answers to tough questions. Helfand's chapters walk us through similar lessons and even provide chapter-by-chapter exercises to test and improve our skills. I enjoyed those problems, which played out more like enjoyable puzzles than algebra homework sets from long ago.

Helfand strays from his central theme by including a mild rant on the importance of linguistic rules, but he admits partway through it that the detour is at least partly due to his pedantic tendencies. One can forgive him and move on to the important conclusion of the section: that words matter because they contain information and therefore deserve our attention just as much as numbers. Having worked in close collaboration with Helfand during his recent tenure as president of the American Astronomical Society, I can assure you that he is a wee bit pedantic, but that tendency enhanced his excellent and effective leadership. He has also used the principles expressed in *A Survival Guide* to inform the educational philosophy of Quest University Canada, which he describes in two enjoyable TEDx talks about the need to change the way we educate university students.

As practitioners of science, we rarely step back and think about how we go about our work. We're too busy getting the work done. But reading through this survival guide, I was struck by the extraordinary power provided by a few simple tools fundamental to science. Sitting here on our small planet we have determined both the scale and the history of our universe, revealed the physical changes Earth has experienced over a time span far in excess of our own lifetimes or that of our species, outlined the basic function of our brains and bodies, revealed the fundamental ways matter interacts and the forces that guide those interactions, and pierced the inner working of things so small we cannot even see them through microscopes. The tools of our trade are powerful, and scientifically inclined readers will enjoy the way Helfand reminds them of that fact. But if this book motivates appreciation of those tools and their application beyond our own community, then we'll really be on our way to a better world.

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The Pope of Physics

Enrico Fermi and the Birth of the Atomic Age

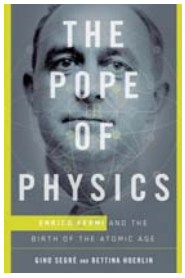
Gino Segrè and Bettina Hoerlin

Henry Holt and Co, 2016. $30.00 (368pp.).
ISBN 978-1-62779-005-5

There are many reasons to love *The Pope of Physics: Enrico Fermi and the Birth of the Atomic Age*, a new biography of the celebrated Italian physicist. It is humane, scientifically astute, and beautifully written. And what a life it chronicles!

Fermi, born in 1901 into a middle-class Roman family, showed an early talent for mathematics. At 17, just a little too young to be drafted into World War I, he

wrote an essay as part of a series of highly competitive exams that earned him entry as a physics student into the Scuola Normale and a reputation for genius.



After conducting research aimed at applying general relativity to the motion of charged particles, Fermi received a physics doctorate magna cum laude in 1922. In the early 1920s, as Benito Mussolini was gaining power, the apolitical Fermi was taken under the wing of politically connected physics professor Orso Mario Corbino. With Corbino's help, Fermi received fellowships at the University of Göttingen, where he met Werner Heisenberg, Wolfgang Pauli, and Paul Dirac, and at the University of Leiden, where he met Albert Einstein.

In 1926, as quantum mechanics was emerging, Fermi was appointed to a position Corbino had created for him and became the University of Rome's first professor of theoretical physics. There, he established a world-renowned physics group that included Franco Rasetti, Edoardo Amaldi, and Emilio Segrè. In that informal, productive, and creative atmosphere, he was sometimes jokingly called the Pope because of his apparent infallibility. In 1928 he married Laura Capon, who came from a well-to-do assimilated Jewish family.

After Fermi achieved fame for his work on the theory of beta decay, his group brought new distinction to Italy by using a small radioactive neutron source to irradiate numerous materials with neutrons. That meticulous work led to Fermi's being awarded the 1938 Nobel Prize in Physics.

