Journal of Statistical Physics, Vol. 75, Nos. 3/4, 1994

Book Review: *Extended Irreversible Thermodynamics*

Extended Irreversible Thermodynamics. D. Jou, J. Casas-Vázquez, and G. Lebon, Springer-Verlag, Berlin, 1993.

The description of equilibrium states of many-body systems, either phenomenologically or microscopically, is a well-understood subject. This is not the case for nonequilibrium states beyond what is now called linear irreversible thermodynamics as formulated by Onsager, Meixner, Prigogine, de Groot, and others slightly over 60 years ago. The main difficulty arises from the basic fact that nonequilibrium states are not uniquely defined. For a given system under specific constraints and a measuring device with a well-defined characteristic time, one should be able to describe the states of such a system through all those variables whose relaxation times are equal to or larger than such a characteristic time. Thus, different systems under diverse conditions will require for their description different variables, very likely in number and in their nature. The effect of incorporating relaxation times into the description of nonequilibrium states other than the very long times associated with the locally conserved variables is generically referred to as extended irreversible thermodynamics. This is an unfinished, very rapidly developing subject and about which there exist several approaches in the literature. The book under review contains the approach developed by its authors, based on ideas set forth by Lambermont and Lebon in 1973 through the discovery of a generalized Gibbs equation leading to the generalized constitutive equations for the heat flux and the stress tensor now referred to in the literature as the Maxwell–Cattaneo–Vernotte equations. The physical fluxes, heat, momentum, and mass fluxes, among others, are raised to the status of independent variables, which in nonideal systems such as glasses, polymers, heterogeneous media, and others play an important role in characterizing their nonequilibrium states.

The authors develop the subject in three parts: the general theory, microscopic foundations, and selected applications. The main ideas and concepts on which it is based, I insist, are still debatable and controversial. The reader may find him or herself skeptical or even in disagreement with

0022-4715/94/0500-0773$07.00/0

some of them; this is not a defect, it is simply a natural consequence of the present status of the theory. Nevertheless, the authors make the effort of discussing other points of view and what I find most attractive about the book is that it gives a very clear and easy reading introduction to the subject, its present accomplishments as well as shortcomings. It is well illustrated with many examples and a set of problems is given at the end of each chapter, making the book suitable for introductory courses in nonequilibrium statistical physics. I should caution the reader that there are some misprints in several equations, but they will become obvious if one pursues the fine details of the material.

For those seeking a simple and broad overview of how this subject is developing, the book is highly recommended.

Leopoldo Garcia-Colin Scherer
Departamento de Fisica
Universidad Autonoma Metropolitana
Iztapalapa
Av. Purísima y Michoacán s/n
09340, Iztapalapa D.F.
Mexico