ing the classical division of the subject: the acquisition of structure-factor data followed by its interpretation. In summary, it remains an excellent introductory text, aimed at a chemistry and biology audience. Its strengths are its conceptual explanation of the physics of diffraction and its practical guidance in the solution of crystal structures.

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Scaling and Renormalization in Statistical Physics

John Cardy
Cambridge U. P., New York, 1996. 238 pp. $32.95 pb
ISBN 0-521-49959-3

John Cardy's *Scaling and Renormalization in Statistical Physics*, part of the Cambridge Lecture Notes in Physics series, is designed as a broad introduction to scaling and renormalization theory of phase transitions. Detailed theoretical discussions are avoided, and there is no attempt to look at the relation to experimental physics. No references to original sources are given, but there is an extensive bibliography for each chapter, referring to more detailed reviews of the topics covered. At the end of each chapter is a selection of problems.

The book opens with surveys of phase diagrams and mean field theory and then discusses renormalization group theory of simple critical points, taking the discussion up to but usually not beyond first-order perturbative results. The second half of the book discusses low-dimensional systems, surface critical behavior, random systems, polymers, critical dynamics and conformal invariance.

The first half covers material that has already been developed in most of the many treatments of the renormalization theory of critical phenomena that have been written in the past 25 years. I noticed at least one point where Cardy's text is seriously out of date: The table on page 100 shows a comparison of critical exponents calculated by the epsilon expansion, from the renormalization group equations and from high-temperature series expansions, and the author states that a significant discrepancy exists between the results given by the different methods. Ways to analyze confluent singularities were applied to this problem more than 15 years ago, and the discrepancies more or less disappeared.

Cardy has made significant contributions to almost all the topics covered in the second half of the book, and he has been one of the leaders in developing the use of conformal invariance in statistical mechanics, which is the subject of his last chapter. He writes as an expert, but I, who am much less expert in this area, found some of his economical explanations baffling. In places, I found his line of thought clearly stated and full of insight, but then lost the track and had to go back very carefully over the text. Cardy's choice of topics is good, but I am not convinced that he has provided sufficient detail for a reasonably good graduate student to follow his arguments.

In a few places, I thought that the author's desire to give a neat explanation led him astray. For example, in his discussion of the Blume–Capel model on page 62, he writes, "At finite but low temperatures, this first-order transition must persist for some distance into the phase diagram, since the thermodynamic quantities are not singular, 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.

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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