition of knowledge is modified in accordance with this criticism, the *KK-thesis* follows from seemingly acceptable assumptions. If the condition of belief is dropped from the definition of knowledge, the *KK-thesis* follows from the requirement that adequate evidence is 'complete' evidence in the sense that no further evidence is required to establish its adequacy. This notion of knowledge may be termed 'knowability' or '*a*'s being in a position to know that *p*.'

The classical definition of knowledge can be criticized on the grounds that it is circular, and open to Gettier-type counter-examples. It is argued that these inadequacies are not relevant to the *KK-thesis*: if the definition is formulated in such a way that these objections are met, we obtain essentially the same results concerning the *KK-thesis* as in the case of the original formulation. Finally, it is argued that certain recent objections to the *KK-thesis* (by David Rynin and Arthur Danto) are ill-founded.

BELIEVING THAT ONE KNOWS

KEITH LEHRER

In this paper, I aver that whatever a man knows, he believes, believes that he knows, and knows that he knows. I attempt to meet objections to this thesis raised by Colin Radford and E. J. Lemmon. There is also critical discussion of Hilpinen's attempt to sustain the thesis by appeal to principles of epistemic logic.

"KNOWING THAT ONE KNOWS" REVIEWED

JAAKKO HINTIKKA

The semantical basis of the *KK-thesis* (implication from knowing to knowing that one knows) is explained and defended against objections by Chisholm and others. The thesis presupposes a very strong sense (perhaps an unrealistically strong one) of knowing. This sense is compared with Malcolm's strong sense of knowing. A qualification to the thesis is needed because of its *de re* character, which essentially restricts it if logical omniscience is not presupposed. A comparison with Sartre's pre-reflective cogito is made.

WHAT MUST BE ADDED TO KNOWING TO OBTAIN KNOWING THAT ONE KNOWS?

CARL GINET

Section I argues that the unqualified KK-thesis is false but that it is necessarily true that if one knows that p then he fails to know that he knows that p if and only if he fails to believe that he knows that p .

Section II argues that Hintikka's thesis in *Knowledge and Belief* that knowing virtually implies knowing that one knows is true if 'virtually implies' is understood in a slightly richer sense than Hintikka gave it; but Hintikka's proof of his thesis begs the question, treating equivocally 'It is possible, for all that a knows, that p .'

Section III develops my own definition of knowledge, adding to justified true confident belief (and defining) the requirement that the justification be externally conclusive.

Section IV argues that my definition conforms to what I said in section I and (contrary to Hilpinen's assumptions) that one can fail to believe that one knows, when one does know, solely through failure to have the concept of knowledge.

Section V discusses Hintikka's idea that the KK-thesis has an affinity for "stronger senses of 'know'" and suggests how confused understanding of my qualified KK-thesis can lead to an absurdly strong definition of knowledge.

ON KNOWING (BELIEVING) THAT ONE KNOWS (BELIEVES)

HECTOR-NERI CASTANEDA

This essay contains: (A) examination of the cases in which (1) " X knows (believes) that p " implies (2) " X knows (believes) that he* (=he himself) knows (believes) that p ," and (B) discussion of the impact of that implication on the relations of epistemic and doxastic alternative-ness. In (A) the quasi-indexical character of 'he*' is explained, and the following claim is defended: In general (1) does not imply (2), because (2) implies that the person X has a first-person idea of himself; but (1) implies (2) in the special cases in which (1) contains a first-person reference—either built in the very meaning of 'know' or 'believe,' yielding, say, 'know*' and 'believe*,' or in the description ' X ' stands for, or in what ' p ' represents. In (B) it is argued that Hintikka's epistemic and doxastic systems deal with *know** and *believe**, respectively; that because of the internality of the first-person reference epistemic and doxastic alternative-ness cannot be transitive, but that *know** (*believe**) does associate with every epistemic (doxastic) world with respect to a person a set of epistemic (doxastic) worlds which are ordered by a transitive relation of alternative-ness.

UTILITY THEORY WITH INEXACT PREFERENCES AND DEGREES OF PREFERENCES

PETER FISHBURN

$a - b <^+ c - d$ is taken to mean that 'your' degree of preference for a over b is less than 'your' degree of preference for c over d . Various properties of the strength-of-preference comparison relation $<^+$ are examined along with properties of simple preferences defined from $<^+$. The investigation recognizes an individual's limited ability to make 'precise' judgments. Several utility theorems relating $a - b <^+ c - d$ to $u(a) - u(b) < u(c) - u(d)$ are included.

ON THE ANALYSIS OF CAUSATION

MYLES BRAND AND MARSHALL SWAIN

In order to avoid the charge of circularity often brought against analyses of causations in terms of regularity or laws of nature, some philosophers have attempted to analyze causation in terms of necessary and sufficient conditions. It is argued that an analysis in terms of necessary and sufficient conditions is defective: for if it is construed in a way that avoids the circularity inherent in the other theories, the analysis yields a contradiction; and if it is construed in a way that avoids the contradiction, then the analysis is subject to the charge of circularity.

NEW CONCEPTS IN THE EVOLUTION OF COMPLEXITY:
STRATIFIED STABILITY AND UNBOUNDED PLANS

J. BRONOWSKI

Two different arguments for vitalism are examined. One claims that a living organism works on too elaborate a plan to be controlled by known physical processes. The other argues that a master plan is needed to explain evolution, and specifically the evolution of complex forms from simple ones. Both arguments are refuted when a distinction is made between bounded plans (which solve a specific problem) and a new concept of open or *unbounded plans*. Evolution proceeds from simple to complex as an open plan by stages of *stratified stability*, and it is shown that this statistical progression does not conflict with the second law of thermodynamics.