

tistical mechanics that has focused on phase transitions and critical phenomena. The usefulness of this new approach in disciplines as diverse as turbulence, gauge field theories and cosmology has made the teaching of statistical mechanics to graduate students especially important. I suspect that most people who have recently taught a graduate course in statistical mechanics see the need for a better, more modern textbook on the subject. Having taught just such a course for the past three years, I received these two books to review with great expectations.

The first of the books, *Fundamentals of Statistical Mechanics*, is based on lecture notes and an unfinished manuscript by Felix Bloch. As noted in the preface by John Walecka, who completed the text after Bloch's death, the book does not deal with the more recent (that is, post World War II) applications of statistical mechanics. Thus, this book would have to be supplemented in the classroom, a course of action in fact recommended by Walecka.

The text covers the fundamentals of both classical and quantum statistical mechanics, and it includes the "ancient" applications to classical ideal gases, blackbody radiation and the quantum ideal gases. Statistical mechanics is developed from the microcanonical ensemble and the ergodic hypothesis, both of which are very clearly presented. The general presentation in this text is very traditional. In the case of introductory statistical mechanics that is an admirable approach. The book contains none of the eccentricity that I feel mars the pedagogic efficiency of the books *Statistical Mechanics* by Shang-Keng Ma (World Scientific, Philadelphia, 1985) and *Statistical Physics, Vol. 1* by Lev Landau and Evgenii Lifshitz (Pergamon, Oxford, 1980).

Eighty-five problems supplement the text. Some simply fill in the gaps in the derivations, while others extend the range of the text. In sum, *Fundamentals of Statistical Mechanics* is a clearly written text on conventional statistical mechanics, and it is certainly suitable for an advanced undergraduate course (in which there is probably little time to treat modern applications) or for the first part of a broader graduate course.

Equilibrium Statistical Physics by Michael Plischke and Birger Bergersen takes a fresh approach to the writing of a statistical mechanics text. Although the book assumes that the student has already had some exposure to the fundamentals, the first two chapters review the basic

principles of thermodynamics and statistical mechanics. From that point on, the book plunges into phase transitions and modern applications, covering Landau theory, the renormalization group in real and momentum space, transport theory, the electron gas, and disordered-spin and electronic systems. A wealth of topics are treated. The recursion relations for the $O(n)$ spin model in $d = 4 - \epsilon$ dimensions are derived to $O(\epsilon)$ (without using graphs); the Bogoliubov theory of He^4 is presented, as are the coherent-potential approximation and the replica trick to provide a few examples. In my perusal of the text, I encountered no glaring scientific errors.

My concern about this text is its broad coverage. Judging from the table of contents, it could be used as a text for either a course on modern statistical mechanics (possibly even a two-semester course) or a course on advanced solid-state physics (many-body theory without graphs). That breadth leads me to believe that the presentation is at times too cursory for a textbook, and I wonder how well students could learn new concepts by reading it. To give a specific example: The authors briefly discuss long-range orientational order in two-dimensional solids in about ten lines (they don't opt for the more conventional terminology, "bond orientational order"). They define $\theta(r)$ as "the angle of a nearest-neighbor bond between two atoms," but give no reference to a global axis. In the absence of an accompanying figure, I don't see how a novice could understand this concept.

Nonetheless I believe the choice of problems is superb. The problems extend the coverage of the text to topics such as polymers, anisotropic spin systems and spin-polarized hydrogen. As the authors note in their preface, some of these problems are quite challenging and time consuming. In any case, because developing homework assignments for an advanced course can be difficult, their presence is certainly welcome. The book also includes many references to journal articles on topics of recent research. However, I found the index somewhat disappointing. For example, "orientational order" is not listed.

These two new books deserve to be considered for use in courses on statistical mechanics. Bloch's text is more suitable for an introduction to the fundamentals. The book by Plischke and Bergersen is an intriguing, fresh approach to modern statistical mechanics pedagogy, though its broad coverage is somewhat skimpy at

times, and reduces its effectiveness as a textbook.

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Solitons: An Introduction

P. G. Drazin and
R. S. Johnson

Cambridge U. P., New York,
1989. 226 pp. \$50.00 hc ISBN
0-521-33389-X; \$20.00 pb
ISBN 0-521-33655-4

The first important point to make about *Solitons: An Introduction* is that it is not a physics book. It is an applied mathematics text. The book contains very little in the way of physical examples or motivation for the equations and methods. A physicist, even a theoretical physicist, might have hoped for a book that kept closer contact with physical phenomena. Nevertheless, considering that the authors are applied mathematicians and taking the book on its own terms, it is generally very good pedagogically and intellectually.

The book is written in a colloquial and accessible style. The authors' use of a first-person-plural active voice makes the reader feel like a participant in the development of the methods. The authors alternate between the use of simple paradigmatic examples and more general discussions to introduce new ideas. In my view they have done a very good job of finding an appropriate level for their intended audience: senior undergraduate and graduate students in the physical sciences and chemistry. In addition, any researcher in physics who is thinking about doing work on solitons or who just wants to know more about the field for cultural reasons would do well to read this book.

The text covers a number of the most important topics on solitons, at least from a mathematical point of view. The Korteweg-de Vries equation is introduced in the first chapter and used as a prototype in much of the subsequent development. The second chapter presents a well-written, informal discussion of simple solutions to the Korteweg-de Vries equation. In later chapters other, more general methods of attacking nonlinear equations are described, often using the Korteweg-de Vries equation as a vehicle. Subjects discussed include inverse scattering methods, the role of conservation laws and integrability, the Lax approach, Backlund transformations, and the methods of Zakharov and Shabat, and of Ablowitz, Kaup, Newell and Segur. All of these subjects are presented in the same

accessible and pedagogically sensitive style that characterizes the earlier parts of the book. Each chapter is followed by useful exercises and references to the original literature.

Chapter 7 contains discussions of the Painlevé conjecture and of numerical methods. The discussion of numerical methods is not as successful as the rest of the book. It is too brief to be of any real use, and it consists of a simple recitation of various numerical approaches to solving nonlinear equations. The final chapter of the book is an epilogue that in the main attempts to give some feel for the dynamics of nonlinear evolution equations by using sequences of pictures of numerical results. These few pages are somewhat successful at accomplishing their purpose, but, given the constraints of the medium, the success will necessarily be limited.

Generally, this book achieves its goal. It is significantly more well written than most texts at a similar level. In addition to their achievements in research, the authors are clearly accomplished pedagogues. All things considered, I cannot think of a clearer introduction to the subject from a mathematical point of view.

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NEW BOOKS

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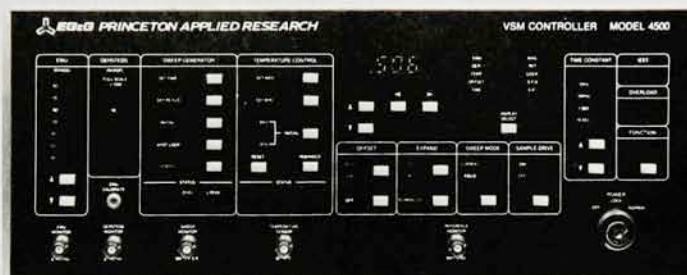
Resonant Heterogeneous Processes in a Laser Field. *Proceedings of the Institute of General Physics Academy of Sciences of the USSR 11.* V. A. Kravchenko, A. N. Orlov, Yu. N. Petrov A. M. Prokhorov, eds. (translated from Russian by S. A. Stewart). Nova Science, Commack, N. Y., 1989 [1988]. 253 pp. \$72.00 hc ISBN 0-941743-70-5

Biophysics and Medical Physics

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