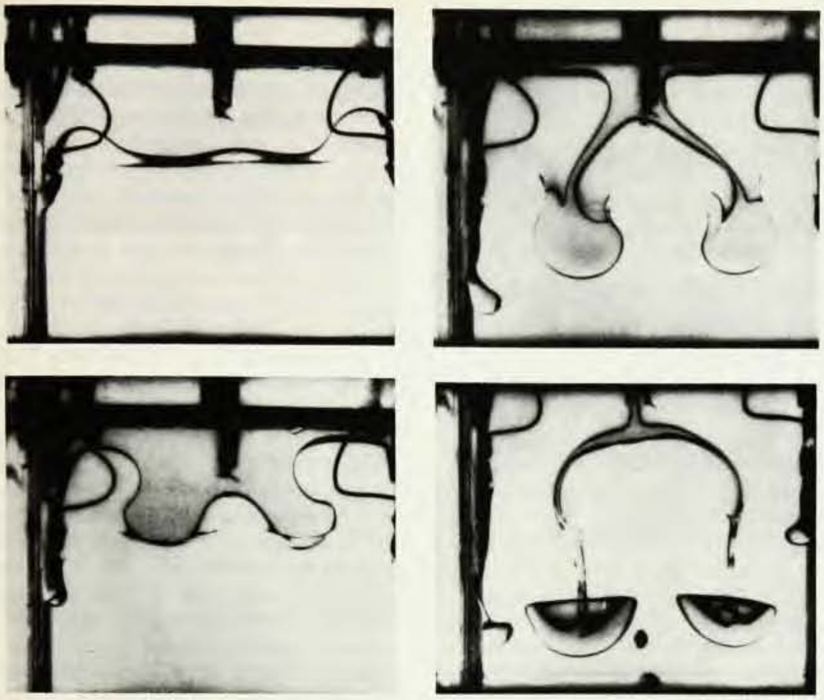

Developing instability that occurs when the field holding a heavier liquid over a lighter liquid is shut off. These stills from the film *Complex Waves II*, produced by the National Committee for Electrical Engineering Films and distributed by Education Development Center, appear in *Continuum Electromechanics* by J. R. Melcher (MIT P., Cambridge, Mass., 1981. $37.50). The book, designed to be used as a graduate-level text and engineering reference work, presents an interdisciplinary account of the interaction of electromagnetic forces and ponderable media, the mechanical responses to electromagnetic fields, and the reciprocal effects of the material motions produced by those fields. It also treats such diverse applications of continuum electromechanics as design of rotating machines and synchronous generators, polymer processing, magnetic melting and pumping in metallurgical operations, and processing of plastics and glass.

the same in all inertial frames of reference (the principle of relativity), and that the speed of light was invariant. Miller shows that Einstein quite explicitly strove to develop special relativity on the basis of macroscopic postulates, because his contemporaneous investigations of the photoelectric effect had convinced him that Maxwell's equations were inadequate on the microscopic level and had made him suspicious of any attempts to *derive* the principle of relativity from atomic theory. Thus Miller brings out an essential feature of Einstein's theory, that Einstein brilliantly foresaw the difficulties involved in merging atomic and electromagnetic theory, which were only to be resolved many years later in quantum electrodynamics, and therefore presented special relativity in a formulation that was independent of any atomic hypotheses. Moreover, because Einstein's approach was basically an alternative formulation, which achieved Lorentz's mathematical results on a very different conceptual basis, one can understand the slowness of the physics community to accept it fully. The attention of most physicists was focused on the rival electronic theories. Which version of the "Lorentz–Einstein" theory was preferable seemed to be of secondary importance. And in *fact* the initial experimental evidence appeared to refute their theory. It was only over the next five years that the experimental findings began clearly to favor special relativity.

The strength of Miller's book is that it provides a subtle appreciation of the debates over the acceptability of special relativity—by no means a simple clash of Newtonian and Einsteinian ideas—and allows one to evaluate more critically the views of Kuhn, Popper and others. Its weakness is that the explanation of the physical ideas is hard to understand. The technical discussions are difficult to follow even for someone with advanced training in physics. For example, we are told that Einstein's version of special relativity actually did make some predictions different from Lorentz's concerning the relativistic Doppler effect, but it is not made clear exactly how this can be so, given the mathematical similarity of the two theories. In addition, Miller has included, for historical completeness, material that interrupts the essential conceptual development of the book. Unfortunately these problems make the book less readable for the general audience of physicists and philosophers, which it deserves since it is a valuable contribution to our historical understanding of the nature of theory change in science.

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Optical Physics. Second Edition

S. G. Lipson, H. Lipson
463 pp. Cambridge U. P., New York, 1981. $55.00 cloth, $22.50 paper

The steady growth of optics in physics and engineering curricula has caused a gradual replacement of many of the traditional workhorses of the past twenty years with a new generation of textbooks in which the conventional development of classical optics has been blended with the advances of the laser era. Most successful new books—*Optics* by E. Hecht and A. Zajac, for example—owe some of their popularity to the authors' awareness of the thinning of the boundaries between optics and current technologies and to their abilities to convey the logical continuity between optics and the rest of modern science.

In the first edition of *Optical Physics* (1969) while S. G. Lipson and H. Lipson developed the traditional principles of optics, they emphasized the applications of these principles to other branches of physics. The second edition has undergone extensive revisions, additions and updating, while it has kept the original unifying concept: It stresses the existence of common traits between traditional optics and, say, electron microscopy, crystallography, astrophysics and radioastronomy. This insistence is a useful and valuable feature.

However, with this laudable concern, the authors might have covered several topics more extensively. Discussions of nonlinear optics, Fourier optics, thin films, lasers and synthetic apertures, for example, may not supply material required for adequate coverage in the classroom.

