spectacular effects as, for example, the resonance built up by soldiers marching in step across bridges, this having led to several disasters; whirling of shafts; the collapse of the Tacoma Bridge; fatigue failure in crankshafts and jet engine compressor blades; rocking of railway trains and the wind-excited oscillations of electric transmission lines (causing short-circuiting), or of steel chimney stacks (causing their collapse).

Returning to the basic purpose of the book—to explain what is involved in engineering—I should like to quote the following passage with which I heartily agree: "The idea . . . that progress is made by pure scientists having ideas, and engineers making them work, is ludicrously superficial. A successful flutter analyst has to make important decisions as a physicist, as a mathematician and as an engineer. . . . Rapid progress in any branch of engineering —not just flutter analysis—becomes possible when those who are engaged on research can cross the ill-defined frontier between pure and applied science without realizing that they have done so".

The book will be particularly useful to the young reader looking for a comfortable way to make himself familiar with the broad aspects of vibration, or to get an idea of what is involved in engineering. He may soon, if his training or profession lies in this field, feel the need to study a more comprehensive theoretical book (one of which has been written by the same author). Also the more advanced reader may find Prof. Bishop's elementary book pleasant reading and this may perhaps prevent him from "not seeing the wood for the trees".

K. R. Weiss

EXPERIMENTAL PLASMA PHYSICS

Plasma Diagnostics with Microwaves

By Dr. M. A. Heald and C. B. Wharton. (Wiley Series in Plasma Physics.) Pp. xvii+452. (New York and London: John Wiley and Sons, Inc., 1965.) 102*s*.

THE interaction of electromagnetic waves with a plasma constitutes a very useful method of measuring three important parameters of a plasma—the electron density, the electron temperature and the magnetic field inside the plasma. The purpose of *Plasma Diagnostics with Microwaves* is to give a summary of the basic theory of this interaction, togother with a description of the experimental techniques and apparatus involved. Most of the material presented has appeared in research reports written by the authors, who have been very active in the application of microwave diagnostics. However, the presentation here is in a manner and of sufficient detail to provide an excellent introduction to an experimentalist new in the field.

As implied by the title, the authors limit themselves to electromagnetic waves in the microwave region, though the theory and the basis of the experimental techniques presented are applicable to infra-red and optical wave-lengths. Probing of a plasma at these wave-lengths has come into extensive use recently since the advent of masers and lasers. The plasmas under consideration are those characterized by high temperature, that is, those of high degree of ionization and low collision frequencies, and of dimensions greater than the electromagnetic wave-length. However, the diagnostics described are applicable to other plasmas.

The first six chapters are concerned with the probing of a plasma with radiation generated externally. In Chapter 1, an account of the theory of electromagnetic wave propagation through a cold plasma is given. In the next two chapters the treatment is extended to warm plasmas, and has a detailed discussion of collision processes in a plasma. Chapter 4 is concerned both with bounded plasmas and spatial non-uniformity. The choice of antenna systems for particular applications is also considered. In Chapter 5 plasmas confined in wave-guides are treated. Included is a discussion of wave-guide propagation in a plasma of both space-charge and electromagnetic waves. An extensive discussion of experimental techniques in general use is given in Chapter 6. The next two chapters are concerned with radiation in the microwave region emitted by the plasma. Both a theoretical description of the various processes by which this radiation is emitted and the details of the experiments concerned with this radiation are discussed. This is followed by a description of the experimental apparatus and the special circuits used in microwave diagnostic experiments. The final chapter is different in content and approach from the rest of the book. It consists of a list of some other plasma diagnostics with the ranges of their applicability. However, the discussion is limited to those diagnostic techniques which provide information similar to that obtained by microwaves. There are two appendixes—review of electromagnetic wave propagation and tensor and matrix algebra.

The book is very readable. The presentation is lucid and coherent. The reference list is very comprehensive and is designed to provide a means of following up those topics which of necessity could not be discussed fully. It is a very useful addition to the growing list of books available to the experimental plasma physicist.

A. E. Dangor

ASPECTS OF RHEOLOGY

Proceedings of the Fourth International Congress on Rheology

Brown University, Providence, Rhode Island, August 26–30, 1963. Edited by E. H. Lee and Alfred L. Copley. Part 1: Pp. x+373. 120*s*. Part 2: Pp. xii+714. 226*s*. Part 3: Pp. xiii+637. 196*s*. Part 4: Symposium on Biorheology. Pp. xi+634. 189*s*. (New York and London: Interscience Publishers, a Division of John Wiley and Sons, Inc., 1965.)

ABOUT ten years ago, a fellow-rheologist commented to me: "You know, there are two kinds of rheologist, the '*P Q*' rheologists and the '*i j*' variety". Until recently, the former, mainly concerned with direct relations between experimentally applied pressures and induced rates of flow, formed a large majority. From the *Proceedings of the Fourth Congress on Rheology*, one concludes that the main interest now lies in tensor theory, except perhaps in the comparatively new and popular field of biorheology, which has scarcely reached this stage. One reason for this development is that in earlier times most rheologists were trained as chemists. The new generation is composed, as is proper, of young physicists with a prime interest in applied mathematics.

The *Proceedings of the Fourth Congress* are so extensive that it was necessary to publish them to four volumes, but the arrangement is not altogether a happy one. At first sight it sounds sensible: Part 1, invited papers and general lectures; Part 2, papers from members of the (American) Society of Rheology; Part 3, other contributed papers; Part 4, a biorheological symposium. But, in fact, biological subjects are to be found in Parts 1 and 3 and other subjects are fairly evenly scattered throughout the first three volumes. These three are edited by Prof. E. H. Lee, and the fourth, independently, by Prof. A. L. Copley.

It is difficult, in a short review, to do justice to nearly 200 papers ranging in subject-matter from aluminium as an unstable solid to the properties of the skin of the hippopotamus. Suffice it to say that, throughout, the standard is very high. Perhaps the most outstanding contribution is that of Prof. C. Truesdell, who was awarded the Bingham Medal for the year. His "Rational Mechanics