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BOOK REVIEW

The Physics of Fluids and Plasmas: An Introduction for Astrophysicists. Edited by A. R. Choudhuri. Cambridge University Press, 1998. 448 pp. ISBN 0521 55487 X, £52.50 (hardback); ISBN 0521 55543 4, £19.95 (paperback).

The publishers advertise this book as a 'textbook... aimed primarily at astrophysics graduate students', but I hesitate to agree: it is rare to find a textbook that is such a pleasure to read.

The astrophysical fluid dynamicist has, by definition, to tread a careful path. Many of the basic concepts and theorems of fluid dynamics are poorly understood in the astronomical community and misconceptions abound. Moreover some of the difficulties of astrophysical modelling are often ignored by the fluid dynamicist (ever in search of a tractable problem) and results are often extrapolated to parameter regimes beyond the realm of applicability of the calculation performed. For this reason, any book that introduces the astrophysicist to fluid and plasma dynamics *and* informs the theoretician of the importance (and limitations) of fluid dynamics in astrophysical situations needs to appeal to both camps. Choudhuri's engaging style ensures that this is just such a book.

The book splits neatly into two parts, one dealing with the physics of fluids and the other plasmas. This is an unusual approach – there are many textbooks that deal with one of these topics, but very few that derive both sets of equations in a unified way. It is a helpful approach as it becomes evident to the fluid dynamicist that there is nothing inherently strange about the equations of plasma physics and that many of the problems of fluid dynamics have an exact analogue in the plasma world.

In chapters 2–8 the equations of fluid dynamics are derived (for both a dilute gas and a continuum fluid) and then the basic properties of the equations are explored. With chapters on ideal fluids, viscous flows, gas dynamics (including waves and shocks), instabilities, turbulence and rotation Choudhuri gives a gentle introduction to the Euler and Navier–Stokes equations and gives many examples drawn from astrophysical problems. The material is, necessarily, not covered in exhaustive detail and many references and further reading are suggested.

In the second half, Choudhuri starts with a clean slate and rederives the continuum equations for plasma physics. Slowly but surely he discusses the dynamics of ionized fluids, starting with those of a charged particle in a magnetic field and moving steadily towards the one-fluid model of magnetohydrodynamics, encompassing the BBKGY hierarchy, Vlasov equations and two-fluid models on the way. By Chapter 14 the MHD equations have been derived and the rest of the book is devoted to discussion of the properties of these equations. It is inevitable in an elementary textbook (especially one that takes such care to derive systematically the equations) that not much space is devoted to the more advanced (and therefore more interesting) aspects of the subject. I would like to see a more complete discussion of the fundamental problems of the dynamics of hydromagnetic waves, magnetoconvection and dynamo theory – but maybe this is beyond the scope of such a book, and others (e.g. Moffatt 1978, Parker 1979, Priest 1982 and Mestel 1999) must take over here. Or perhaps Professor Choudhuri could be persuaded to write a companion volume.

REFERENCES

Mestel, L. 1999 *Stellar Magnetism.* Oxford University Press.

Moffatt, H. K. 1978 *Magnetic Field Generation in Electrically Conducting Fluids.* Cambridge University Press.

Parker, E. N. 1979 *Cosmical Magnetic Fields.* Oxford University Press.

Priest, E. R. 1982 *Solar Magnetohydrodynamics.* Reidel.

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