

Chapter 3 introduces the formalism of nonlinear elasticity, and chapter 9 presumes knowledge of differential geometry. Students attempting to learn the more advanced subjects from the book will likely run into difficulties. For example, one of the most important facts about rubber is that it is nearly incompressible. That fact first appears in chapter 2 and is then invoked as needed without ever being explained. In chapter 3, the authors mention that “an arbitrary pressure may be added to the stress without affecting the motion of an incompressible body.” That point is true but similarly unexplained. To my taste, the theory in chapter 3 is harder to follow than the comparable discussion by L. R. G. Treloar in his third edition of *The Physics of Rubber Elasticity* (Oxford U. Press, 1975), which is not explicitly mentioned in the bibliography. (A paperback reissue of Treloar’s classic text is scheduled for publication in the US this coming winter.) Also, chapter 9, titled “Stability of the Spherical Shape,” for which the authors apologize as it contains only a negative result, is quite difficult to follow; but with a nicely readable history of rubber in chapter 11, Müller and Strehlow redeem themselves.

One of the intents of the authors is

to use balloons as the occasion to study certain fundamental ideas, including hysteresis and spontaneous symmetry breaking. Those ideas do arise in the investigation of balloons. Symmetry breaking emerges in the authors’ discussion of how rubber behaves when one stretches it along two axes. Hysteresis shows up somewhat less naturally through their examination of many balloons attached to a column at a fixed pressure. By the time the book gets around to hundreds of interacting balloons, the ideas are obscured by an artificial setting. For a study of hysteresis, the Preisach model in ferromagnetism is simpler and more standard.

Other shortcomings of the book, which include occasional bits of ungraceful English, are probably due to its origins in lecture notes. The publisher is selling the book, which was written, illustrated, and probably largely typeset by the authors, for \$60—or 50 cents a page. I find myself wondering how long the physics community will continue to support spending so much on such volumes when the proceeds do not go to the authors, high prices limit access to the work, and researchers support a distribution network that the internet is making obsolete.

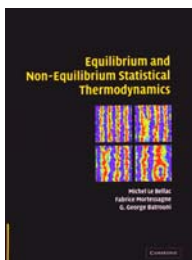
Price aside, *Rubber and Rubber Balloons* is an engaging supplement for courses on statistical mechanics or soft condensed matter physics. It provides a simple and familiar setting in which to explore some of the most important ideas of those subjects.

Michael Marder
University of Texas at Austin

Equilibrium and Non-Equilibrium Statistical Thermodynamics

Michel Le Bellac, Fabrice Mortesagne, and G. George Batrouni
Cambridge U. Press, New York, 2004. \$75.00 (616 pp.). ISBN 0-521-82143-6

As a physicist who has spent several decades in industry and only used statistical mechanics occasionally, I have lost track of new textbooks on the subject. For 25 years I was president of Data Transport Systems Inc in New York City and occasionally held visiting positions at many research organizations, including the Institute for Advanced Study in Princeton, New Jersey, and CERN. Now, retired to resume an academic life, I find it a pleasant task to browse new books.



My first task is to choose a textbook for a graduate course in statistical mechanics; the second, to locate a textbook that also helps define new research directions.

The first task, on pedagogy, is straightforward. I was educated in statistical mechanics, and among the traditional textbooks I used were *Fundamentals of Statistical and Thermal Physics* (McGraw-Hill, 1965) by Frederick Reif and *Statistical Mechanics* (Wiley, 1963) by Kerson Huang. Compared with those texts, *Equilibrium and Non-Equilibrium Statistical Thermodynamics* by Michel Le Bellac, Fabrice Mortessagne, and G. George Batrouni is thoroughly modern. It offers several examples in which classical concepts are applied or expanded in light of recent developments: Analyses of critical phenomena are discussed and extended to incorporate broken symmetries and renormalization groups; quantum statistics, a staple of old textbooks, is applied to quark–gluon plasma; and Monte Carlo techniques are extended for bosons and fermions.

The modernity of the text is also illustrated in the numerous exercises in each chapter, posed for students and faculty. The exercises cover topics on the contribution of nuclear quadrupoles to specific heat, the Ginzburg–Landau theory of superconductivity, the equilibrium radius of a neutron star, Landau diamagnetism, the ultra-relativistic fermion gas, superfluidity for hard-core bosons, and the quantum Hall effect. In addition, the book contains enough traditional exercises, such as calculating specific heats for a rod (chapter 1) and calculating the partition function for atoms and spin systems (chapter 3), to keep students busy. For a physicist teaching up-to-date thermodynamics and statistical mechanics for the first time, the book effectively creates a good lesson plan.

The second task—finding a book that connects speculative research to what is solidly established in the field—is not as straightforward as the first. For example, suppose someone attempts to define equilibrium and steady states of turbulent systems as they relate to generally accepted fundamentals of ensemble theory and hydrodynamics. How could he or she explain the limiting behavior of such systems when mention of turbulence is absent? In fact, *Equilibrium and Non-Equilibrium Statistical Thermo-*

dynamics, like many other books on statistical mechanics, does not address the question of turbulence in ensemble theory and hydrodynamics. Nonetheless, the book provides an adequate reality check for those who realize that such attempts to define equilibrium and steady states of turbulent systems must reduce to well-known nonequilibrium concepts, such as transport theory and the Kubo approach. Thankfully, the bibliography includes enough links to the literature on modern nonequilibrium

statistical mechanics.

After conducting an informal survey of some of my colleagues in the US, I found that, to my pleasant surprise, the textbooks by Reif and Huang are still classic choices for graduate-level texts on statistical mechanics. I would be inclined to use *Equilibrium and Non-Equilibrium Statistical Thermodynamics* as a modern pedagogical graduate textbook. It is less strong as a guide for researchers, but not without merit.

Amador Muriel

New York City