

grubby battle, the aristocrat providing witty and slightly malicious comments on the struggles of the deeply engaged. From time to time, with a pithy remark and a clever piece of calculation presented in a somewhat indifferent manner, he could make—as in the matter of the hydrogen bomb—a contribution of very great significance. All along, one had the feeling that he was a visitor from another world, the world of pure mathematics. Other things—physics, politics, human affairs—although of some interest, were not enough to stir one deeply. This attitude is not a pose, it is the essence of this remarkable personality.

I have not attempted to assay the importance of Ulam's mathematical contributions as they are detailed in this book, because I am not at all equipped to do so. The reader, if he is a mathematician, will find a wealth of topics on which Ulam worked and suggestions and hints of further work. He will also meet briefly some of the great mathematicians of our time as they are refracted in the prism of Ulam's experience.

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Beam and Fiber Optics

J. A. Arnaud

447 pp. Academic, New York, 1976.
\$34.00

The announcement in 1970 by F. P. Kapron, D. B. Keck and R. D. Maurer of the Corning Glass Works that they had produced a glass fiber that would transmit light efficiently over long distances made optical communications a practical possibility and led to an increased effort to understand the fine details of light propagation in fibers. (The announcement appeared as "Radiation Losses in Glass Optical Waveguides" in *Appl. Phys. Lett.* 17, 423, 1970.) In large part this book is an outgrowth of that effort, although a good deal of the material is concerned with guiding systems that predate the fiber.

The Corning people demonstrated that 1% of the light introduced at one end of a kilometer-long fiber could be recovered at the other end. At present, the fiber can be 10 km long with a 1% optical-power recovery, which is a plentiful percentage by communications-systems standards. In the pre-1970 days, the 99% figure for optical-power absorption and scattering loss occurred in fibers that barely reached across the room. While lossy fibers of that kind were not of much use for communications, they were fine for other applications. These applications included endoscopy (in which fiber bundles are used for viewing inside the body), image intensification (fiber bundles are em-

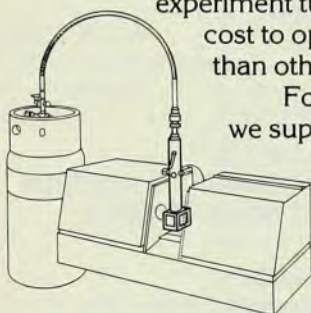
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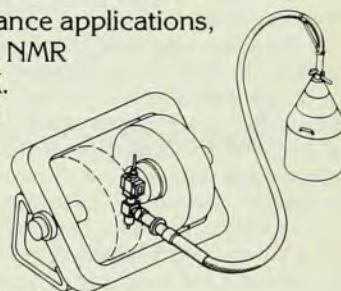
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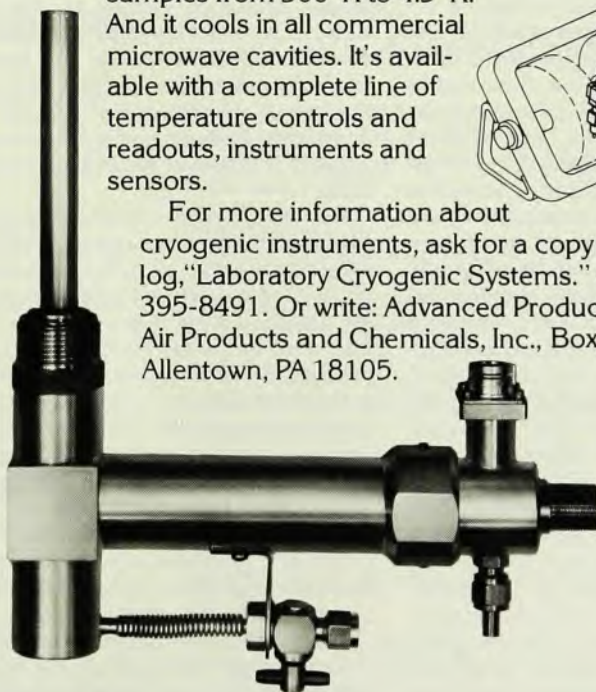


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New high-capacity optical fiber at right transmits 65% of initial laser-light intensity, versus 1% for fiber at left. From Philips Laboratories (Aachen, W. Germany).

played as components in intensifier tubes to transmit a digitized image), and the familiar illumination exotica where fibers provide what for some is an aesthetic distribution of illuminated points. To deal with the analysis of the electromagnetic problems associated with these applications, a book like N. S. Kapany's *Fiber Optics* (Academic, New York, 1967) provided just about everything you wanted to know.

