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Book Review: *Thermal Physics-Entropy and Free Energies*

Thermal Physics-Entropy and Free Energies. J. C. Lee, World Scientific, Singapore, 2002

This book will not be everyone's cup of tea, but I enjoyed reading it. As the author says in the preface it is written in a relaxed style and it makes use of frequent analogies between the thermal world and the human world. It is intended to be used as a supplementary text or as an introduction to the field. There are relatively few equations in the text, even though the author discusses an array of topics from the very elementary to the quite sophisticated.

Chapter l, Introduction to Thermal Physics, contains the first view of the author's technique in which he presents the analogy between the particles in an isolated system obeying the quasi-ergodic theorem and a driver driving at random through the streets of Hattiesburg (the author's home) for an inordinate length of time.

Chapter 2 contains some useful mathematics and a brief discussion of the central limit theorem. Chapter 3 discusses isolated thermal systems, concentrating on ideal gases and spin systems. The concepts of micro- and macro-states are introduced, and the peaks in distributions for large systems are emphasized. The fundamental thermodynamic variables and equations are introduced, and emphasis is placed on the entropy and how it changes. The approach to thermodynamic equilibrium is related to traffic control systems. There are brief mentions of rubber bands, colloidal suspensions, and negative temperatures for spin systems. The maximum entropy principle is a central focus.

Chapter 4 discusses closed systems and the canonical ensemble. The minimum free energy principle is introduced. There is a nice section criticizing the concept of entropy as a measure of disorder. Again, ideal gases and Ising models are used as examples. Chapter 5 discusses open systems and systems with variable volumes. Chapter 6 on energy vs. free energy makes the analogy between the surroundings and the system and a bank

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and a customer. Chapter 7 on phases and phase transitions contains the usual material in addition to surfaces and mixing and demixing.

Starting with Chapter 8 on second-order phase transitions, considerably more advanced concepts are introduced, including order parameters, universality, mean field theory, and Landau mean field theory. Static scaling theory is introduced. All of these are described with a minimum of mathematics and a maximum of insight. Chapter 8 on the Landau–Ginzburg free energy functional continues this trend and discusses the Cahn–Hilliard equation and renormalization group theory.

Finally, Chapter 10 on Monte Carlo and finite-size scaling is a simple but deep presentation of these concepts.

In all of these chapters. there are useful analogies presented relating the tendencies of systems to approach equilibrium with more mundane topics like relocating squirrels.

The author has been extremely successful in carving out his desired goals. The effect on potential readers is hard to assess, but I found the book entertaining and informative.

Irwin Oppenheim
Chemistry Department
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139