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From Falling Bodies to Radio Waves: Classical Physicists and Their Discoveries

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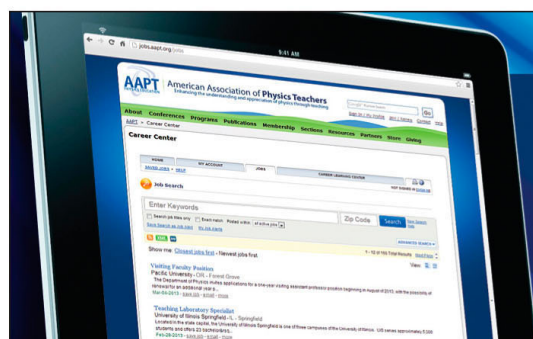
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BOOK REVIEWS

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From Falling Bodies to Radio Waves; Classical Physicists and Their Discoveries. Emilio Segrè. 298 pp. Freeman, New York, 1984. Price \$24.95 (cloth); \$13.95 (paper). (Reviewed by Thomas B. Greenslade, Jr.)

Before starting to consider Segrè's account of the personalities who developed what is now called classical physics, I spent some time thinking about the uses which physicists make of the history of physics. More than the practitioners of any other field of science, we are keenly interested in our past. This may be due to the relative maturity of physics as a science; to a lesser degree the fact that physics has more artifacts from the past surviving than the other pure sciences reminds us of our history.

In particular, how is the history of physics used in the teaching of the subject? I suspect that most of us like to slip in historical anecdotes when starting a new subject, and when passing over the joints in our lecture notes. The historical anecdote also provides a change of pace for the students, a time when they can catch up on the equations on the board and relax their minds for a short while. Very rarely do we ask students to learn historical material for examinations.

To teach physics in historical context is quite reasonable. The students can be shown how one scientific idea leads to another, and how a scientific idea can be set in a general technological context. For example, we often mention that the development of steam engines led to general considerations of thermodynamic efficiency.

To teach physics in historical chronology can be a disaster. With this approach the student generally cannot see all the material which is necessary to go on to higher levels of physics, or to other graduate and professional careers. There are too many blind alleys which are of interest primarily to the specialist. Students get a better idea of how science does *not* work rather than how it does work. An example on the upper-class level would be following through James Clerk Maxwell's papers on his electromagnetic theory as he gradually discarded mechanical analogies and went into pure abstraction. The striking exception to this has been the history of physics laboratory. However, this seems to be used mostly for nonscience students who are not constrained to "cover the material."

At the onset, it should be understood that this is not the book to use if you want to learn classical physics and its history simultaneously. It is assumed that the reader already has a good grasp of physics. As the title suggests, the physics itself defers to the physicists; Segrè says in the introduction that the book "is a testimonial to my affection for my scientific forefathers," and his approach to encapsulated scientific biography is uniquely personal.

The book starts with "a whimsical prelude" in which Segrè describes fictional meetings with Galileo, Huygens, Newton, Gay-Lussac, Faraday, Clerk Maxwell, and Helmholtz. Huygens is a charming man-of-the-world, but the

encounter with Newton proves to be a nightmare; the great man is remote and suspicious in person, and Segrè retreats to the present and attempts to reach Newton through his writings. Segrè attends one of Faraday's Friday Evening Lectures at the Royal Institution in which the lecturer runs 20 minutes short, and fills in the remaining time with original speculations. The final visit with Helmholtz is heavily laden with Prussian symbolism and forebodings for the future.

The remainder of the book, apart from 14 mathematical appendices, is divided into sections on Galileo and Huygens; Newton; Light; Electricity; Heat; and Kinetic Theory. The number of pages given to each topic do not, however, correspond to the relative weight which is commonly placed on them either in the introductory course, or in the classical portion of the overall undergraduate curriculum. Perhaps in compensation for the relative lack of emphasis given to thermodynamics in modern courses, Segrè spends one quarter of his book discussing the work of Carnot, Clapeyron, Kelvin, Joule, Clausius, Boltzmann, and many others who showed how the subject once called heat could be tied into the mainstream of physics, and how the development of microscopic theories pointed the way toward quantum physics.

I found the book irresistible for browsing. For example, on p. 231 there is Clausius' drawing of the decomposition of an arbitrary reversible cycle into a collection of Carnot cycles. This led me to leaf back a couple of pages and read about his formulation of the ideas of entropy. I have always wondered how far back one has to go to find mathematical developments in their present form, and here was a case which was easy to pin down—it was 1865–7. Recently a student asked me who first used the idea of the moment of inertia; on p. 41 we find that it was Huygens.

The bibliography refers mainly to original sources, though there are references to a number of recent biographies of physicists. Missing are references to readily accessible journal articles (in *Scientific American* and *American Journal of Physics*, for example) about specific pieces of scientific work. A minor point is that students who have studied Maxwell's equations from recent American textbooks are going to find some unexpected constants in the equations.

I think that this book can be read with a certain understanding of the physics by a third-year undergraduate, but a better time might be after graduation and before starting out in graduate work in physics. Segrè's book may be the historical analog of the Feynman Lectures.

Thomas B. Greenslade, Jr. received his B. A. in physics from Amherst College, and his Ph.D. in experimental low-temperature physics from Rutgers University. Since 1964 he has been a faculty member in the physics department of Kenyon College. He has research interest in the apparatus used to teach physics in the nineteenth century.