At the same time that the lossy-fiber applications were being pursued, there was a substantial effort to explore the light-guiding potentialities of various lens and gas-filled-tube systems in order to see if a practical transmission line could be developed—one that would permit the eventual utilization of the bandwidth the laser had made available. Jacques Arnaud contributed to this effort as well as to the analysis of fiber propagation, and the present book represents, in substantial part, an expansion on his efforts in these fields. His experience parallels that of Dietrich Marcuse in many ways; this book covers much the same ground as do Marcuse's two books on the subject: *Theory of Dielectric Optical Waveguides* (Academic, New York, 1974) and *Light Transmission Optics* (Van Nostrand Reinhold, Princeton, 1972).

The book itself concentrates on analysis techniques for optical guiding systems, although other topics such as physical aspects of fiber and gas lens fabrication are also discussed in brief. Arnaud describes both ray-theoretic and wave approaches. The book sticks fairly close to the author's research, with the result that some topics are dealt with in unexpected detail (for example, several pages are devoted to the effect on loss and coupling of a layer of silver placed between dielectric slab guides), while other topics, such as the Goos-Hanchen shift near incidence at

the critical angle, are given too brief dismissal.

The book fits in as a useful addition to the texts associated with optical communications. The approach is generally unorthodox, with early analogies drawn between wave mechanics and light-beam propagation and with the introduction of Maxwell's equations held off until nearly halfway through the book. This approach may have a special appeal to some readers. On the debit side, the book suffers from a parochialism in the literature citation and in a lack of clarity in the derivation of some basic concepts. On the credit side, there is a great deal of useful material concerning propagation in lens, fiber and film systems; bending losses, pulse dispersion and coupling characteristics, and ray approaches to the solution of resonator and guiding problems. The optical communications researcher will do well to add Arnaud's book to his library.

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The Elementary Language of Solid State Physics

M. H. B. Stiddard

188 pp. Academic, London, 1975. \$14.00

This book presents a brief but not particularly elementary introduction to solid-state physics. For those who wish to tackle solid-state physics for the first time, its compact size may be appealing. One should note, however, that because this book was written "primarily as an aid to students of chemistry," physics students may find some of the discussions phrased in language somewhat foreign to them.

Because Melville Stiddard intended *The Elementary Language of Solid State Physics* to serve as a bridge between physical chemistry and solid-state physics, one should ask how well it does this job. Part of the answer emerges from a brief survey of the topics covered, which go beyond those in a typical physical-chemistry textbook. The treatment of crystal symmetry is quite detailed and includes an introduction to tensors and their transformational properties. Stiddard discusses the ideas of reciprocal lattice and Brillouin zones, introducing concepts that form a necessary background to the solid-state literature. The chapter on lattice dynamics includes a section on the vibrational modes of a diatomic lattice, as well as a very brief introduction to phonons. In his discussion of the free electron gas, he derives the density of electron states and uses it in conjunction with the Fermi-Dirac distribution function to calculate the electronic heat capacity, the Richardson-

Dushman equation and the Pauli spin magnetization. Stiddard also gives a very condensed discussion of electron-transport properties using the Boltzmann equation. The longest chapter covers band structure and includes such topics as the nearly free electron model, the tight-binding approximation, effective mass, the Fermi surface and the temperature dependence of the conductivity of semiconductors.

From the above summary, one may see that the author covers a reasonable selection of topics but does not attempt to treat the whole field of solid-state physics. Many of the topics are clearly and interestingly presented. For instance, I was intrigued to learn that the pressure of the electron gas in a metal is about 10^4 atmospheres. However, several topics, such as phonons and the Fermi surface, Stiddard has introduced so briefly that their significance is not readily apparent. He presents very few experimental data, so the reader will have to go elsewhere to learn about properties of real materials.

A weakness of the book is that the level of background expected of the reader varies greatly from section to section. In the chapter on the free electron gas, the author has written an introduction to quantum mechanics on a quite elementary level. In a later discussion of energy bands, however, he uses degenerate perturbation theory. This section and others would prove difficult for a reader without more extensive knowledge of quantum mechanics. Another problem the reader will encounter is a number of typographical and other errors. One particularly misleading derivation indicates that the wave vectors that label Bloch functions must be reciprocal lattice vectors.

I think *The Elementary Language of Solid State Physics* will find its most ready audience among physical-chemistry graduate students and research chemists who are initiating investigations of the solid state. For these readers the book should provide a useful background for further study of the field.

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Introduction to Liquid State Physics

C. A. Croxton

283 pp. Wiley, New York, 1975. \$26.50

In his preface Clive Croxton writes "This book was written in the belief that the theory of liquids is now ready for dissemination to a wider and more general audience—to chemists, metallurgists, biophysicists and engineers, not to mention the non-specialist physicist who also needs to know something of the liquid state." He is probably correct. Over the