American Journal of Physics

BOOK REVIEWS | APRIL 01 2018

BOOKS RECEIVED FREE

Am. J. Phys. 86, 320 (2018)
https://doi.org/10.1119/1.5026097

BOOK REVIEWS

The downloaded PDF for any Review in this section contains all the Reviews in this section.

Craig F. Bohren, *Editor*

Pennsylvania State University, University Park, Pennsylvania 16802; mailing address: P.O. Box 887, Boalsburg, PA 16827; bohren@meteo.psu.edu

The Last Man Who Knew Everything: The Life and Times of Enrico Fermi, Father of the Nuclear Age. David N. Schwartz. 453 + xxiii pp. Basic Books, New York, 2017. Price: $35 (hardcover). ISBN 978-0-465-07292-7. (Cameron Reed, Reviewer.)

Enrico Fermi was one of the most accomplished and influential physicists of the twentieth century, but has been the subject of only a handful of biographical treatments. The first of these, *Atoms in the Family*, was written by his wife Laura shortly before his death in 1954. In 1970 came Emilio Segrè's *Enrico Fermi, Physicist*. Now after a gap of over a quarter-century, two new biographies of Fermi have recently appeared: Gino Segrè and Bettina Hoerlin's *The Pope of Physics* (2016), and David Schwartz's longer and somewhat more comprehensive *The Last Man Who Knew Everything*, the subject of this review. Gino Segrè is the nephew of Emilio Segrè and is himself a physicist. Schwartz is more removed from Fermi—he holds a Ph.D. in Political Science—and so brings a different perspective to his work, but is familiar with the physics world: His father, Melvin Schwartz, shared the 1988 Nobel Prize for Physics with Leon Lederman and Jack Steinberger for their discovery of the muon neutrino; Steinberger was a student of Fermi.

Schwartz relates that he became interested in Fermi when his mother came across a stash of letters and papers concerning Fermi left by his father, who died in 2006. Surprised that no full-length biography of Fermi was available, he set to the task. From the outset, Schwartz emphasizes the need to grasp how Fermi's remarkable breadth of knowledge and creativity were shaped by history, his personality, and the scientific and political circumstances of his times. He has succeeded admirably; the result is a very readable volume that should be in the collection of anyone interested in twentieth-century physics.

Schwartz breaks Fermi's life into four parts, proceeding largely chronologically: Becoming Fermi (from his birth in 1901 through his education and early academic appointments until late 1925), The Rome Years (1926–1938), The Manhattan Project (1939–1945), and The Chicago Years (1946–1954). These parts comprise 27 fast-paced and very readable chapters; there are also extensive notes and a bibliography. Schwartz has made good use of Fermi's collected papers, primary and secondary literature, and interviews with Fermi family members and many of Fermi's colleagues and students, and members of their families. Fermi was held in high regard as a teacher and mentor, and the recollections of his students are particularly illuminating and poignant.

Fermi's most notable contributions to physics are of course his development of Fermi-Dirac statistics, his theory of beta-decay and the weak interaction, the discovery with his Rome collaborators of neutron-induced radioactivity (which eventually led to the production of transuranic elements), the quasi-accidental discovery of the effect of thermalizing neutrons on reaction cross-sections, and the construction of the first chain-reacting nuclear pile at the University of Chicago. An unidentified Chicago colleague of Fermi's reportedly said that he learned how to "think like a neutron." No matter how many times one reads of the slow-neutron discovery, one is struck by the dramatic confluence of conflicting evidence, luck, and chance favoring a mind armed with deep background knowledge. Fermi and his Rome group came infinitesimally close to discovering fission in 1934, and one can only wonder how different subsequent history might have been had they done so. The story of the startup of the CP-1 pile at Chicago on December 2, 1942 is no less dramatic, but the drama had a different flavor. Based on experiments with 29 prior subcritical piles at both Columbia and Chicago, Fermi knew full well what to expect, but played to his audience's appreciation of being present at a historic event by drawing out the approach to criticality in incremental steps. CP-1 ran at a power output of one-half of a Watt that day. Only two years later, the gargantuan 250-megawatt plutonium production reactors at Hanford, descendants of CP-1, were beginning to come online, a remarkable testimony to the scientific, engineering, and organizational talent deployed in the Manhattan Project.

In the spring and summer of 1945, Fermi served on a panel with Robert Oppenheimer, Arthur Compton, and Ernest Lawrence which advised the Interim Committee, which had been established by Secretary of War Henry Stimson to provide advice on atomic policies. Fermi was present during a critical meeting at which it was concluded that Japan should not be given advance warning as to impending use of the bombs. Schwartz infers, however, that Fermi was uncomfortable with this decision, but went along perhaps because he was sensitive to his position as a foreign-born national of what had until recently been an enemy country. As Schwartz accurately points out, Manhattan Project scientists have assumed a greater burden of guilt than they deserve for the bombings: By that point the decision was in the hands of generals and politicians. A few years later Fermi found himself in a similar situation when, as a member of the General Advisory Committee of the Atomic Energy Commission (AEC), he strongly opposed development of the much more destructive hydrogen bomb. Despite this, he dutifully returned to Los Alamos to work on it following President Truman's early-1950 directive that research on such weapons be accelerated.

