

equally to both analyzers. This is the paradox, in its physical and simple meaning.

We emphasize that our short description does not cover classical "hidden variables."⁴ However, no theory of that kind exists today that could reproduce the successes of quantum mechanics.

The reader should notice that neither the pioneer work of Bell² nor philosophical discussions of reality have been needed in our reasoning.

We conclude that the EPR state cannot exist if quantum mechanics is correct as we teach it today. We emphasize that the proof of nonexistence should preempt any other argument. Clearly our proof would be invalidated by the existence of an action at a distance that would always make particles act as nonseparated even if their wave packets were separated by miles. We would be only too happy to see the proof of such a beautiful phenomenon. At the moment we are not attracted by the assumption of a miracle that allows us to ignore distances to explain a puzzle that originates only from distance. Unfortunately, while we concentrated on the question of existence we had to ignore the other side of the coin, namely the considerations, based on the quantum-mechanical formalism, that appear to compel the creation of the EPR state. Fritz Rohrlich (November, page 13) emphasizes the power of the superposition principle, which follows simply from the linearity of the Schrödinger equation. However, that principle is not to be interpreted as giving a sufficient condition for establishing the existence of a state. The superposition of a proton and a neutron as an isolated particle does not exist, while a superposition of two different neutral kaons does, and has⁵ very peculiar properties. Also, while we surely expect the conservation laws to be respected, we must acknowledge our ignorance of what the final state of the photons is, so no conclusion is drawn on that account. The experiments are not *gedanken* experiments and thus have not yet given "the answer to Einstein." If Aspect's results had shown a correlation different from that of John Clauser and Fry then the existence of some unknown action at a distance would possibly have been demonstrated. As it is, the results seem to reject such a notion, unless we add to our inventory the miracle of velocities larger than that of light.

In conclusion, EPR remains a problem, and more work is needed. We make no progress attributing the problem to the inability of children of a classical world to understand quantum-

mechanical amplitudes. The neutral-kaon system is much more challenging than is the comprehension of the simple dictum "forget about the distance," yet the undergraduate "children" understand it.

It is also important to note that classical mechanics, if given the same privilege of actions at a distance, is a more powerful tool for contriving fancy correlations because it has no inevitable uncertainties. Pictures of two brothers establish their resemblance better if taken with a sharp lens rather than with a hole camera.

References

1. A. Aspect, P. Grangier, G. Roger, *Phys. Rev. Lett.* **47**, 91 (1981).
2. F. Selleri, G. Tarozzi, *Riv. Nuovo Cimento* **4**, 1 (1981).
3. U. Fano, *Rev. Mod. Phys.* **29**, 74 (1957).
4. O. Piccioni, P. Bowles, C. Enscoe, R. Garland, W. Mehlhop, in *Open Questions in Quantum Physics*, G. Tarozzi, A. van der Merwe, eds., Reidel, Boston (1985), p. 103.
5. A. Pais, O. Piccioni, *Phys. Rev.* **100**, 1487 (1955).

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1/86

Star Wars petition

I regard the "Star Wars" petition that is being circulated at many universities as misguided. The reason is not that I am in favor of SDI; I agree that the program is ill conceived and most unlikely to yield results anywhere near those advertised as its aim by the Reagan Administration. It is also, in my view, an enormous waste of money. I have, in sum, no quarrel with the first paragraph of the petition.

On the other hand, research on the various aspects of this effort is, *per se*, neither useless nor immoral. Indeed, it would be irresponsible of the American government *not* to support it at some level. I therefore find it quite inappropriate for those who oppose SDI to mount a self-righteous campaign to pressure other physicists not to participate in it (and that is surely what the drive does). The argument concerning the use of an institution's name is weak and irrelevant; universities can successfully protest such political misuses and have already done so.

However, the most distasteful aspect of the campaign, to my mind, is the implication that were it not for the stated objections, those who sign the petition might engage in SDI research. (Otherwise what meaning does a pledge "neither to solicit nor accept SDI funds" have?) Many of its signatories work in fields and have interests that would make their doing SDI research extremely unlikely. To use the pretense of self-

restraint as an argument to tell others what not to do is surely hypocritical.

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11/85

The impropriety of anti-SDI petitions can perhaps be best appreciated by considering the following *gedanken* experiment. Imagine a group of biologists and physicians circulating a petition against accepting funds for AIDS research. They might argue that the involvement of prestigious institutions in such research would give legitimacy to homosexuality and drug abuse. They could make a case that AIDS treatments may not be effective against advanced cases, and that the virus might mutate anyway, defeating any therapeutic scheme. At the same time a less-than-effective treatment might give people a false sense of security and encourage them to indulge in aberrant behavior. This hypothetical group of scientists might further argue that AIDS is an effective deterrent against aberrant lifestyles, and that medical research against it might draw attention away from other programs such as preventive medicine. The thought that a treatment for AIDS might save at least some lives would never cross their minds.

