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Book Review: *From Microphysics to Macrophysics. Methods and Applications of Statistical Physics*

From Microphysics to Macrophysics. Methods and Applications of Statistical Physics. Roger Balian, Vols. 1, 2, Springer-Verlag, Berlin, 1991.

Statistical physics or "the many-body theory" represents a considerable achievement of theoretical physics. It is the insight of Gibbs which allows one to make, in a simple way, the transition between some 10^{23} microscopic characteristics of individual objects (coordinates and momenta in classical case) to a few measurable macroscopic parameters (temperature, volume, pressure, etc.). The power of Gibb's approach (mechanical energy $\rightarrow$ statistical sum $\rightarrow$ thermodynamic potential $\rightarrow$ equation of state) has been demonstrated by the work of another genius. Onsager, who showed that this scheme can describe the phase transitions in spite of the trivial way in which temperature enters the statistical sum. In spite of many technical problems, the principal approach to the transition between microphysics and macrophysics has been established, and this achievement should be easily and clearly accessible to each teacher, engineer, and researcher independently of his/her field of research. Therefore, each now book on statistical physics is to be welcomed.

Although the general approach, historical remarks, and a few interesting analogies in the book under review are very attractive, it is hard to see who the potential reader of this book might be. Indeed, it contains the description and applications of statistical physics "in the broadest meaning of the term." The latter is certainly manifest in more than 1000 pages of text. The description of solid state theory, for example, contains more than 100 pages, which is too much for somebody who is familiar with the subject and, at the same time, is not enough for a first-time reader. It is clear, therefore, that this book cannot be used as a supplementary text for an undergraduated course, together with, say, that of Callen[1] or Reif.[2]

On the other hand, this book cannot be used by graduate students either, because of their need for a knowledge of sophisticated and modern mathematical techniques to be used in their research. These are exemplified

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by diagrammic techniques, Green's functions, renormalization groups, and others which are not mentioned in this book, but are well described in the texts by McQuarrie,[3] Mahan,[4] and Reichl[5] as well as a number of others.

Probably, this book interposes somewhere between the two groups, and has some similarity to the first part of the Landau and Lifshitz text on statistical physics, which, however, contains a much deeper description of the material and more stimulating ideas. However, it would be wrong to adopt the attitude that "everything which describes the same as the Koran is not needed, and everything which contradicts it has to be burned."

Let us therefore mention some specific features of this book. Unlike most other books, the whole description of the main ideas of statistical mechanics is performed for quantum systems, which is "conceptually simpler than classical statistical mechanics," and the latter is obtained as a limit of the quantum case. Another distinguishing property of this book is the large number of problems which are given with hints to their solutions at the end of each of 15 chapters. Full solutions of different problems are given in the last chapter. This feature makes this book, along with those of Kubo[6] and Landsburg,[7] useful for both tutoring and self-study.

Teachers of college courses may find some pedagogical material in the applications considered (classical and quantum gases and their condensation properties, liquid helium, radiation, solid state physics).

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1. H. B. Callen, *Thermodynamics and an Introduction to Thermostatics*, 2nd ed. (Wiley, New York, 1985).
2. F. Reif, *Statistical and Thermal Physics* (McGraw-Hill, New York, 1965).
3. D. A. McQuarrie, *Statistical Mechanics* (Harper and Row, San Francisco, 1976).
4. G. D. Mahan, *Many Particle Physics* 2nd ed. (Plenum Press, New York, 1990).
5. L. E. Reichl, *A Modern Course in Statistical Physics* (University of Texas Press, Austin, Texas, 1980).
6. R. Kubo, *Statistical Mechanics* (North-Holland, Amsterdam, 1965).
7. P. T. Landsberg, *Problems in Thermodynamics and Statistical Physics* (PION, London, 1971).