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REVIEWS

The Particle Kinetics of Plasmas. By I. P. SHKAROFSKY, T. W. JOHNSTON and M. P. BACHYNSKI. Addison-Wesley, 1966. $27.50.

Sources of Plasma Physics. BY H. S. GREEN and R. B. LEIPNIK. Wolters-Noordhoff, 1971. 630 pp. Dfl. 118,75 or $35.00.

These books have in common that they are advanced texts, well written by men of considerable experience in plasma physics, but whereas the first deals in detail with the specialized field of classical transport properties of plasmas, the second provides a broad survey of those branches of mathematical physics on which plasma physics is based. The first book is a valuable addition to the rapidly growing literature of plasma physics, even though *particle* kinetics is not as relevant to plasma transport properties as was once hoped. The second is more difficult to assess, for although it contains many interesting articles, the ground covered in electrodynamics, fluid mechanics and kinetic theory is so wide that the relevance to plasma physics is often tenuous. However, it is a scholarly treatment of the foundations, even if these are sometimes "well below ground level", and will be appreciated by the more academically minded plasma physicists.

Turning now to the contents of *The Particle Kinetics of Plasmas*, we find in chapters 1 and 2 a broad survey of the subject leading to the Boltzmann equation. The approximations involved here are well explained. In chapter 3 the expansion of the electron distribution function in spherical harmonics is discussed and in chapter 4 this theory is applied to electron–atom interactions. Elastic collisons and scattering cross-sections are considered from both theoretical and experimental points of view in chapter 4 and in the following chapter there is an account of *bremsstrahlung* and high-frequency electrical conductivity. Chapter 7 contains an excellent account of the Fokker–Planck equation and its application to various relaxations between the particle systems; and in chapter 8 both the Boltzmann and Fokker–Planck collision terms are employed to calculate the electrical conductivity of a plasma. In chapter 9 the equations of magnetohydrodynamics and the approximations involved are carefully explained and some elementary applications are made. The final chapter provides an account of the Chew, Goldberger and Low equations for collisionless plasmas in strong magnetic fields.

The authors have related results in the text, where possible, to experimental work. There are some defects, e.g. the lack of any account of entropy production, of the role of spatial symmetries and of Onsager's relations; there is also the rather limiting choice of equal ion and electron temperatures in the chapter on transport coefficients. But these are small shortcomings in an excellent text, which sets the earlier work of the authors on the transport properties of plasmas into a systematic account.

Sources of Plasma Physics consists of five long chapters and five appendices (130 pp.) dealing with mathematical theory. Chapter 1, entitled "Fundamentals",

is a general survey of the macroscopic and microscopic descriptions of plasmas and ranges from measure theory to quantum and fluid mechanics. Chapter 2 is an "Introduction to electromagnetic fields", which starts by explaining the physical basis of Maxwell's equations and ends with multipole expansions and the interaction of charged particles. It is really too advanced to be an introduction and yet it does try to explain everything from first principles. As a *revisionary* account for someone with prior knowledge of the subject, it would be excellent; a similar remark applies to the other chapters in the text. Chapter 3 on "Fluid mechanics" includes an account of classical thermodynamics by Carathéodory's axiomatic approach plus some (inadequate) material on irreversible processes in fluids, and ends with a brief account of shock-wave theory. The range is wide – too wide for the novice – and yet much of the material is elementary, although given a sophisticated presentation. Chapter 4 is entitled "Advanced electromagnetism" and covers such topics as special relativity, wave guides, radiation of moving charges and magnetohydrodynamics. The final chapter deals with "The molecular theory of fluids", to which subject Professor Green has made distinguished contributions. It covers statistical mechanics of both equilibrium and non-equilibrium situations, but it is hard to see how much of the material would be more than marginally relevant to dilute plasmas.

The authors here have produced a sort of advanced Joos' *Theoretical Physics* with plasma applications in mind, which will appeal more to mathematical physicists than to plasma physicists. There is a high standard of mathematical rigour and a clear exposition. The authors intend to produce a second volume dealing directly with plasma physics and when this is available one will be better able to judge the relevance of the present text.

L. C. Woods

Aerodynamics of Bodies of Revolution. By N. F. Krasnov, edited and annotated by D. N. Morris, translated from 2nd Russian edition by J. B. Gazley. Elsevier Publishing Company, Inc., New York, 1970. 895 pp. $16.00.

When is a Russian book worth translating? Of course we welcome a reliable translation of a distinguished work, such as Sykes and Reid's impeccable English version of Landau & Lifshitz's *Fluid Mechanics* and even the flawed translation of Sedov's *Similarity and Dimensional Methods in Mechanics* has proved useful. But is the effort justified for anything less than a first-rate book?

Deane Morris has laboured heroically to improve Krasnov's 1964 Russian compendium, which aims to cover everything known about the external aerodynamics of axisymmetric shapes at speeds from transonic to hypersonic, including the method of characteristics, linearized theory, blunt bodies, heat and mass transfer, and rarefied and free-molecule flow. He has corrected errors carried over from uncited papers, reworked defective tables and rewritten confusing sentences, while scrupulously noting all changes of substance. He has added an introduction to each chapter summarizing it from the perspective of a Western expert in the 1970s, explaining errors and adding recent or omitted

references. Finally, he has compiled an index and supplemented the original inadequate bibliography with as many specific Russian and other references as he could identify.

Yet this huge book remains undistinguished and unscholarly, outdated, uncritical and still unreliable. For example, writing more than ten years after Ferri's discovery of the vortical layer and vortical singularity on an inclined cone in supersonic flow, the author repeats (p. 208) the earlier erroneous argument according to which the entropy would be constant on each azimuthal plane (and this one lapse has escaped the editor's eagle eye). Perhaps the editor should have devoted his labour not to this translation but to a book of his own.

M. VAN DYKE

Mechanics of Fluids. 2nd Edition. (S.I. units.) By W. J. DUNCAN, A. S. THOM and A. D. YOUNG. Edward Arnold, 1970. 725 pp. £8 (hardback) or £4 (paperback).

This is the second edition of the book first published in 1960. The main new feature of this edition is the use throughout the book of S.I. units although the previous slug-foot-second system has not been discarded entirely. The section on turbulent boundary layers in large pressure gradients has been enlarged, giving reference to work published since the first edition. Other changes include the rewriting of the section on the measurement of efficiency in roto-dynamic machines and the inclusion of an appendix giving the application of vector analysis to fluid mechanics, although the main body of the text does not use vectors to any great extent.

Over the years, this book has been found to be very suitable as a text for an introductory course in fluid mechanics to engineering undergraduates. Parts of the book stand out as first class expositions of the subject. In particular the long chapter on boundary layers is written at just the right level for engineering undergraduates and is suitable for a third year specialist course.

It is unfortunate that the price of this book has increased so drastically considering that it has changed from a hardback to paperback format, but it is still good value for money.

D. J. MAULL