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Book Review: *Statistical Mechanics*

Statistical Mechanics. Shang-Keng Ma, World Scientific, 1985.

The late Prof. Sheng-Keng Ma has given us a refreshing and creative exposition of statistical mechanics. The book is meant as an introduction for graduate students, who will enjoy the charming, informal style, the realistic physical examples, and the reiterative connections to the fundamental hypothesis.

After a review of thermodynamics and a discussion of detailed balance, Prof. Ma reasons inductively from the entropy of an ideal gas to the Boltzmann equation for the entropy, $S = k \ln \Gamma$, where Γ is the volume of the region of motion in phase space within which the molecules of the system are confined. Great emphasis is given throughout the book to this underlying hypothesis and to its rich ramifications. Ma develops the thermodynamics from this hypothesis and introduces the term "partition function." He achieves this without the use of Gibbsian "ensembles" and, in fact, mentions the concept of an ensemble only briefly.

A chapter on probability and statistics leads to the idea of correlation functions, the central limit theorem, and the fluctuation-dissipation theorem. Having discussed various noninteracting molecular systems in the earlier chapters, Ma now moves to interacting systems: nonideal gases, phase equilibria, magnetism, and the Ising model. Before continuing with various topics in equilibrium statistical mechanics, he discusses dynamical properties, the rationale being that one must know how equilibrium is reached before one can know what equilibrium is. The Boltzmann equation of motion is presented and made plausible, then applied to examples for which collisions are not important (plasma oscillations and zero sound in a Fermi gas) and for which collisions are important (ideal gas transport properties and the H theorem). The diffusion equation is discussed in some detail. A short chapter is devoted to computer simulation methods. Next Ma returns to the theoretical bases and more discussion of the basic hypothesis and its implementation. The last section of the book is entitled "Condensation" and includes mean field theories of phase transitions, surface fluctuations, and special models (XY model, quantum vector model,

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and crystal model). Each chapter ends with a few problems, some of which are just suggestions for further reading and thought.

There are certainly flaws in this book. It contains many typographical errors. The English is often awkward and sometimes even grammatically incorrect (but still very readable). The examples suit physicists better than chemists. The notation is sometimes unconventional. There are not enough problems, nor are any answers provided. The sequence of topics will not suit every instructor. Most teachers will feel obliged to provide more information on the ensemble concept. The index is inadequate and incomplete.

In summary, however, Prof. Ma's book is such a delight to read and provides such a firm foundation for further study in statistical mechanics that I, for one, will use it the next time I teach introductory statistical mechanics.

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