J. Fluid Mech. (1993), *vol.* 253, *pp.* 722–723

REVIEW

Bénard Cells and Taylor Vortices. By E. L. Koschmieder. Cambridge University Press, 1993. 337 pp. £35.

This text provides a critical and comprehensive review of experimental and theoretical work on the stability of fluid layers heated from below and on the stability of flow between rotating cylinders. These two areas associated with the pioneering work of Bénard, Rayleigh and Taylor have many features in common, and for many years have provided a focus for the investigation of pattern selection in physical systems. A volume that concentrates on and compares the considerable amount of research that has now been completed is certainly justified.

The general features of linear stability theory and the methods by which theoreticians have attempted to probe the nonlinear features of these problems have many aspects in common, although as we are told, the detailed behaviour of each system, particularly in the nonlinear regime, is markedly different in many respects. Thus the tendency of the wavelength of the roll pattern to increase with increasing Rayleigh number in the Rayleigh–Bénard problem is contrasted with a tendency for the wavelength of Taylor vortices to remain close to the critical value. In the former case, the failure of classical infinite-layer theory to predict the wavelength dependence is highlighted in a very readable account of important developments in the late 1970s and early 1980s, and the author treads carefully through the 'minefield' of end-wall effects, surface-tension effects, experimental imperfections and non-Boussinesq effects, all of which can affect pattern selection in large-planform systems. The shortcomings of both theoretical and experimental treatments are described with expert insight, particularly on the experimental side. Certainly the author's detailed and penetrating discussion of much of the experimental work in the subject will be of particular value to theoreticians working in the field.

The work is divided into two parts, with roughly two-thirds devoted to the stability of fluid layers heated from below, including separate discussion of both the surface-tension phenomenon originally observed in Bénard's experiments and the instability due to buoyancy studied by Rayleigh. Separate chapters deal with linear and supercritical experimental work and with linear and nonlinear theories, with emphasis on large-planform systems. The confusion over the significance of hexagonal cells was resolved in the 1950s, but among topics identified as still posing a significant challenge are an adequate theoretical explanation for the wavelength of the roll pattern in Rayleigh–Bénard convection and of many aspects of the strongly nonlinear regime.

The last third of the book is devoted to Taylor vortex flow and the associated flow patterns which arise in the gap between rotating cylinders. Again, separate chapters deal with linear and supercritical experimental work, including the observation of wavy vortices and the plethora of cell transitions observed in experiments, still largely unexplained. The transition to turbulent flow is also discussed. Again end-effects are highly significant, and as well as chapters dealing with both linear and nonlinear theories there is a brief discussion covering miscellaneous topics such as eccentric cylinders, conical cylinders and rotating spheres.

The book is of course highly specialized. For instance, for the Rayleigh–Bénard problem attention is focused almost entirely on large-planform systems, with only limited discussion, for example, of smaller geometrical configurations, rotational effects or two-phase fluids. However, with 500 references covering the history and modern development of the two areas, the book provides an invaluable source of information both for the graduate student starting research and as a timely description of 'where we are now' for those actively researching in the field. The author stresses the need for agreement between experiment and theory in the verification of scientific results, and his work probably represents the best critical summary so far of what has indeed been verified in this fascinating area of fluid dynamics.

P. G. DANIELS

ADDENDUM TO BOOK REVIEWS

Mécanique des Fluides Fondamentale. By R. K. ZEYTOUNIAN. Springer, 1991. 615 pp. DM96.

The relatively short review of this book published in the *Journal of Fluid Mechanics*, vol. 246 (January 1993), pp. 692–693, and particularly the final paragraph of the review, may give the impression that the book is more limited in scope than is in fact the case. To correct this impression, the review should be supplemented by the following list of chapter titles:

Chapitre I. Les equations de Navier–Stokes.

Chapitre II. Quelques formes simplifiées des equations de Navier–Stokes. Les Equations d'Euler et de Navier.

Chapitre III. Formulation des problèmes mathématiques correspondants aux equations de Navier–Stokes, de Navier et d'Euler.

Chapitre IV. Le concept de modèles en mécanique des fluides théorique.

Chapitre V. Sur la stabilité des ecoulements laminaires.

Chapitre VI. Bifurcations et comportements chaotiques dans les fluides.

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