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12/85

MICHAEL WEISSMAN AND JOHN KOGUT REPLY: Roger Newton raises some issues worth clarifying. The key paragraphs of the anti-SDI pledge are the ones concerning the overall dangers of the program (with which Newton agrees) and the pledge not to participate (to which Newton strongly objects). The paragraphs concerning the relations between universities and SDI are less important and were used on only some campuses, not including ours. It does remain true, however, that the SDI organization continues to cite university work and applications as evidence of the value of the program.

Many of us who started or signed the pledge are very much eligible to apply for SDI money. For example, one of us (Kogut) is currently trying to obtain support for constructing a compact supercomputer; the other has done consulting for Rockwell on infrared detectors. No one has claimed, nor has the press inferred, that most of the signers would have been likely to get SDI money soon—despite the prospect of an increasingly SDI-dominated research environment. However, nearly all the senior signers have risked irritating their granting agencies, their administrators and often some of their colleagues. Nearly all the junior signers have drastically limited their options in the job market. Thus the pledge has succeeded in making an

unusually serious, emphatic statement on a life-and-death issue by requiring more or less sacrifice of its many signers.

The first paragraph of the pledge states that SDI "is a step toward the type of weapons and strategy most likely to trigger a nuclear holocaust." If Newton really agrees with that understated paragraph, we do not understand how he can justify giving either direct technical aid or indirect, but real, political support to the program.

We disagree fundamentally with the moral tone of Zumbulyadis, in that we believe no one deserves to die of either AIDS or nuclear war, no matter how "aberrant" his behavior. His analogy is utterly false in that AIDS is now killing people and, unlike nuclear war, may be substantially curable by technical means. Star Wars presents us with a clear choice: destabilizing war preparations, fraudulently sold as a "Peace Shield" cure, versus sincere international negotiations, which offer some hope of prevention. The two approaches are in direct, not hypothetical, conflict.

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1/86

Journal policy

Two unfortunate practices seem to be getting more common in physics journals. The first is to cite a book without giving page numbers. Even in a book with a good index it can be time consuming to find a reference. In some books it is impossible. There may be a few cases in which a reference is to an entire book, but in most cases the lack of a page reference is inconvenient at best, and at worst makes the citation useless.

The second practice is reporting the results of computer calculations without giving any idea of how these were obtained. A paper reporting the results of an analytic derivation would not be accepted for publication if no details of the derivation were given. The same should be true for a numerical calculation. The algorithms used should be discussed in sufficient detail in the paper itself or in references that the reader can understand how the results were obtained. A reader with access to appropriate computing facilities should be able to reproduce the results. Even if a technique is well known, reference to the literature takes little space and would be helpful to a reader who is new to the field.

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1/86

Editorial policy

I must take exception to the use of the PHYSICS TODAY Editorial page for the advocacy of one physics discipline over another, as was done by George Field in the April issue (page 144). At present the largest portion by far of the budget of the Office of Space Science and Applications goes to astronomical missions. Cost overruns in these missions have prevented the start of new initiatives such as the International Solar Terrestrial Program, the Comet Rendezvous and Asteroid Flyby missions and TOPEX, the three unnamed missions that are vying for a new start with the Advanced X-Ray Astrophysics Facility. These three missions are well conceived and will return excellent science. They deserve the support of the physics community as much as AXAF does. We should do everything we can to support NASA and all its programs rather than advocate one over the other, especially in the Editorial pages of PHYSICS TODAY.

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6/85

Math anxiety and physics

Sheila Tobias's "Math anxiety and physics: Some thoughts on learning 'difficult' subjects" (June, page 60) raises an interesting issue. Some students become immobilized by anxiety and need to be encouraged simply to get started. Perhaps the anxiety that physics students experience when confronted with a problem to solve is similar to the anxiety that keeps a writer from putting down that first word. I instruct my students to follow these specific steps:

► Draw a diagram. Use the diagram as an extension of your memory; put all the given information on the page. It is easier to remember information when it can be retrieved visually, and the mind is freed up for more creative thinking.

► Write down the most general equations that apply to the category of problem involved. For example, for motion problems:

$$\begin{aligned}x &= x_0 + v_0 t + 0.5 a t^2 \\v &= v_0 + a t \\a &= \text{constant}\end{aligned}$$

► Find the values of the variables in the general equations. This is the step that usually entails the most difficulty and requires the most understanding. Expect there to be more than one unknown and to have to solve simultaneous equations to evaluate them.

► Solve the algebra.

BARRY WERNER
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8/85

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