

wrong article. (Russian, having no articles at all—except for those of the penal code—is much less definite a language than English, and a translator often has to guess.) The present translation is guilty on both counts; the text is often so awkward that we could hardly let it pass without comment.

This comment notwithstanding, the book will certainly find a large and grateful readership. Mature researchers will appreciate that it fills an important gap in the literature, many professors will be glad to have it as supplementary reading for their solid-state physics or electrical engineering courses, and students will enjoy learning from it. It will be most helpful to those who view carrier scattering theory entirely from a user's perspective. We anticipate that its reliable physical arguments will be quoted often in support of an estimate or a back-of-the-envelope calculation.

ANATOLY A. GRINBERG

SERGE LURYI

AT&T Bell Labs, Murray Hill,
New Jersey

The Shaky Game: Einstein, Realism and the Quantum Theory

Arthur Fine

U. of Chicago P., Chicago,
1986. 186 pp. \$25.00 hc
ISBN 0-226-24946-8

Does it matter now, more than 30 years after his death, what Albert Einstein thought about quantum theory? The answer to that question may surprise you, but it is resoundingly clear. In 1985 alone, 50 years after it was written, there were 48 journal citations to the Einstein-Podolsky-Rosen paper! How many papers ever receive that many citations?

The Shaky Game spends part of its time examining Einstein's thoughts on the subject, and comes up with some surprising insights, based partly on Arthur Fine's discussion of unpublished correspondence. The rest of the book is an exposition of Fine's thoughts on the subject. Fine is a formally minded philosopher of science, and his discussion of the literature is taken largely from fellow philosophers, so the physicist reader will find no intuitive or physical explanation of Bell's theorem or of the work of John Clauser and Michael Horne, nor any discussion of the beautiful experiments that have been recently performed or their implications.

Instead the reader will find Fine's own version of Bell's theorem, which is quite interesting in its own right, but which I have a difficult time trying to derive any physical insight from. The author has discovered a set of theorems that use the results of defining simultaneous probabilities for the possible outcomes of a class of EPR experiments. Then if one integrates the results over, say, one particle, one arrives at a set of marginals that represent probabilities for the second particle, regardless of what happens to the first. Fine shows that in those cases in which the Bell inequalities hold, these marginal probabilities are positive, and so represent "classical probabilities." But in precisely those cases where the Bell inequalities are violated, these marginal probabilities become negative.

This result sounds fascinating, and one feels that it must be providing an important clue to quantum reality. But it involves integrating over situations that Henry Stapp has called "counter-factual," that is, situations that cannot be experimentally realized because they would violate the uncertainty principle. One must therefore make classically "reasonable" extrapolations to such situations, and it is difficult to know exactly what that means. Fine makes no real attempt to relate this approach to that of John S. Bell or to the more general one of Clauser and Horne, nor to answer the serious objections to his work that have been raised by such people as Abner Shimony. Rather, he presents his results as if they offered a complete explanation, which I found rather frustrating. (He gives some arguments for dismissing "locality" considerations, on which most other approaches are based. But they are based on his own models, for which he presents no details, so one cannot judge them critically.)

A further problem with the presentation is that while Fine's proofs are rather mathematical, this book is written with no mathematics whatsoever, which gives his explanations a rather fuzzy quality, as one is not aware of exactly what he has assumed or of how general the results are. Nonetheless I once heard Richard Feynman give a colloquium at MIT on his own unsuccessful efforts to introduce negative probabilities as an explanation for quantum theory, and I can't help but think that there is an important tie-in lurking here somewhere.

Fine also introduces his own non-realist view of quantum theory, which he calls the "Natural Ontological Attitude," a sort of hands-off

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philosophy of just accepting the world as one finds it and not trying to force it to match one's preconceptions, which I think most physicists would feel at home with, although I think it would appall Einstein, as it involves not asking questions that should be meaningful, independently of quantum theory.