With the advent of anti-Semitic laws in Italy and the growing alliance between Mussolini and Adolf Hitler, the Fermis surreptitiously emigrated to the US after the Nobel ceremony in Stockholm. Within weeks of arriving in New York and starting his position at Columbia University, Fermi learned of the discovery of fission. As World War II began, he undertook his crucial wartime work, which built on his prewar neutron-physics expertise. By 1942 he had moved to the University of Chicago where, on a former squash court, he built the first reactor and created the first sustained neutron chain reaction. He provided advice for the construction and operation of the Manhattan Project's first plutonium production reactors in Hanford, Washington, and later moved to Los Alamos, New Mexico, to become a group leader with the bomb design project.

After the war the Fermis returned to Chicago, where Enrico headed the Institute for Nuclear Studies. At his urging, computing facilities and a cyclotron were built there, which opened the way for groundbreaking research in the new field of elementary-particle physics. After nearly a decade in productive postwar research, Fermi died of stomach cancer in late 1954.

Authors Gino Segrè, the nephew of Fermi's colleague Emilio Segrè, and Bettina Hoerlin, whose father Hermann Hoerlin was an industrial physicist and group leader at Los Alamos National Laboratory, are wonderful writers with a deep sense of the personalities, science, historical backdrop, and locales of Fermi's story. Although the book told a familiar tale, I literally could not put it down once I started it. Its account nicely complements Emilio Segrè's *Enrico Fermi: Physicist* (University of Chicago Press, 1970), which contains more scientific detail, and Laura Fermi's classic *Atoms in the Family: My Life with Enrico Fermi* (University of Chicago Press, 1954), with its lively and charming first-person narrative.

The book also contains new insights that paint a poignant picture of a human genius. For example, as he lay dying, Fermi calmly measured the flux of his intravenous nutrients, counting drops with his stopwatch. The story brings to mind his legendarily calm calculation of the detonation power at Trinity. The book also contains an extraordinary essay arguing that Fermi's approach to physics "combined a breadth of knowledge, mathematical acumen, a strong dose of intuition, and mental agility." That essay alone, perhaps alongside a description of Einstein's much more visual approach, would be wonderful for a course on variants of scientific creativity.

I strongly recommend *The Pope of Physics* for anyone who wants to know more about Fermi or to use his example in teaching.

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Applied Thermodynamics for Meteorologists

Sam Miller

Cambridge U. Press, 2015. $84.99 (392 pp.).
ISBN 978-1-107-10071-8

Thermodynamics, a subject essential to meteorology, can be a bit of a puzzle for undergraduates—and not a few of their instructors. Some key topics in the subject, such as entropy, challenge or upend intuition. Others, such as moist thermodynamics, are essential for understanding the circulation of the atmosphere and the chance of severe weather but are usually not addressed in introductory physics classes. As a result, meteorology students confront the mysteries of water and energy all at once in their undergraduate thermodynamics class while they gasp for air and grasp for practical ways to apply their knowledge.

Striking the right balance between theory and application is a challenge for instructors and for the authors of the textbooks they use. During the past two decades, several authors have attempted to find that balance. Craig Bohren and Bruce Albrecht, in their *Atmospheric Thermodynamics* (Oxford University Press, 1998), say they aspire to provide "rollicking good literature" for students, but the book's digressions and wealth of detail make it the text that instructors should read before teaching the subject. Judith Curry and Peter Webster's *Thermodynamics of Atmospheres and Oceans* (Academic Press, 1999) uses a broad multidisciplinary approach but deals only briefly with applications. Anastasios Tsonis's *An Introduction to Atmospheric Thermodynamics* (Cambridge University Press, 2002) targets the one-semester undergraduate course in thermodynamics in departments of meteorology or atmospheric science, at the cost of meteorological applications. Grant Petty's *A First Course in Atmospheric Thermodynamics* (Sundog Publishing, 2008) opts for less detail on the more obscure or philosophical aspects and more focus on observations and severe-weather indices. After some trial and error, our program at the University of Georgia has settled on Petty's book.

Into this mix comes Sam Miller's *Applied Thermodynamics for Meteorologists*.