society, especially those of nuclear arms. His views on such matters strike me as sound and realistic.

One gathers that Peierls and his wife Genia took difficulties in their stride also in their practical life. He writes lightheartedly about boats and trains nearly missed, about broken-down cars and about moving house with a six-week-old baby. The generous hospitality of the Peierlses is in line with that attitude.

It is almost unavoidable that a book of this kind, written largely from memory, will contain some inaccuracies. For instance, Hanni Bretscher did not take part in the climb of her husband Egon and Felix Bloch during which Bloch fell down and broke a leg. Liquid helium does not show a strange behavior below 4.2 K (the boiling point), but below the lambda point, 2.19 K. Another criticism might be that the enumeration of a large number of students, coworkers and visitors, often without much detail, is not particularly meaningful to someone who has never met them. But such minor points do not detract from the value of this entertaining and instructive odyssey.

There is one serious omission. In his early work Peierls explained the positive Hall effect. He was the first to show that an unoccupied state near the top of an energy band behaves as a positive particle. That much we find in the book. But the notion of positive holes has become an absolutely indispensable element of solid-state electronics. Without it our present-day computers, calculators, quartz watches and so on could not have been designed. Writers on the history of solid-state electronics often fail to mention that it was Peierls who introduced that notion, and he himself does not stress the point. As a reviewer of his book I consider it my duty to do so.

Accretion Power in Astrophysics

J. Frank, A. R. King and D. J. Raine
262 pp. Cambridge U.P., New York, 1985. \$59.50

The process of accretion by celestial objects has gained considerable new interest in recent astronomical research because of the discovery of "compact (binary) x-ray sources." These stellar-sized x-ray emitters are thought to be neutron stars onto which is falling matter from a companion star (around which the compact star is also revolving). Because the gravitational field on the surface of a neutron star is some 10^{11} times that of the Earth, the matter arrives at very high velocities (at substantial fractions of the speed of light). The associated kinetic energy is deposited partly in an "accretion disk" that forms around the neutron star and serves to remove the matter's relative angular momentum, and partly on the stellar surface. The energy lost by friction in the disk and on impact at the surface is radiated mainly at x-ray wavelengths for accreting neutron stars or putative solar-mass black holes, but may be radiated as well at longer (uv and optical) wavelengths for accreting white dwarfs ("cataclysmic variables") or very massive black holes (active galactic nuclei? quasars?).

Accretion Power in Astrophysics, written by researchers in the field, is a first attempt to summarize knowledge of accretion physics, accumulated from hundreds of research papers, in a comprehensive, rather concise graduate-level book. It will provide the student and the interested professional astronomer or physicist with a solid introduction, long overdue, to a fascinating topic.

The book starts off with the basic concepts and such key words in accretion jargon as the "Eddington limit," describes the expected spectra and goes on to summarize gas dynamics, steady spherically symmetric accretion and plasma and shock dynamics before covering accretion of high-angular-momentum matter in binary systems. In this last section the authors discuss the so-called Roche lobe and the all-important sources of viscosity and, subsequently, disk formation. Disk physics is described in some detail: the relevant time scales (dynamical, viscous and thermal); steady, thin disks and their spectra; and instabilities and time-dependent phenomena. The book then takes us from the disk to the compact object itself. It describes boundary layers between disks that extend all the way to the stellar surface (low magnetic fields) and boundary layers for a strongly magnetized neutron star or white dwarf, where the disk terminates outside the star. This is the case when an equilibrium stellar period can be established, at which the accretion torques on the star vanish. A very detailed (perhaps too detailed) discussion of accretion columns comes next, followed by a short (maybe too short) discussion of black holes.

Most of the remainder of the book deals with the large accreting objects that may be the working parts of quasars and active galactic nuclei. The authors describe the basic radiative properties of these objects in a very useful summary and mention briefly three models for the nucleus, along with their pros and cons. Of the three, they suggest, along with many workers in the field, that supermassive black holes are the best models for quasars and active nuclei. They thus go on to analyze the supply of gas for accretion and the possibilities of spherical and

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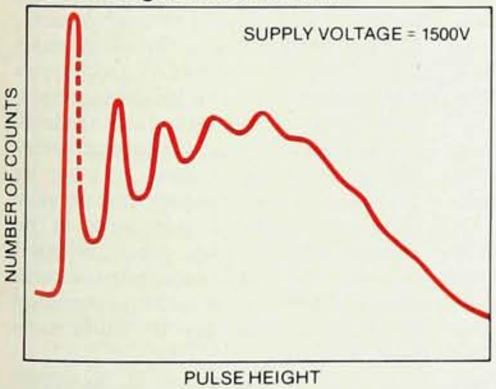

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disk accretion onto the supermassive black hole. Both of the widely accepted models—the electrodynamic model and the thick-disk model—are described simply and eloquently, leaving the reader with the desire to investigate some of the topics further on his own.

