monotonically building up in almost all countries.

Davis's book throws no light on the social and political forces that were at work during these years, but the book can, perhaps, lead people to reflect on these forces and to wonder once again at the complex interactions between individuals and history.

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The reviewer, brother of the late J. Robert Oppenheimer, is on leave of absence from the University of Colorado where he is a professor of physics.

In the tradition of Enrico Fermi

ADVANCED QUANTUM MECHANICS, By Jun J. Sakurai. 336 pp. Addison-Wesley, Reading, Mass., 1967. $15.00

by Henry S. Valk

In the past few years there has been a multitude of books on quantum mechanics and field theory, and it might be thought that there is little need for yet another. However, as Jun J. Sakurai's recent work shows, there is always a place for good physical discussions of the subject. This text is an attempt to provide graduate students with an introduction to the recent (since 1927) advances in quantum physics and is an outgrowth of lectures that Sakurai gave in the third quarter of a required three-quarter quantum-mechanics course at the University of Chicago. If one is to judge by his text, the author has followed in the tradition of Enrico Fermi's lectures at the same institution: The basic theory is presented in a straightforward fashion with an emphasis not on the most elegant but on the most physical approach to each topic. The result is a book that can be read with profit by either second-year graduate students or professional physicists.

The subject matter, the quantum theory of radiation, Dirac theory and the covariant formulation of quantum electrodynamics, is divided into four chapters. The first chapter introduces the reader to basic aspects of classical field theory. This is followed by a chapter on the quantization of the radiation field. Here Sakurai pursues the traditional approach of Fermi and Heitler rather than the usual methods of Bleuler and Gupta. Most physicists find the Bleuler–Gupta formalism more intellectually satisfying because it exposes the relativistic aspects of the problem in a simple manner. I must admit, however, that the author has a point when he remarks that the simplicity of the Bleuler–Gupta approach is offset for the beginner by the corresponding necessity of introducing concepts such as the indefinite metric and negative probabilities. The third chapter is an exposition of the relativistic quantum mechanics of spin-1/2 particles; the Dirac wave equation, *Zitterbewegung*, the inadequacy of the one-particle interpretation, and the quantization of the Dirac field are all here, but developed with especial emphasis on symmetry principles. The final chapter (comprising nearly half of the book) concerns the covariant description of the interaction of photons and electrons. Again the material is treated in the traditional manner.

The problems (47 of them) and examples spread throughout the text amply illustrate the physical principles and provide the reader with a continuing test of his understanding. The only real annoyance in the book is one common to many first editions, namely that of misprints and typographical errors. One of the most glaring of these mistakes is "communication" for "commutation," on pages 24 and 28.

Although the adherence to the conventional may disappoint some readers, I must confess that I found it refreshing to discover a book without a new "gimmick." In a time when so many authors feel the need for such devices to justify their efforts, Sakurai and his publishers deserve congratulations for having produced a direct and eminently readable account of what every young (and old) physicist should know.

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"Warfare for science"

THE GERMAN ATOMIC BOMB. By David Irving. 397 pp. Simon & Schuster, New York, 1967. $16.95

by Joseph J. Ermenc

This book appeared in 1967 as a British importation entitled *The Virus House*. This title indicates the "cover" name for the small wooden laboratory on the grounds of the Kaiser Wilhelm Institute of Biology and Virus Research at Berlin-Dahlem where some experiments were directed toward achieving a self-sustaining nuclear reactor. The code name of the laboratory was intended to mislead and keep away unwanted visitors, and its use as a title of a book evidently accomplished a similar objective for prospective readers in the US; hence its reappearance under a more interesting title, with minor changes in the text and photograph format. This title, however, will be considered misleading by many readers as there was no German Atomic Bomb Project.

In general, this is a very interesting and detailed account of the simulta-

WERNER HEISENBERG

neous development of nuclear science and nuclear technology in Nazi Germany between 1939 and 1945. It should be interesting to the nuclear expert as well as the layman conversationalist looking for new facts and controversial conclusions.

The research for the book has been exhaustive. Indeed, two of the leading characters in this absorbing narration, Werner Heisenberg and Paul Harteck, with whom I discussed parts of *The Virus House*, have said that it is factually correct; but they were not in agreement with the author's conclusions. My feeling is that many of the conclusions are premature. One finds that the conclusions do give the story a dramatic quality, which does a lot to

hold the reader's interest, but such conclusions are minor distortions.

In this regard, a proper perspective may be obtained if one recognizes that the author is dealing with the first phase of a revolutionary technological development in which the problem was to reduce an idea to a working or "practical" demonstration. Much of the work required knowledge beyond the established frontiers: Uncertainties had to be reduced to risks. There was no clear vision at this stage of cause and effect, nor can there be in this type and phase of technological development. It is extremely easy to second-guess about the developments, at this stage after the fact, but rather misleading.

At this pioneering phase of technology the Germans did not achieve a self-sustaining nuclear reactor by the end of the war in May 1945. Yet in May 1942, Heisenberg and his assistant R. Döpel, assisted by his wife, a lawyer, achieved a 13% increase in total neutrons. "They were the first experimenters in the world to obtain a positive neutron production from a pile." The way seemed clear for the achievement of a self-sustaining nuclear reactor. Yet this result was not achieved during the remaining three years of the war. Why not? Irving mentions an "error of consequence," conflicts of interest between individuals and groups, and perhaps most important, that no leader in German science (or technology) was plumping for an all out effort to develop a nuclear bomb.

While the Nazi war slogan was "science for warfare," German nuclear scientists took as their slogan "warfare for science." This view was accepted by General Leslie R. Groves, the head of our atomic-bomb project, as being "much to the point."

