Schröter, J.

The microscopic background of thermodynamics. (English) Zbl 0599.76004

J. Non-Equilibrium Thermodyn. 10, 315-326 (1985).

In this report two modes of description of a macroscopic system are contrasted: (1) by thermodynamics, using balance equations, and constitutive laws; (2) by quantum mechanics, in terms of observables, represented by "selfadjoint operators on a separable Hilbert space", a statistical operator, and canonical equations of motion. The classical dilemma resulting from the fact that these descriptions are strictly contradictory - as expressed by the cliché that thermodynamics is deterministic and irreversible while quantum mechanics is statistical and reversible - is discussed at some length. It is suggested that the dilemma can be solved and that a "microscopic background of thermodynamics" can be provided by quantum mechanics if only two (or three) postulates are added to its usual axioms.

These postulates delimit the class of macroscopic observables and statistical operators. They correspond to a particular assumption of "coarse graining". Developing this idea further, the author indicates how, for special systems, the microscopic description (based on quantum mechanics or classical [statistical] particle mechanics) can be reduced, first to kinetic description in terms of a Boltzmann type equation of motion, and finally, by obtaining so called normal solutions of the Chapman-Enskog type, to a generalized thermodynamic description in terms of a sequence of (generalized) balance equations. As an example the case of dilute gas of "Brownian particles" governed by the Fokker-Planck equation is treated. No details of calculations and results are given in this report, but a full list of references is provided.

Reviewer: U.Uhlhorn

MSC:

76A02 Foundations of fluid mechanics
82B30 Statistical thermodynamics
81P05 General and philosophical questions in quantum theory
76P05 Rarefied gas flows, Boltzmann equation in fluid mechanics

Keywords:

macroscopic system; balance equations; constitutive laws; statistical operator; canonical equations of motion; microscopic background of thermodynamics; coarse graining; kinetic description; Boltzmann type equation of motion; normal solutions of the Chapman-Enskog type; Fokker- Planck equation

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