

Physics in America from the top down

The Physicists: The History of a Scientific Community in Modern America

D. J. Kevles

512 pp. Knopf, New York, 1977. \$15.95

Reviewed by Lewis Pyenson

The sea of specialized monographs washes up more detritus than we generally care to acknowledge. Presses and their learned advisers accommodate weak dissertations instead of returning them straightaway for distillation into one or two solid articles. Collections of previously published essays are issued with glowing tributes. Studies of isolated institutions are offered as synthetic achievements. Biographies are received as historical *chefs d'oeuvre*. Especially in the field of history of science many of these inconsequential treatises are framed for posterity because short-sighted senior professors have encouraged numerous students to pursue slight, unimaginative and poorly researched themes.

From time to time a few books on the history of science do surface from the academic maelstrom. *The Physicists* by Daniel J. Kevles is one. Spanning more than a century (from 1865 to 1976), it details activity in one discipline, physics, and in one country, the US. Sciences in various cultural environments have long provided material for historical treatments. Many authors make little attempt, however, to connect social activity with learned discourse. Although pleas for such an interaction have recently been broadcast far and wide, most historians of science still avoid integrating material reality with scientific ideas. This integration is central for Kevles, and his book contributes to a small but growing literature by historians of science, such as Paul Forman and Karl Hufbauer, who have persuasively transcended mere chronicles of formulas, personalities, and institutions in delineating national settings of scientific disciplines.

Through Kevles's fabric runs the thread that physics in the US has been controlled and directed by an aristocracy



Physicists at Caltech, circa 1930. Einstein is seated, in stiff collar and tie. To his left is Paul S. Epstein, his right Robert A. Millikan. On the far left of the photograph sits a dour J. Robert Oppenheimer. Before the open door stands future nobelist Carl D. Anderson, a face in the crowd. (Photograph: California Institute of Technology, courtesy of AIP Niels Bohr Library.)

of talent. Leaders of the discipline mostly succeeded in diverting private, government and university funds to finance cherished projects of greater or lesser scientific merit. Physical research traditionally suffered at the hands of government nabobs and capitalist robber-baron whose inconstant support followed the phases of the business cycle. Largely a story of administrator keepers and their scientist charges, *The Physicists* centers on men at the top deliberating in committee rooms, laboratory rooms, board rooms and, one suspects, barrooms. The ruling elite of American physics are painted larger than life. Beneath them we stand in awe. As if part of a Rubens canvas they encircle a blazing incarnation of the mammon who speeds their projects to completion or to oblivion. Many of the elite were good, even very good, physicists, but many were also mean men of private wants and unsavory prejudices. All too infrequently does Kevles reveal their feet of clay.

Seen by its benefactors, physics was a science like many others, and to discuss the largesse of one or another Croesus

Kevles ranges far from physics. He provides a breathtaking view. From a wide variety of sources he presents university presidents spouting scientific platitudes, journalists eager to confirm the sentiments of their readers, congressmen fearful of alienating their constituents, directors of foundations anxious to create a healthy business climate, and powerful scientists swayed by cupidity and ambition. We pass from national geological surveys in the nineteenth century to elementary-particle surveys in the twentieth, from artillery-ranging during the first world war to nuclear deterrents in the cold war, and from panics in the 1880's to funding crises in the 1930's and 1970's.

This stunning panorama is captured, however, at the expense of a clear focus. Halfway through the book we wonder whether, by substituting various names and scientific concepts, much the same story could be told for physical chemistry or even marine biology. Such a doubt can be worried into a more serious objection. Among historians of science "discipline" and "profession" connote special social structures, but in *The Physicists* these

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words function without apparent precision. "Community" and "society," vigorously debated since the end of the nineteenth century, are notions embellishing the narrative instead of directing it. The "community" of American physicists announced in the subtitle rarely makes a proper appearance. Despite suggestive asides we are never clear about precisely who was a physicist, what most physicists did, and how they were drawn to their calling. Attention is lavished on twentieth-century figures who lightened philanthropic and ultimately public coffers during campaigns for high-energy machines, but scant remarks are directed to less glamorous fields of physics and their rank-and-file exponents. The narrative remains unconvincing on the aspirations and achievements of physicists teaching in small colleges or those who, working in obscure government or industrial laboratories, pursued research of little immediate interest to mandarins circulating reports along the corridors of power.

Why did so many young men and women persist with a physics career if only a small number could ever rise to the heights of their avatars? How does the appeal of physics differ from that of neighboring disciplines? Kevles's *Physicists* provides a solid foundation for considering these and other questions that will be posed by future social historians. The notes furnish a sure guide to many primary and secondary sources. Bibliographical commentary (that is, alas, more critical in some places than in others) and archival deposits provided in appendices will be consulted widely. Scholarly apparatuses by no means detract from a readable book, one that has clearly been many years in the making. At a time when a disproportionate number of historians of science are contemplating biographies of exemplary individuals or narrow surveys of ideas and institutions, *The Physicists* comes as a breath of fresh air. Kevles's book will find a secure place on the syllabuses of teachers, above the desks of research administrators, and near the laboratories and blackboards of its subjects.

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Nonlinear Laser Spectroscopy

V. S. Letokhov, V. P. Chebotayev

466 pp. Springer-Verlag, New York, 1977.
\$27.90

The intense monochromatic radiation generated by lasers has made it possible to observe a variety of nonlinear effects

when such radiation interacts with atoms and molecules. These nonlinear effects have been studied very thoroughly for more than a decade and have been responsible for the evolution of a number of new and very important spectroscopic techniques. Nonlinear laser spectroscopy has indeed revolutionized the field of spectroscopy and thus opened up a number of applications in fundamental and applied research. Researchers in the US and the USSR using nonlinear saturation techniques have achieved spectroscopic resolving power in excess of 10^{11} and a further improvement is likely in the near future.

Authors Vladilen S. Letokhov and Veniamin P. Chebotayev, who are both from the USSR and are very well known for their many outstanding contributions to nonlinear spectroscopy, have succeeded in collecting in one volume all there is to know about nonlinear laser spectroscopy.

The book begins with the basic theory of resonant light interaction with atoms with special emphasis on saturation effects and the generation of narrow resonances. This is followed by detailed treatments of almost every kind of nonlinear line-narrowing scheme that has ever been conceived in two-level and three-level systems. In each case numerous references have been made to much of the work that has been performed within as well as outside the USSR.

Special topics include an analysis of two-photon transitions, particularly with counterpropagating traveling waves to eliminate Doppler broadening, and a study of coupled Doppler-broadened transitions including stimulated Raman scattering. An entire chapter is devoted to the important problem of the lineshape observed in nonlinear spectroscopy and how the lineshape is modified by misalignment, collisions, competing resonances, time-of-flight and second-order Doppler effects.

Applications of nonlinear spectroscopy in the study of atoms and molecules are well covered. In fact about one fifth of the book is devoted to this topic, including numerous references to the literature.

The authors go on to explore the use of narrow resonances generated by nonlinear interactions for laser frequency stabilization and optical clocks, and for the measurement of fundamental constants. A review of recent measurements of the second-order Doppler effect and molecular recoil is also given. The book closes with a discussion on gamma-ray spectroscopy without Doppler broadening and the prospects for laser nuclear spectroscopy in general.

In spite of the fact that Letokhov, at the Institute of Spectroscopy in Moscow, and Chebotayev, at the Institute of Semiconductor Physics in Novosibirsk (Siberia), are 4000 km apart, the book is well