very well translated from Russian by P. J. Shepherd. In the first three chapters (half the book), Zubarev discusses the basic foundations of statistical mechanics dealing with classical and quantum systems in equilibrium and driven by mechanical perturbations. The last chapter details the method of the nonequilibrium statistical operator, which was principally developed by the author and his research group.

Throughout, discussions are thorough and thoughtful with logical and straightforward presentations. The college professor who teaches a course in statistical physics at the upper undergraduate or first-year graduate level may find the first half very helpful because Zubarev discusses many questions about the foundations of statistical mechanics that are glossed over in standard textbooks—and he clearly points out what has been established and what has not. In other words the book serves as a first-rate reference about these questions.

The second half is considerably more difficult to follow; it deals with more complicated nonequilibrium processes. He introduces the more involved physical concepts as well as the more sophisticated mathematical tools. This part will be useful for study by advanced graduate students and researchers. In summary, the monograph is an excellent addition to the growing literature in nonequilibrium statistical thermodynamics.

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Introduction to Quantum Optics

H. M. Nussenzveig
246 pp. Gordon and Breach, New York, 1973. $19.95

Physics has been profoundly influenced in the last three decades by the availability of sources in different octaves of the electromagnetic spectrum. The 1950's saw the application of coherent radio and microwave radiation to the elucidation of atomic, molecular and even field-theoretic physics. Nuclear magnetic resonance is a prime example of the first two, while the Lamb shift and anomalous moment of the electron shook field theory out of the doldrums. With the advent of the laser in the early 1960's physics again took a great leap forward. As an intense source of electromagnetic radiation, the laser led to the field of nonlinear optics, and its unique coherence properties led to many fascinating phenomena such as photon echo, self-induced transparency and optical nutation. The great bulk of the electromagnetism mentioned above is most appropriately described via the classical Maxwell equations. However, in many laser-based problems, the quantum nature of the electromagnetic field is apparent; this observation has occasioned much study over the past ten years. For example, the fundamental understanding of the linewidth and photon statistics of laser radiation requires the quantum theory of radiation. It now appears likely that the 1970's will see the advent of the x-ray laser and the quantum properties of the emitted radiation will be of even greater interest.

It is in this context that H. M. Nussenzveig's *Introduction to Quantum Optics* fits. It begins by developing the notion of coherence in the electromagnetic field both classically and quantum mechanically and applies these concepts to such topics as laser theory and superradiance. It is perhaps worth noting that "Dicke-superradiance" has not had much impact on laser physics to date, but with the advent of uv and x-ray lasers (involving swept excitation), it promises to be of considerable interest. This has been borne out by recent studies. Nussenzveig has consistently aimed his presentation at the maximum

physics for the minimum mathematics. Naturally the full machinery of the quantum theory of radiation is necessary in a large fraction of the book's efforts, but even in the most technical cases he has represented the material in a clear, concise and pedagogically appealing fashion. This book should be of interest to the beginning student and should have appeal to the researcher wishing to review certain aspects of quantum optics. This timely book promises to have enduring value over the next years and fully deserves the warm reception that I believe it will be accorded.

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The Discovery of the Conservation of Energy

Y. Elkana
213 pp. Harvard U. P., Cambridge, Mass., 1974. $8.50

Particularly for the teacher of physics, Yehuda Elkana's new and important book is a carefully documented treatment of the physics, biology and philosophy that was brought to bear on trying to understand the nature of force, heat, and energy and their conservation. It is a highly useful study, and Elkana, who is in the department of history and philosophy of science at the Hebrew University in Jerusalem, pursues the subject in an interesting and clear manner.

The main theme of Elkana's thesis centers on the work of Hermann Helmholtz, but he carefully lays the foundation for his discussion of Helmholtz's 1847 paper "Über die Erhaltung der Kraft" by first analyzing the tradition in mechanics, then discussing various studies in heat and energy and he includes a chapter devoted to explaining the contribution of physiologists in their search for the origins of animal heat.

Elkana analyzes Helmholtz's work in depth both from a physics and philosophy point of view, and taking as his motto a quote from H. A. Kramer: "In the world of human thought generally and in physical science particularly, the most fruitful concepts are those to which it is impossible to attach a well-defined meaning."

The book concludes with a discussion of the origin and growth of Helmholtz's scientific metaphysics and its influence on the maturation of the concept of the conservation of energy.

Students of nineteenth-century physics may quarrel somewhat with Elkana's enthusiasm for the pioneering contributions of Helmholtz to the detriment of James Joule, Couling and J. R. von Mayer, but the careful documentation he presents is persuasive in its detail and useful in its commentary. The analysis of the work of Count Rumford, Sir Humphrey Davy and Michael Faraday in particular, I found very interesting. Elkana emphasizes the lack of any conservation concepts in Rumford's contributions, Faraday's commitment to the conservation of force and gives rather more credit to Davy than many students of the subject would feel to be appropriate. The author has a very gentlemanly style of presentation and appears to be much more tolerant of Davy's early experiments on the nature of heat than most physicists who have analyzed their details would accept.

One rather odd coincidence is illustrated by the book's dust jacket. It features a large steam engine with the quote "Science owes more to the steam engine than the steam engine to science." Yet in the discussion of the "simultaneous discovers" of the energy conservation principle Elkana specifically rejects the thesis that a concern with engines was an important factor, particularly in the work of Sadi Carnot, and throughout the book relies much more on the philosophic conceptions of the scientists than any technological influences.

The book is a stimulating addition to the literature of 19th-century physics and should prove interesting to historians of science, physicists and philosophers alike.

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Experimental Principles and Methods Below 1 K

O. V. Lounasmaa
316 pp. Academic, New York, 1974. $20.25

It boggles the imagination to contemplate the thousands of manhours of wasteful, redundant effort that this book will eliminate. In a pioneering research area such as millikelvin cryogenics, where the basic impediment to progress is experimental technique, the appearance of a book such as this one is a godsend to the experimenter. Even an inferior book written by a novice would be useful because it would invariably contain at least a few hints or tricks that would save untold effort. Hence Olli Lounasmaa should be plaudited for merely undertaking the project. The fact that he is an expert in the field (he has established in Helsinki one of the world's leading low-temperature