"You'll get all the answers to the grand unified theory later . . . I'm just here to fit you for wings."

what we are proposing amounts, in the words of the latter, to "abandoning the fundamental modes of thinking that are essential in our attempts to understand the world." In responding to this, we note that most quantum physicists follow von Neumann[5] in supposing that a Hilbert space is the proper mathematical structure for describing a quantum system, that physical properties correspond to subspaces of the Hilbert space, and that the negation of a property corresponds to the orthogonal complement of its subspace. It is regrettable that so few seem to be aware that these principles inevitably require some modification of the usual rules of propositional logic when dealing with quantum properties. (For an elementary discussion of this point, see Sec. IVA in ref. 6.) Such a modification was proposed in 1936 by von Neumann and Garrett Birkhoff,[7] and we strongly urge our colleagues to read at least the introduction to this paper in order to convince themselves that it is possible to tinker with the rules of propositional logic without losing one's reason, bringing about the collapse of Western civilization, or joining the postmodernists. Having done so, they will be in a much better position to examine our proposal with an open mind, since it is (in our opinion) far less radical than the one proposed by two prominent 20th-century mathematicians. What we are recommending[8,9] is a syntactical rule governing how logical expressions can be formed in a meaningful way, which prohibits combining propositions from distinct, incompatible consistent families. Each consistent family, on the other hand, constitutes a logic in which the usual rules of reasoning apply. Hence, rather than demanding that physicists learn new rules of reasoning, we are doing precisely the opposite: showing how the standard rules of reasoning can be safely imported into the quantum domain without leading to any inconsistencies, paradoxes, or contradictions. Inconsistencies arise, new modes of reasoning have to be invented, and the meaning of the logical connectives AND and OR becomes problematical precisely when the rules we propose for meaningful statements are ignored, and attempts are made to combine with one another statements belonging to different, incompatible logics. When the rules are followed, the consistent histories approach is consistent, as conceded by one of its severest critics.[10]

In addition, Goldstein asks whether "$S_z = 1/2$ or $S_x = 1/2$" makes sense if one has measured one component of spin, but forgets which one. Note that different apparatus settings are needed to measure different components of spin. These different settings correspond to macroscopically distinct quantum states with mutually orthogonal projectors, and these settings must be included as part of a consistent quantum description.

Jean Bricmont also raises the issue as to why true statements about the French and American revolutions can be combined, whereas this is not possible in his example of two successive measurements of a spin-half particle. The answer is that decoherence is a sufficiently effective process that all ordinary macroscopic events, including those that constitute human history, can be embodied in a single consistent family, often referred to as a quasiclassical family.

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ROBERT B. GRIFFITHS
rgrif@cmu.edu
Carnegie–Mellon University
Pittsburgh, Pennsylvania
ROLAND OMNÈS
Roland.Omnes@th.u-psud.fr
University of Paris XI
Orsay, France

Correction

April 2000, page 83—Robert Rathbun Wilson was misquoted in his response to the question: Is there anything here that projects us in a position of being competitive with the Russians, with regard to this race? The last sentence of Wilson's reply should have read: "In that sense, it has nothing to do directly with defending our country, except to make it worth defending." ■