I liked the style and order of presentation the authors chose for summarizing this modern zoo of phenomena and theories, and I agree with their choice of topics and the relative space devoted to them. The fundamental physics is always given in a simple manner, while more elaborate considerations and calculations are represented by graphical results. Many problems still remain in the understanding of accretion. For example, spectra of low-mass x-ray binaries indicate deposition of relatively more energy in the disk than is expected from the simple models; star-disk torques are probably the cause and our knowledge of them is far from complete. But this book manages to describe much of the basic framework for understanding accretion power in astrophysics in a simple, confident manner—whence it mostly draws its charm.

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Statistical Optics

Joseph W. Goodman
550 pp. Wiley–Interscience, New York, 1985. $44.95

Amplitude and phase fluctuations are universal features of electromagnetic fields, especially in the visible region of the spectrum. The vast majority of natural sources radiate through a chaotic sequence of elementary emission processes so that even after careful filtering they still resemble random signal generators more than they do well-designed electrical oscillators. Even a highly stabilized continuous-wave laser is only an approximate realization of the ideal electromagnetic disturbance because even the best laser sources are not immune from measurable fluctuations as a result of spontaneous emission, mechanical vibrations and other disturbances.

One of the tasks of statistical optics is to characterize these fluctuations and to indicate how one can detect and identify them. One needs to know how random disturbances propagate through communication channels, how they degrade the response of an optical system and how the resulting signals can be corrected and restored to reproduce the ideal undistorted image as faithfully as possible. This is a tall order indeed, one that requires the successful fusion of probability theory and traditional optics, and the development of sensible models of the real physical systems.

Ultimately, even under the best circumstances, optical signals must be processed if one is to extract useful information, and detectors introduce their own brand of defects into the incoming messages. One example of the type of breakthroughs possible with the ingenious application of statistical approaches is stellar speckle interferometry, invented by A. Labeyrie in 1970 and demonstrated on real-life astronomical observations by D. Y. Gezari, Labeyrie and R. V. Stachnik. This procedure can, in effect, "restore" the high-spatial-frequency information of star images that is lost as a result of atmospheric aberration.

Recognizing that statistical optics should be viewed as a standard component of any advanced optics curriculum, Joseph Goodman intends the text reviewed here to be valuable to both optical and electrical engineers and also useful for physicists. Goodman is a recognized expert in and contributor to this area of research, and he has been able to strike a balance between a strong physical orientation and a rigorous mathematical description. Thus I expect *Statistical Optics* to be useful both for the theoretically inclined student or researcher and for the more applications-oriented reader, who may want to know how a particular technique pertains to the solution of a given problem.

The book is designed as the major text for a full 15-week course, but according to the author it can also be useful for a single-quarter course if the student already has a good grounding in probability theory, stochastic processes and Fourier methods. The first three chapters, dealing with random variables and random processes, are so well done, however, that it would be a pity if they were skipped simply for lack of time.

Optics begins in Chapter 4 with a discussion of first-order coherence for polarized and partially polarized thermal sources and for laser beams. Of necessity the description of the laser is somewhat sketchy (it would be impossible to expect more details in the context of a classical presentation), but I was pleasantly surprised that some of the best-established statistical properties of lasers are well represented. The discussion continues, in the next two chapters, with the concepts of coherence of optical waves and higher-order coherence. The framework of these chapters is traditional but the style is modern and the treatment quite accessible to the advanced graduate audience to which they are directed.

The chapter on the effects of partial coherence on imaging systems is an outstanding survey of a broad field that could easily suffer from an excessively mathematical approach. Goodman has succeeded in developing the relations that exist between object and image in a logical way while taking full account of the coherence properties of light. Approximately the last third of this chapter deals with interferometric imaging systems, showing how measurements of light coherence at the receiving end can effectively be used to provide useful information about the source.

Another important aspect of image formation is the signal degradation imposed by the medium through which the waves propagate. Goodman's treatment assumes that light is produced by incoherent radiators and that it propagates through media whose characteristic scales of inhomogeneity are much larger than a wavelength. A more general treatment would have required a considerably greater effort—with doubtful pedagogical results, in view of the increased complexity of the subject matter. The discussion of stellar speckle interferometry in this chapter is one of the most lucid and complete that I have seen at an introductory level.

The last chapter of the book is concerned with light detection by photosensitive systems. It contains a useful survey of the semiclassical theory of photodetection along the lines of the early pioneering studies of the mid-1960s. The emphasis is on the photocount statistics of the traditional models of light sources (thermal, coherent, partially polarized and so forth), with a few pages devoted to the problem of the intensity correlation. A minor limitation of the semiclassical approach is that it precludes the analysis of one currently fashionable area of research, the squeezed states of the electromagnetic field. In view of Goodman's pedagogical aims, this limitation represents quite an understandable tradeoff.

The book contains three mathematical appendices, a good number of problems in each chapter (but no solutions) and selected references to research articles and other relevant sources. The text is definitely a success and is likely to remain a standard reference in this area for quite some time to come.

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Astronomy and Astrophysics Abstracts, Vol. 39: Literature 1985, Part 1. S. Böhme, U. Esser, W. Fricke, H. Hefele, I. Heinrich, W. Hofmann, D. Krahn, V. R. Matas, L. D. Schmadel, G. Zech, eds. 1149 pp. Springer-Verlag, New York, 1985. $79.00. *Bibliography*