gular, and perturbation theory should have a finite radius of convergence." I believe that the conclusion that the first-order phase transition persists is correct, but the reason is not, as there are strong arguments for a weak singularity at first-order phase transitions. I was also completely mystified by the statement on page 183 that "the expectation value [of a time-dependent correlation function] is not, of course, calculable within the equilibrium Gibbs distribution, which is time independent." Surely equilibrium distributions have well-defined time-dependent correlation functions.

I think this challenging book will prove very useful to those trying to learn the subject, provided that they take the time to read widely in the supplementary references. For many students it will be too difficult to read on its own.

David Thouless
University of Washington
Seattle, Washington

The Physics and Applications of Photorefractive Materials

Lazlo Solymar, David J. Webb and Anders Grunnet-Jepsen
Oxford U. P., New York, 1996.
493 pp. $135.00 hc
ISBN 0-19-856501-1

A little more than 30 years ago, physicists at Bell Laboratories were focusing an infrared laser beam on crystals of lithium niobate to produce green light by nonlinear optical second-harmonic generation. Continued exposure to the laser light left the crystals with a puzzling, inhomogeneous distortion of the refractive index, yet the crystals could be restored by heating or by uniform illumination. Two enduring truths about this "photorefractive" effect soon emerged: It occurs in nearly every material lacking inversion symmetry, and it has many potential applications.

The photorefractive effect is an unconventional nonlinear optical phenomenon occurring in materials that are photoconductive, have partially filled charge traps and exhibit a change in their refractive indexes in the presence of an electric field (see the article by Jack Feinberg, PHYSICS TODAY, October 1988, page 46). Under nonuniform illumination, charge carriers liberated in the bright regions diffuse into the dark regions and are retrapped, generating a spatially varying electric field that in turn changes the refractive index of the material through the electro-optic effect. The most common use of the photorefractive effect is in the recording and manipulation of volume holograms, which can store enormous amounts of information, perform complex parallel computations, amplify optical beams and correct distorted images, to name a few of the many applications demonstrated.

The last three decades have not been lacking in activity, and the subject presently occupies hundreds of scientists and engineers worldwide. The subject is mature and the time is right for a thorough and cohesive text like *The Physics and Applications of Photorefractive Materials* by Lazlo Solymar, David J. Webb and Anders Grunnet-Jepsen.

The book's first section is a clear and thorough development of basic photorefractive physics and will serve as a good text for those having some familiarity with physical optics and semiconductors. It first covers the properties of volume diffraction gratings and coupled wave equations and then the material response to illumination. It finally combines the two to describe the main dynamics of grating formation and two-beam energy coupling.

The second section, in part an annotated review of the literature, extends the analysis considerably. A long chapter reviews charge trapping and transport in real materials and their relation to photorefractive dynamics. Three more chapters describe the rich subject of dynamic multiwave interactions. The final section surveys many applications, concentrating on the big three: optical data storage, image processing and amplification and parallel computation. The final chapter includes a description of the one and only photorefractive device currently on the market, a narrow band interference filter produced by Accuwave, of Santa Monica, California. The three appendices introduce the reader to a more rigorous treatment of optical anisotropy, give a résumé of the electro-optic effect and outline techniques for determining the many material parameters found in photorefractive models.

The authors are candid about biases introduced by their experience and interests. As a result, most examples involve one particular material ($Bi_{12}SiO_{20}$), and there is substantial attention to moving gratings and AC field techniques. I would have displaced some of the latter with more coverage of *my* favorite topics—charge transport processes and photorefractive polymers—and photorefractive waveguides and liquid crystals also deserve some discussion. There is insufficient attention to the difficulties introduced by beam attenuation in nonsymmetric beam geometries and to beam fanning and spatial solitons. An annotated summary of the properties and growth of common photorefractive materials would have demonstrated the wide range of properties and helped the reader select materials for a particular experiment or device.

The Physics and Applications of Photorefractive Materials will be a valuable text and resource for many novice and experienced scientists and engineers. I learned many new and useful things from it and got a better picture of how the subject developed, both historically and conceptually.

Stephen Ducharme
University of Nebraska—Lincoln

Fundamentals of Semiconductors: Physics and Materials Properties

Peter Y. Yu and Manuel Cardona
Springer-Verlag, New York, 1996.
617 pp. $49.95 pb
ISBN 3-540-61461-3

Those who have taught graduate courses in semiconductor physics have often had to struggle with the appropriate selection of topics, what with the proliferation of new physics, new structure fabrications and new device applications. The authors of *Fundamentals of Semiconductors*, Peter Y. Yu and Manuel Cardona, have wrestled with the very same problem in courses they have taught, and they have come up with a concise and yet satisfactory list of topics. The most striking feature of their book is its modern outlook: a long chapter on both the electron and phonon properties in heterostructures, a survey of growth techniques and a discussion of the influence of defects on electronic properties. All of the