

Newspeak with translations into the Oldspeak that most of us still use.

Reference

1. N. D. Mermin, *Phys. Rev. Lett.* **74**, 831 (1995).

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The Letters reply by Yakir Aharonov, Sandu Popescu, and Jeff Tollaksen gives a misleading impression of the consistent histories interpretation of quantum mechanics. As I pointed out in the same issue, consistent histories is an alternative to their time-symmetric formulation. It resolves the “collapse problem” of quantum foundations, which Aharonov and coauthors admit they have failed to do. However, that is not its only or even its principal virtue. It also solves what I call the second quantum measurement problem: how to infer from the measurement outcome the state of the measured system at an earlier time before the measurement took place. Thus the consistent histories approach, without any fuzzy references to “ensembles,” provides a proper probabilistic framework for inferring that S_x for a spin- $\frac{1}{2}$ particle actually was $-\frac{1}{2}$

before the measurement took place. This approach evades the criticisms expressed by Michael Nauenberg and Art Hobson in their letters in the same issue.

Furthermore, consistent histories, unlike certain aspects of the approach of Aharonov and coauthors, is fully consistent with the Hilbert-space structure of quantum mechanics introduced by John von Neumann and now taught to all students of the subject. Indeed, with a consistent histories analysis one can locate fairly precisely¹ the error in reasoning that leads to claims such as that the measured spin of a spin- $\frac{1}{2}$ particle can equal 100.² Claims about what weak measurements actually measure, when made by those who have not yet solved either the collapse problem or the second measurement problem, should be treated with great caution.

The claim that the consistent histories approach is controversial was true back in the 1990s, and the controversy led to a clearer formulation of the interpretation. However, no significant problems have come to light in the decade since the publication of my book.³ The fact that something has been ignored does not imply it is controversial. Admirers of Richard Feynman, some of whose writings were cited by Aharonov and coauthors in their reply,

may be interested to know that shortly before his death he was quite sympathetic to an early form of the consistent histories or decoherent histories approach to understanding quantum mechanics (see *PHYSICS TODAY*, February 1999, page 11)—an open-mindedness worth imitating.

References

1. R. E. Kastner, *Stud. Hist. Phil. Mod. Phys.* **35**, 57 (2004), <http://arxiv.org/abs/quant-ph/0207182>.
2. Y. Aharonov, D. Z. Albert, L. Vaidman, *Phys. Rev. Lett.* **60**, 1351 (1988).
3. R. B. Griffiths, *Consistent Quantum Theory*, Cambridge U. Press, New York (2002), <http://quantum.phys.cmu.edu/CQT/>.

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reply: We are grateful to David Mermin for stating loud and clear, in his unmistakable style, that “the authors are correct.” As for the rest of his letter, a lesson on clear writing from a great master of the subject is always welcome. We did strive for clarity in our article, but there is always space for improvement, and Freudian slips of Newspeak often creep in—that’s their very nature.

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However, as Mermin certainly knows, analyzing sentences in isolation without the many clues found in context doesn't do them justice. The initial setup is indeed elementary, and we put in all the details, so it is hard to see how it could be misinterpreted. The situation becomes far more interesting and surprising, though, when weak measurements are taken into account; to ignore them, as Michael Nauenberg and Art Hobson did, is to completely miss the point. We believe that no true understanding of quantum mechanics can be obtained without taking weak measurements seriously.

The letter by Robert Griffiths is mainly concerned with the merits of the consistent histories approach to quantum mechanics. It is an interesting subject but one that has very little to do with our article. We presented a number of quantum effects that arise in the context of pre- and postselection, first and foremost the effects that appear when weak measurements are involved. And no, there is no error in reasoning when we claim that in a situation like that described in our article, spin measurements may, in a consistent way, indicate that spin- $\frac{1}{2}$ particles have value 100; that is a statement of fact about results of measurements, which incidentally have been confirmed experimentally. One is free to disagree with the meaning we attach to those facts but cannot deny the facts themselves. Of course, since our effects are purely quantum mechanical, they can be analyzed using any interpretation of quantum mechanics, including consistent histories. However, before having such a discussion, it helps if the effects are first discovered! Their existence is our main message.