In a recent interview in *Der Spiegel,* former Reichsminister Albert Speer, the munitions minister during the War years, recalled a meeting he had with the leading German nuclear scientists after the Heisenberg–Döpel success of May 1942 when the prospects of future developments were being discussed. Said Speer, ". . . There was not much music in the thing . . . therefore I didn't report the matter to the Fuehrer until two weeks or so later and then only in a very casual way."

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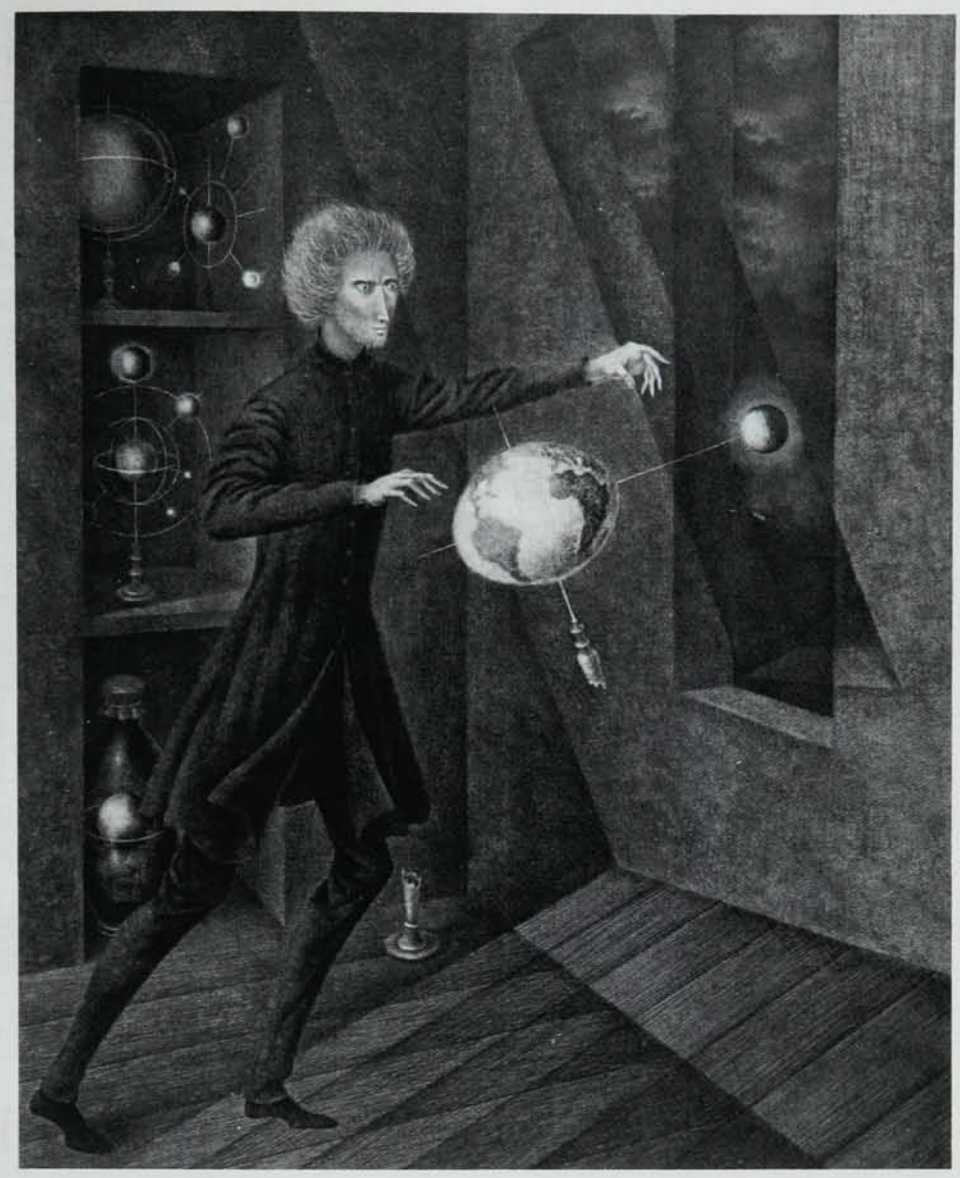

"THE PHENOMENON OF GRAVITY" by Remedios Varo, 1963. As earth escapes from its axis and center of gravity, astronomer tries to conserve his equilibrium, but he is astonished to find his right foot in one dimension and his left foot in another.

A masterful description

THE RIDDLE OF GRAVITATION. By Peter G. Bergmann. 270 pp. Charles Scribner's Sons, New York, 1968. $7.95

by Joseph Weber

Peter G. Bergmann was just 21 years old when he arrived in Princeton, with a fresh PhD from the University of Prague, to work with Albert Einstein. Physicists are well acquainted with Bergmann's excellent books, with the large number of outstanding theorists he has taught and with his many splendid research papers.

The Riddle of Gravitation is a beautifully written introduction. Important concepts are explained in a clear and interesting way, in a few sentences, usually with an illustration. Included are the notions of product spaces, relativity of simultaneity, spacelike and timelike intervals and the space–time geometry near the Schwarzschild radius. A separate chapter is devoted to event horizons.

Areas of current research are described in a masterful way. Bergmann gives us a view of gravitational collapse, gravitational radiation, cosmology, particle motion, quantization and the question of observables. Several appendixes enable the challenged reader to obtain intuitively satisfying deductions of the law of equal areas, the inverse square law, the Lorentz transformation and the Schwarzschild radius.

This book fills several needs. The serious physics student, the student whose primary interests are outside of