I caught a few surprising errors in this book. Einstein did not coin or even ever use the term "photon" (p. 44; this is usually attributed American chemist Gilbert Lewis in 1926, although he did not have the modern sense in mind and there were earlier precedents); it is claimed that the DuPont company had no previous involvement with the United States military (p. 207; DuPont was extensively involved in the production of propellants); and Oppenheimer did not view the

Trinity test from Campaña Hill (p. 257; he was at the South-10,000 control station). Astrophysicist Hannes Alfvèn's name is misspelt and he is transformed from a Swede into a Norwegian on p. 282. Some people appear with little or no explanation of their background or relationship to the story; this occurs with Vannevar Bush (p. 185) and James Conant (p. 212), two senior administrators of the Manhattan Project, and also with Ward Evans (p. 313), who was one of the panelists on Oppenheimer's 1954 security hearing. These are, however, fairly minor issues that are not likely to be caught by readers who are not intimately familiar with the relevant history and physics, and they certainly do not detract from appreciation of Fermi's life and work. Schwartz has a habit of playing amateur psychologist, such as when he attributes Fermi's life-long interest in analyzing probabilities to the unexpected and very upsetting death of his older brother Giulio when Fermi was 13. In what struck me as an extremely unfair assessment, Schwartz strongly criticizes Fermi for not anticipating the effects of neutron-capturing xenon-135 during the startup of the first Hanford reactor. Xe-135 is formed from the decay of iodine-135, which is a direct fission product. However, fission leads to literally hundreds of products which themselves decay to other species, and the detailed behavior of any one product simply could not have been predicted in advance. Indeed, DuPont engineers over-designed the piles as a precaution against exactly this type of contingency.

In the end, much will remain unknown about Fermi's thoughts on the use and legacy of nuclear energy and weapons: He left little in the way of private letters, diaries, or memoirs, and never achieved the level of public exposure and political influence that contemporaries such as Oppenheimer or Edward Teller sought. But the value of his contributions to physics and quality of his character will remain unquestioned, and long-overdue biographies such as this will help bring appreciation of his contributions to a wider audience.

Cameron Reed is the Charles A. Dana Professor of Physics at Alma College, emeritus. He served as the editor of the American Physical Society's "Physics & Society" newsletter from 2009–2013, and is currently Secretary-Treasurer of the APS's Forum on the History of Physics. His interests lie in the physics and history of nuclear weapons; his text "The History and Science of the Manhattan Project" was published by Springer in late 2013.

BOOKS RECEIVED

An Introduction to Quantum Theory. Jeff Greensite. 501 pp. IOP, Bristol, 2017. Price: $150 (hardcover) ISBN 978-0-7503-1168-7.

Fractional Diffusion Equations and Anomalous Diffusion. Luiz Roberto Evangelista and Ervin Kaminski Lenzi. 358 pp. Cambridge U.P., New York, 2018. Price: $89.99 (hardcover) ISBN 978-1-107-14355-5.

Graphene: The Superstrong, Superthin, and Superversatile Material that will Revolutionize the World. Les Johnson and Joseph E. Meany. 268 pp. Prometheus, Amherst, New York, 2018. Price: $19 (paper) ISBN 9781633883253.

Fluid Dynamics: Boundary Layers. Anatoly I. Ruban. 395 pp. Oxford U.P., New York, 2018. Price: $75 (hardcover) ISBN 978-0-19-968175-4.

Statistical Mechanics of Lattice Systems: A Concrete Mathematical Introduction. Sacha Friedli and Yvan Velenik. 641 pp. Cambridge U.P., New York, 2018. Price: $69.99 (hardcover) ISBN 9781107184824.

The Black Book of Quantum Chromodynamics: A Primer for the LHC Era. John Campbell, Joey Huston, and Frank Krauss. 758 pp. Oxford U.P., New York, 2018. Price: $75 (hardcover) ISBN 978-0-19-965274-7.

Applied Computational Physics. Joseph F. Boudreau and Eric S. Swanson. 934 pp. Oxford U.P., New York, 2018. Price: $60 (paper) ISBN 978-0-19-870864-3.

Double Photoionisation Spectra of Molecules. John D. Eland and Raimond Feifel. 207 pp. Oxford U.P., New York, 2018. Price: $85 (hardcover) ISBN 978-0-19-870864-3.

Interacting Systems Far From Equilibrium: Quantum Kinetic Theory. Klaus Morawetz. 573 pp. Oxford U.P., New York, 2018. Price: $85 (hardcover) ISBN 978-0-19-879724-1.