J. Fluid Mech. (1973), *vol.* 60, *part* 4, *pp.* 825–826

Printed in Great Britain

REVIEW

Buoyancy Effects in Fluids. By J. S. TURNER. Cambridge University Press, 1973. 367 pp. £9.00 or $ 29.50.

This book is the latest of the Cambridge Monographs on Mechanics and Applied Mathematics and is a welcome addition. It contains a wide range of topics involving density variations in fluids with emphasis on problems of turbulence, including convection above heated surfaces. The book is intended to be a general introduction to the subject and it will be valuable to graduate students with some prior knowledge of fluid mechanics and to specialists in other branches of fluid mechanics who wish to acquire an understanding of buoyancy effects. Dr Turner emphasizes experiments and this, of course, reflects his excellent experimental work over the years. There are a large number of beautiful photographs of internal wave motion in stably stratified fluids in the laboratory and in the atmosphere, of jets and hydraulic jumps, of convection cells and thermals and of wave breakdown and turbulence.

The book begins with a short background discussion of the mathematical aspects of buoyancy, including a statement of the Boussinesq approximation. The second and third chapters discuss linear waves, including nonlinear interactions and finite-amplitude disturbances. There is a valuable section on finite-amplitude waves in a fluid with continuous density gradient, and I was glad to see reference to the important recent work on upstream influence, although I disagree with the implication that upstream influence is mainly of "philosophical importance". The third chapter also contains a good discussion of slow viscous flow of stratified fluids, although in reading this discussion I became aware of a deficiency of the book in giving little or no attention to the analogy between rotating and stratified fluids. It is especially important for a newcomer to the subject to know about this analogy. For example, the solution for a sink was first found for a rotating fluid and the phenomenon of selective withdrawal was first observed in the rotating case.

The remainder of the book is concerned with instability and turbulence. In chapter 5 turbulent shear flows are discussed for the neutral, stable and unstable cases. I have to complain about a number of things in this chapter. Here one realizes for the first time that Dr Turner's book is not accurate enough in discussion of meteorological phenomena. This is first revealed by his statement that the momentum transfer τ is constant in the "lowest few hundred metres of the atmospheric boundary". In fact, use of the theory involving the assumption of constant τ and constant buoyancy transfer q is greatly hampered because q and τ vary very significantly in the lowest 50–100 metres and even more above this. These variations are caused by unsteadiness, horizontal inhomogeneity and Coriolis forces. The last of these will frequently cause a 20% variation of τ and q in the lowest 50 metres. In the lowest 300 metres there is a 50% variation of τ in the Leipzig profile, for example.

I must also quarrel with the discussion of the properties of mean gradients of velocity and temperature in turbulent convection with shear. It amounts to a survey of similarity theory and frequent claims that the theory is verified in the atmosphere. No mention is made of the possible importance of molecular coefficients in the dimensional arguments. The $z^{-\frac{4}{3}}$-law for mean buoyancy gradient is "derived" by the statement that τ cannot enter the analysis in free convection, i.e. for large values of z/L, where $L \sim \tau^{\frac{3}{2}}/q$ is the Monin–Obukhov length. This is not a very clear statement even when molecular coefficients are neglected. In fact, as $\tau \rightarrow 0$ one approaches the problem of simple convection over a heated plate in which the author acknowledges that molecular coefficients are important parameters.

The discussion of the $z^{-\frac{4}{3}}$-law for velocity gradient is also faulty. The author assumes similar profiles for density and velocity, whereas the usual and more fundamental approach is to assume a constant turbulent Prandtl number Pr_t. He then states that constant Pr_t is verified in the atmosphere whereas, in fact, excellent data of Swinbank indicate a systematic decrease of Pr_t with height, and most meteorologists believe that Pr_t decreases with height. This, of course, affects the velocity gradient which apparently follows a $z^{-\frac{5}{4}}$-law instead of $z^{-\frac{4}{3}}$. In addition, Dr Turner claims that the similarity prediction for mean temperature gradient is also supported by observations, whereas observations dating back to 1965 indicate a fundamental disagreement and support a $z^{-\frac{3}{2}}$-law. Again in the discussion of the buoyancy subrange, the author claims that the k^{-3}-law has some support from observations but the cited reference only suggests the existence of a range in which the drop-off is faster than $k^{-\frac{5}{3}}$. In general the data, especially in the higher atmosphere, are chaotic at wavenumbers below the $k^{-\frac{5}{3}}$-range.

Chapters 6 and 7 discuss convection from isolated sources and from heated surfaces and constitute an excellent summary of experimental and theoretical work on the subject. The author discusses the mean temperature gradient above the thermal boundary layer and repeats the erroneous interpretation of Townsend's observations that is found in many other discussions of the problem, namely that Townsend's observations verified the Malkus prediction of a z^{-2}-law. In fact, Townsend contended only that he had found a z^n-law where n lies between $-1{\cdot}3$ and $-2{\cdot}5$. This is hardly helpful in deciding between the z^{-2} Malkus theory and the $z^{-\frac{4}{3}}$ similarity theory of others.

