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REVIEW

Thermodynamic Theory of Structure, Stability and Fluctuations. By P. GLANSDORFF and I. PRIGOGINE. Wiley, 1971. 306 pp. £5.50.

The task addressed in this monograph is to extend the methods of thermodynamics to fluid and chemical dynamics. A unified approach to nonlinear irreversible phenomena is sought which will be applicable from equilibrium to turbulence. Stability is the principal process discussed. Conventional entropy is the key variable. Starting with the basic conservation equations for fluid systems, the authors construct volume integrals which are related both to the stability of the fluid and to the entropy production rate. A parallel development of the authors' philosophy at first appears ambidextrous. On one hand, deep in the text, one reads that the derived integral criteria are sufficient conditions for stability, not necessary conditions. On the other hand, in introductions and ends of chapters, one is led to believe that these criteria completely define stability problems. This latter hand is soon discovered to be the upper hand; it overrides all reservations in its enthusiastic espousals.

The monograph has three parts. The theoretical developments in the first part do not bring the reader near the present frontiers of stability theory. Reference to particularly relevant previous work is so slight that the entire literature on 'energy integral' global stability studies receives no mention. The second part of the monograph starts with the development of an interesting approximation technique applicable to nonlinear and non-self-adjoint problems. The general procedure is called the method of local potential and can be used either as an iteration scheme, in which one approaches a correct solution starting with a good guess, or as a self-consistent numerical procedure essentially equivalent to the Galerkin method. Unfortunately, the principal application of this method in the monograph is to determine approximate solutions of the Orr–Sommerfeld problem for the linear instability of plane Poiseuille flow. The extensive computer analysis which is reported leads to manifestly incorrect results, e.g. figure 12.3, although the technique should work as well as other Galerkin-type numerical schemes. The third part of the monograph describes chemical instabilities, in particular the intriguing Zhabotinski reaction. This reaction produces periodic colour changes in space and time with no observable macroscopic motion. After several chapters in which models of such phenomena are explored, one is still far from quantitative explanation of any observations. However, the compatibility of the mathematical results with the general integrals constructed in part one is frequently noted. One fears entrophobia will be served by such adulation of thermodynamic gods.

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