The chapters dealing with wave propagation, interference and diffraction are probably the best sections of the book. These subjects, properly based on Fourier analysis, are presented in informal and generally clear language. Other chapters are weakened by omissions. The treatment of polarization, for example, depends too much on formalism and not enough on more applied aspects; the development of optical instruments and image formation contains detailed coverage of the imaging problem, the effects of finite apertures and the coherence of the illuminating source, but only a limited survey of common optical instruments. These are not serious shortcomings and could be remedied in a future edition, if the authors are so inclined.

The chapter on coherence devotes a fair number of pages to spatial and temporal coherence, light fluctuations and photon statistics, which I consider important and, indeed, essential entries in a modern textbook. It falls short, however, with the description of the laser as a source of coherent light. There is a definite inconsistency in stressing, on the one hand, the coherence of laser light and in explaining, on the other, the physical operation of this device in terms of spontaneous and stimulated emission processes. There is no easy way, in my opinion, for an inquisitive student to understand from this section the ultimate (and simple) reason why laser light is not just a highly monochromatic version of a thermal source.

An unusual and possibly questionable aspect of this book is that geometrical optics and the study of aberrations are relegated to two sketchy appendices and a few isolated comments and figures (see, for example, Chapter 9, concerned with image formation through optical instruments). While this is not inconsistent with the approach the authors state in the preface, potential users of this book will do well to keep this limitation in mind, especially since most students approach their first intermediate optics course with only a rudimentary knowledge of geometrical optics.

The appendix on Fourier transform computations is an excellent idea that should encourage the use of the many readily accessible minicomputers for numerical studies. Perhaps a future edition of this book may take advantage of this welcome break with tradition and require students to become more actively and systematically engaged in numerical work.

My general impression is that this book will find only limited use as the sole textbook in a traditional course because of the background knowledge of some conventional topics that it requires of students. In a typical curriculum, in which intermediate optics is the only course on this subject that physics and engineering students may elect to take, this book may play a useful role as a side reference. For other institutions, where optics represents a major program, these comments may not be appropriate. Thus, while not enthusiastic about the approach and selection of topics, I do not find myself with serious reservations. *Optical Physics* may offer teachers of optics some useful and broad-ranged supplementary information for their courses.

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Optical Fiber Transmission Systems

D. Personick
179 pp. Plenum, New York, 1981. $25.00

Optical Fiber Systems and Their Components: An Introduction

A. B. Sharma, S. J. Halme, M. M. Butusov
246 pp. Springer, New York, 1981. $38.35

Optical Fiber Technology, Vol. II

C. Kao, ed.
343 pp. IEEE, New York, 1981. $29.95

Optical fiber communication systems, which only a few years ago were considered nothing more than laboratory curiosities by many "hard-nosed" engineers, are at this moment being introduced into almost every area of telecommunication. As even more research and development effort is turned toward this area, three books have made timely appearances, each intended to fulfill a particular need different from the others and each succeeding in its mission. D. Personick's *Optical Fiber Transmission Systems* is a textbook oriented toward practical applications. *Optical Fiber Systems and Their Components*, by A. B. Sharma, S. J. Halme and M. M. Butusov, is a textbook with a decidedly academic leaning. C. Kao's *Optical Fiber Technology*, a collection of articles, is a handy reference.

Optical Fiber Transmission Systems covers a broad range of topics with impressive depth. Personick presents his material in a thorough, concise, yet entirely readable manner. Many practical "tips" and the liberal sprinkling of typical numerical values throughout the book make it useful for the novice system designer. The "specimen specifications" given from time to time ingeniously acquaint the reader with the state-of-the-art properties of optical transmission devices.

BELL LABORATORIES

While problem sets at the end of each chapter suggest that Personick intends the book to be an undergraduate text, an unevenness in the level of presentation is apparent. Chapters 1, 2, 4 and 5 are significantly more elementary than Chapter 3. There is also a disparity between the levels at which physical and electrical engineering concepts are presented. For example, while the critical angle of incidence is carefully defined, decibels are assumed to be known by the reader.

Chapters 1 and 2 provide excellent background for a qualitative understanding of optical fiber systems and a good background for the quantitative material in Chapter 3. Chapter 1 covers fibers and fiber making, propagation in fibers, LED and diode laser sources, positive–intrinsic-negative and avalanche-photodiode detectors. Chapter 2 discusses digital signal formats, error rates and practical constraints.

Chapter 3 is not as easily readable as the other chapters because of its high information density. The topics include transmitter design, receiver design, fundamental sources of noise and their properties and avalanche gain. Performance calculations are made for binary digital receivers, analog receivers and the impulse responses of fibers. The completeness of the presentation is marred somewhat by the omission of heterodyne detection.

In Chapters 4 and 5 Personick returns to the very readable style of the early chapters. Chapter 4 discusses modes and coupling of light into the fiber; source noise (both beat noise and mode hopping); delay distortion; tradeoffs between coupling efficiency, loss and delay distortion; and examples of typical systems (both digital and analog). Chapter 5 describes applications in telephone trunk plants, telephone loop plants, cable television and telemetry. Although the typical numerical values given for the parameters discussed are, in general, quite representative of the current state of the art, one exception occurs when the duct cost given in comparing optical fibers with conventional cables is too high, perhaps by more than an order of magnitude, and the conventional cable is undersized, by a factor of 2. The distorted values tend to bias the outcome of the comparison very strongly in favor of optical fibers.

Personick has written an excellent, readable introductory text for optical communication engineers. The in-depth analysis of system performance in Chapter 3 should become a classic in the field (which is only fitting since much of it is based on Personick's own