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Flying over thin ice

I enjoyed the article "The thinning of Arctic sea ice" by Ron Kwok and Norbert Untersteiner (PHYSICS TODAY, April 2011, page 36). I suggest that the possible cause of the 1 W/m^2 surplus heating is from airline traffic in the vicinity. I

say this for the following reasons:

► In the energy balance, Kwok and Untersteiner write, "the solar and atmospheric radiation terms dominate."

► The authors also write, "Radiative energy fluxes from the atmosphere and the annual advection . . . are two orders of magnitude larger than 1 W/m^2 ."

► People from the US Midwest observed that the sky became much less hazy during the flight moratorium after 9/11.

► Jet contrails contain water vapor and, more importantly, carbon particles that act as cloud condensation nuclei that enhance the high cloud layer.

► "High, thin cirriform clouds (composed mostly of ice) tend to promote a net warming effect."¹

► The time frame of the warming coincides with the development of jet air travel.

It seems quite possible that a little extra high cloudiness produced by jet flights in the area of the Arctic causes the little extra heating needed for the melting.

Reference

1. C. D. Ahrens, *Meteorology Today: An Introduction to Weather, Climate, and the Environment*, 8th ed., Thomson Brooks/Cole, Belmont, CA (2007), p. 452.

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Kwok and Untersteiner reply: As discussed in our article, an average heat imbalance at the surface on the order of $1 \text{ W} \cdot \text{m}^{-2}$ is required to explain the observed thinning of the Arctic sea ice cover during the past three decades. And the level of scientific understanding of the geophysical processes responsible for delivering that heat to the sea ice cover remains low. Comparatively, the current best estimate for the globally averaged radiative forcing by persistent linear aircraft contrails¹ from 2000 to 2005 is $+0.010 \text{ W} \cdot \text{m}^{-2}$, where a positive forcing leads to mean surface warming and a negative forcing to cooling. Even though uncertainties are involved in determining global values of contrail forcing, that level of forcing, if distributed uniformly over the globe, is unlikely to account for the observed thinning of the Arctic ice cover.

Reference

1. P. Forster et al., in *Climate Change 2007: The Physical Science Basis—Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, S. Solomon et al., eds.,

Cambridge U. Press, New York (2007), p. 129.

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The levity of dark energy

The term "dark energy" was coined by Michael Turner (or his student Dragan Huterer) in 1998; it is meant to be distinct from the "inflation" that occurred at a much higher density in the early universe. There are good reasons to favor another term for dark energy. I prefer "levity." Here's why:

► Levity works in opposition to gravity. Linguistically, the terms are opposites.

► Dark energy was chosen as the name for the phenomenon because dark matter was being studied at the same time. The two may have no genetic relationship.

► Dark matter is dark because it can't be detected optically. Dark energy is dark because its action is unknown. Those features are not equivalent. With luck and perseverance, the action of dark energy will be discovered.

► It's easy to teach the concept using the term "levity." People intuitively know what it means.

► "Dark energy" feeds into the media misconception that science is somehow mysterious and difficult to grasp. The reality is that science is very clear but based on a demanding process.

► Levity in common usage includes an aspect of nonlinearity and perhaps an odd localization. I assume that the phenomenon of dark energy has congress with both of those concepts as well.

► Levity in common usage is a healthy and fairly routine part of human existence. I assume that the phenomenon of dark energy will likewise be found to be a common feature of the physical world.

Considering that undergraduate students are still taught to write electrical current flowing from $+$ to $-$, I see little possibility for such a simple improvement as the one I'm laying out. I hope I'm wrong. The change could happen, but it would take an effort. People would have to use the term commonly, and it would have to become popular.

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