tion, work that Dalitz discusses in detail in *Reminiscences*.

Throughout these essays by Dirac's former colleagues, students and friends are comments on his life and personality. An entire section in *Reminiscences*, moreover, is devoted to Dirac's "Human Side." This section opens with a captivating account by Margit Dirac relating how she met her husband in Princeton in 1934 through her brother, Eugene Wigner, whose own recollections of Dirac follow later. Sevda A. Kursunoglu describes Dirac, in a delightful essay spiced with humor, as she knew him in Florida after he retired as Lucasian Professor of Mathematics at Cambridge in 1969. Additional contributions by J. E. Lannutti, Harish-Chandra, N. Kemmer, Rudolf Peierls, A. D. Krisch and H. E. Stanford complete the section, which taken as a whole does indeed convey a portrait of Dirac to the reader. His best known mannerism, of course, was his legendary monosyllabic mode of communication, illustrated by numerous anecdotes and perhaps traceable to the demands of a domineering father. But there is much more: We learn of his love of walking and travel, his kindness and humility, his hopes and fears. Lannutti writes that until he met him, "Dirac was not a person. Dirac was an equation, a theory of anti-matter, a delta function, a monopole or a kind of statistics." All that changed through personal association. Nevill Mott summed up his impression in a letter to his parents in 1931: "Dirac is rather like one's idea of Gandhi." Someday, hopefully, Dirac too will find his biographer.

ROGER H. STUEWER
University of Minnesota

Klaus Fuchs, Atom Spy

Robert Chadwell Williams

Harvard U. P., Cambridge, Mass., 1987. 267 pp.
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Almost 30 years after he was convicted of passing nuclear information to the Soviet Union, Klaus Fuchs continues to arouse considerable interest. Robert Williams throws new light on the Fuchs case in this carefully researched book. He makes it clearer than earlier accounts have done that Fuchs was an active and committed Communist before he left Germany in 1933. Fuchs's Communism sprang from his opposition to Nazism, and was not regarded as a serious danger by the British authorities when they allowed him to join the British atomic project in the summer of 1941. Fuchs had been dismayed by the Nazi–Soviet pact of 1939, but after Hitler's invasion of the Soviet Union in June 1941 he decided to inform the Soviet authorities about British work on the atomic bomb. Williams publishes for the first time the two confessions Fuchs made to the British authorities; these are still classified in Britain but have been released in this country. His book also contains the confession of Harry Gold, Fuchs's espionage control when Fuchs was a member of the British team on the Manhattan Project from December 1943 to June 1946.

These confessions tell us as much as we are likely to know for some time about the information Fuchs passed to the Soviet Union. Fuchs helped the Soviets not only by informing them of the designs for the gaseous diffusion isotope separation plant and for the implosion bomb, but more importantly perhaps by alerting them to the fact that Britain and the United States took the possibility of an atomic bomb seriously. During World War II this political information was the true atomic secret, and it persuaded Stalin to initiate a Soviet atomic project in 1942.

Fuchs acted for political and ideological reasons, not because he believed that scientists should be open about their research. As the cold war developed he became less anxious to provide information to the Soviet Union. He did tell his Soviet contact about the early work at Los Alamos on the hydrogen bomb, but his period of greatest usefulness to the Soviet Union seems to have ended in 1945.

Williams mentions that Fuchs may have been, without knowing it, under the control of MI6 (the British secret intelligence service) after 1947, but he does not follow up this intriguing suggestion. This book, excellent though it is, does not answer all the questions that the Fuchs case raises.

DAVID HOLLOWAY
Center for International Security and Arms Control
Stanford University

The Advancement of Science, and Its Burdens

Gerald Holton

Cambridge U. P., New York, 1986. 351 pp.
$39.50 hc ISBN 0-521-25244-X;
$12.95 pb ISBN 0-521-27243-2

In this thoughtful book, Gerald Holton considers both blades of our sword of Damocles, the thought-provoking advancements and the concomitant burdens of science. Holton, a renowned historian of science, takes the philosophical and historical high road on his trip from the past glories of Albert Einstein, Werner Heisenberg and Robert Oppenheimer to the burdens of the broader societal implications that scientists must consider—the bad along with the good. It is pedagogically wise for our graduate students to have this book to bridge the river of human events from those glorious achievements to the other side of burdens, at once less precise and less logical. Holton's approach works extremely well when addressing the "achievements" side of the coin, but is less satisfactory for the flip side because the burdens are more complicated than nature itself.

First, the "advancement": Both experimenters and theorists suspend their disbeliefs to jump creatively to their solutions based on intuition. Holton has examined data books to discover that Robert Millikan ignored data with "larger errors" because deep down he wanted electrons to have a unit charge. This bold, controversial stroke eliminated the fractionally charged electrons that had some support in other laboratories. Alternatively, theorists suspended various disbeliefs to create the discreteness of quantum mechanics and a relativity where time is suspect.

By using fundamental presuppositions containing elements of symmetry, causality, completeness, continuum and invariance, Einstein concluded that "the noblest aim of all theory . . . is to make these irreducible elements as simple and as few in number as is possible without having to renounce the adequate representation of any empirical content." Holton contends that the two-dimensional approach of combining physical phenomena and mathematical analysis must be expanded to include a third, orthogonal axis that folds in the presuppositions of symmetry, causality and so forth. This type of right-brained thinking is not strictly linear and logical in that it can require suspending disbelief and tolerating ambiguity, but it often has led to the "truth." The first two-thirds of the book contain a number of interesting quotes and insightful revelations, such as the image of Max Planck, the creator of the quantum concept, fighting its corpuscular implications in 1927 by saying, "Must we really ascribe to the light quanta a physical reality?" Or consider Wolfgang Pauli's statement in 1925 that "physics is decidedly confused at the moment; in any event it is much too difficult for me and I wish I . . . had never heard of it."