Fine points out that Einstein's views of realism did not include "hidden variable theories," which were concocted by realists well after EPR, and which Einstein thought presented too simple a solution to a difficult problem. The author has his own explanation of EPR, based on what he calls "prism models," but I think Einstein would be equally dissatisfied here. Actually, Fine seems to imply that if Einstein were alive, he would support most of Fine's views, while to me the opposite seems to be the case. I think Fine has much too formal a view of things to please Einstein, but alas, we'll never know.

An example is the author's judgment of the EPR paper itself, which he calls "tangled and flawed," because it isn't presented as a perfectly organized Aristotelian syllogism. I would call the paper breathtakingly beautiful, striking right at the Achilles' heel of quantum philosophy. It's hardly an accident that after all this time, the paper just won't go away. Every physicist should read the paper for himself anyway, and he can decide for himself who is right. Fine points out an interesting tidbit: Einstein did not write the paper; Boris Podolsky wrote it after consultation with Einstein. (Einstein was apparently mainly worried about even simpler problems with measurement theory, but history has shown that only the later spin version of EPR, due to David Bohm, has experimental significance for hidden variables.)

All in all, the book has some interesting quotes from Einstein on quantum theory and causality, and follows the development of Einstein's ideas on the subject, which were always somewhat vague. This by itself makes the book worth reading for Einstein buffs. Fine has an interesting way of looking at EPR, but makes no attempt to put it into context with other, more physically transparent work on the subject, so the book's pedagogic value is not too high. His explanations are not very clear and I often disagree with his judgments. I think the nonhistorical part of the book will be of limited interest to most physicists.

DANIEL M. GREENBERGER
City College of the
City University of New York

The Life It Brings: One Physicist's Beginnings

Jeremy Bernstein
Ticknor and Fields, New York,
1987. 171 pp. \$16.95 hc
ISBN 0-89919-470-2

Jeremy Bernstein's autobiography of his first 30 years describes a common and unremarkable pattern for the upbringing of a theoretical physicist: A bright Jewish youngster goes off to Harvard, where he studies mathematics and physics, following which he pursues postdoctoral positions at Princeton, Brookhaven and abroad and begins a successful academic career. Despite this apparently ordinary material, Bernstein's book is an entertaining and fascinating work.

Bernstein's insight into what it means to be a theoretical physicist is especially interesting because he did not expect to pursue a career in science. In high school he was not absorbed in mastering calculus or quantum mechanics, but worked on the school newspaper and formed friendships with jazz greats like Duke Ellington. As an undergraduate at Harvard he eventually found that he had an aptitude for mathematics and a naive fascination with relativity. After beginning Harvard graduate school in mathematics, he ultimately finished with a degree in physics.

The title of the book comes from a quotation in a letter J. Robert Oppenheimer wrote to his brother Frank. "I take it that Cambridge has been right for you, and that physics has gotten now very much under your skin, physics and the obvious excellences of the life it brings." These "excellences" are implicit in Bernstein's book: the opportunity to use one's intelligence to understand nature at a fundamental level, to meet and work with talented and fascinating people, and to travel all over the world. Bernstein's descriptions of the great physicists with whom he worked, such as Julian Schwinger, T. D. Lee, C. N. Yang, Murray Gell-Mann and Robert Oppenheimer, are wonderfully drawn, as is his encounter with French civilization.

The book is a success very simply because Bernstein, a member of the staff of the *New Yorker*, writes so marvelously. In a tone that is both graceful and conversational, he succinctly evokes Cambridge and Paris of three decades ago. He allows us to relive what we each felt when first learning physics and mathematics, and the thrill of participating in exciting work like that engendered by the discovery of parity violation. *The*

Life It Brings is a delightful exposition of what it means to be a young physicist. It will be enjoyed by physicists and nonphysicists alike.

ROBERT N. CAHN
Lawrence Berkeley Laboratory
University of California

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