The last three chapters treat mixing across density interfaces and double-diffusive convection occurring, for example, in heated or cooled salt water. The former has been studied in a recent experiment by Dr Turner. His discussion is an authoritative summary of our present knowledge of heat or salt transfer in stably-stratified fluids in the presence of mechanically-produced turbulence. Turner's experiment and, for example, that of Kato & Phillips are wonderfully simple, but are of great importance in understanding geophysical problems.

I have been critical of certain parts of the book, particularly those parts concerned with turbulent convection, but it is a good book on the whole and I recommend it to anyone interested in acquiring a general knowledge of the effects of buoyancy in fluids. If one goes on to do research on one of the areas in which buoyancy is important, one must, of course, consult the original papers but this is inevitable and is not a criticism of Dr Turner's welcome contribution to a subject of such great importance in meteorology and oceanography.

R. R. Long

EUROPEAN MECHANICS COLLOQUIA 1974

Details of the 11 Euromech Colloquia to be held during 1974 are shown below. Euromech Colloquia are informal conferences on specialized research topics, and participation is restricted to a small number of European research workers actively engaged in the field. Overall responsibility for Euromech Colloquia is in the hands of an international Committee, and the organization of each Colloquium, including the selection of participants for invitation, is entrusted to a Chairman for that Colloquium. People who are interested in taking part in one of the Colloquia listed below may write to the appropriate Chairman.

	Title	*Chairman*
Euromech 35	Exchanges at the air–sea boundary 9–12 September 1974 Marseille	Professor A. Favre Institute de Mécanique Statistique de la Turbulence 12 Avenue du Général Leclerc Marseille 3e, France
Euromech 46	Numerical and experimental investigations of the stability of boundary layers 4–8 March 1974 Oberwolfach	Professor R. Eppler and Professor F. X. Wortmann Universität Stuttgart Institut A für Mechanik, Keplerstrasse 17 D7 Stuttgart 1, Germany (B.R.D.)
Euromech 47	Kinetics in shock tubes 8–10 April 1974 Southampton	Professor K. N. C. Bray Department of Aeronautics and Astronautics The University Southampton SO9 5NH, England
Euromech 48	Transport, erosion and deposition of sediment in turbulent streams 22–24 August 1974 Lyngby/Copenhagen	Professor F. Engelund Institute of Hydrodynamics and Hydraulic Engineering Technical University of Denmark, Building 115 DK-2800 Lyngby/Copenhagen, Denmark
Euromech 49	The mechanics of fluid suspensions and polymer solutions 2–5 April 1974 Jablonna (Poland) and	Professor G. K. Batchelor Department of Applied Mathematics and Theoretical Physics University of Cambridge, Silver Street Cambridge CB3 9EW, England Dr S. Zahorski Institute of Fundamental Technological Research ul. Swietokrzyska 21 00–049 Warszawa, Poland
Euromech 50	Wind-tunnel simulation of the atmospheric boundary layer 25–27 March 1974 West Berlin	Professor R. Wille Technische Universität Strasse des 17. Juni 135 1 Berlin 12, Germany (B.R.D.)

	Title	Chairman
Euromech 51	Small-scale mixing in stably stratified fluids 24–27 June 1974 Cambridge	Dr J. S. Turner Department of Applied Mathematics and Theoretical Physics University of Cambridge, Silver Street Cambridge CB3 9EW, England
Euromech 52	Drag reduction in turbulent flow due to additives 27–30 August 1974 Stockholm	Professor M. Landahl Division of Mechanics The Royal Institute of Technology 10044 Stockholm, Sweden
Euromech 53	Thermoplasticity 16–20 September 1974 Jablonna (Poland)	Professor P. Perzyna Institute of Fundamental Technological Research ul. Swietokrzyska 21 00–049 Warszawa, Poland
Euromech 54	Finite deformations in plasticity 30 September–3 October 1974 Jablonna (Poland)	Professor A. Sawczuk Institute of Fundamental Technological Research ul. Swietokrzyska 21 00–049 Warszawa, Poland
Euromech 55	Optical interferometry in experimental gas dynamics 25–27 March 1974 Bochum	Professor W. Merzkirch Ruhr-Universität, Buscheystrasse 1c D-463 Bochum-Querenburg, Germany (B.R.D.) and Dr C. Veret Office National d'Etudes et de Recherche Aérospatiales 29 Avenue de la Division Leclerc 92 Chatillon-sous-Bagneux, France

Further information about Euromech Colloquia generally may be obtained from the present (1973) members of the Euromech Committee:

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