

cases (nuclear and cluster) the quantum theory of oscillation begins with the mean field and then goes on to the random phase approximation. Concepts like the response function are introduced. The quantum discussion is often prefaced by classical considerations (using, for example, the liquid drop model), which are generally helpful in developing an intuitive grasp of the phenomena involved.

This is a successful book. It can be read as an introduction to the field, although considerable effort will be required of serious readers if they wish to follow the details of the theoretical developments presented. A knowledge of nuclear theory would be very helpful, but in any event, a clear picture emerges: Oscillations of a finite system, whether that of a nucleus or of a metallic cluster, have many phenomena in common, and common methods are employed for their explanation.

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The Creation of Scientific Effects: Heinrich Hertz and Electric Waves

Jed Z. Buchwald

U. of Chicago P., Chicago, 1994.
482 pp. \$75.00 hc
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ISBN 0-226-07888-4

If you want to read history of science the way it should be written, with careful attention to technical detail, valuable discussion of the scientific context and interesting personal glimpses from diaries and letters, then Jed Buchwald's *The Creation of Scientific Effects* is for you. Using published work, laboratory notebooks, diaries and letters, Buchwald reconstructs the history of the work of Heinrich Hertz from his days as a student to his work in Hermann Helmholtz's laboratory through his 1889 experiment demonstrating the interference, and thus the existence, of electromagnetic waves.

All contemporary physicists "know" that Hertz tested Maxwell's prediction of electromagnetic waves and, by demonstrating their existence, gave support to Maxwell's theory of electromagnetism. Buchwald shows, however, that Hertz's experiment had very different origins and that it was only at the very end of the sequence of experiments that he even began to

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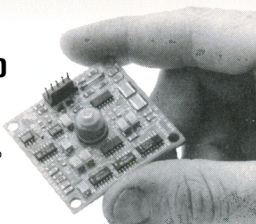
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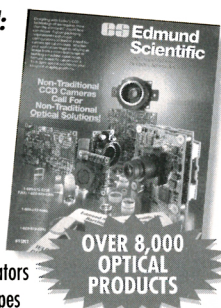
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think of waves. Hertz's motivation, Buchwald shows, was the conflict in Germany toward the end of the 19th century between two competing views of electromagnetism: There was Helmholtz's view, in which everything was explained in terms of interaction potentials with no specification of the nature of electric charge or current, and there was Wilhelm Weber's, which used electric particles—"atoms" of electricity—that exerted central forces on one another (with the forces depending on both distance and the first and second time derivatives of the distance). As a student Hertz was also imbued with the view that the purpose of experiment was to produce novel effects (hence the title of the book), rather than to test theory. Thus he regarded experiments that showed a positive effect more highly than those that gave a null result.

Buchwald's book, particularly for those who know the history and its modern interpretation, is a fascinating detective story. How will Hertz, who appears to be looking elsewhere, reach the point where he will demonstrate the existence of electromagnetic waves, and how will he actually demonstrate it? Along the way we are given detailed accounts of the experiment in which Hertz failed to show the electric nature of cathode rays, his observation of the photoelectric effect, his experiments on the evaporation of liquids and his first construction of a spark-switched oscillator with a resonant spark gap used as a detector. Hertz could then attempt to show that electric forces propagate and demonstrate indirectly that dielectric polarization can be caused by electromagnetic action, something he was not able to observe directly. Hertz used his oscillator-resonator apparatus to show the interference between the electric force produced directly by a spark gap and the force produced by a wire attached to the gap. Once he had demonstrated this interference, he began to think about electromagnetic waves and performed the experiment showing the interference of the waves produced by the spark gap and by reflection from a metal plate.

Throughout this account, Buchwald interprets the experiments in the context of what Hertz knew at the time. Thus there is no space-charge explanation of Hertz's failure to show the electric nature of cathode rays. This treatment results in a more correct and, I believe, a more interesting history. We learn what the science was at the time, with all its complexity, not the interpretation given later. Although the text con-

tains considerable technical detail, it is quite readable, even for those without extensive knowledge of electromagnetic theory. For those who want even more technical detail, Buchwald includes 80 pages of appendices.

Buchwald previously gave us excellent histories of optics and electromagnetic theory in the 19th century: *The Rise of the Wave Theory of Light* (University of Chicago, 1989) and *From Maxwell to Microphysics* (University of Chicago, 1985). This account of Hertz's experimental work is a worthy successor to those volumes. I strongly recommend it.

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The Physics of Liquid Crystals

▶ P. G. de Gennes and J. Prost
Oxford U. P., New York, 1993. 597 pp. \$90.00 hc ISBN 0-19-852024-7

The past 20 years of theoretical and experimental liquid crystal research have been very fruitful. This is especially true in the area of smectic liquid crystals, marked by the discoveries of the twist-grain boundary phase (the liquid crystal analog of the Abrikosov flux lattice in type-II superconductors), the breakdown of conventional elasticity and hydrodynamics and the existence of frustrated smectic phases. A nearly complete understanding of the fascinating cholesteric blue phases has also been obtained. More recently there has been a flurry of theoretical activity regarding nematic polymers as well as large-scale numerical simulations of low-molecular-weight and polymeric liquid crystals.

The Physics of Liquid Crystals by Pierre-Gilles de Gennes and Jacques Prost is an update and revision of de Gennes's classic volume of the same title published more than 20 years ago. In revising the first edition, the authors have chosen to focus on some but not all of the important developments since then. Even with the omissions the book is nearly 600 pages long (nearly twice the size of the first edition), so some judicious selection of topics was certainly required. The new material focuses on smectic and columnar phases, with the single chapter on smectics in the first edition expanded into four chapters covering the statics, dynamics, defect structures and phase transitions of smectic and columnar phases. The first edition's chapters on nematics and cholesterics have been updated to some degree, most notably with the addition of a lengthy discussion of the cholesteric blue phases. Some of the