sity, the *mass*-centered diffusion flux must be considered, which implies that the appropriate concentration variable is the *mass fraction*. It is often necessary to use the mass-centered system for another reason also: When chemical reaction occurs, moles are not conserved, whereas mass is; the mass fraction also recommends itself when the molecular weight of the diffusing substance is uncertain, as in the case of a hydrocarbon fuel diffusing toward a flame. The reviewer did not find in the book any statement of the above views (which may be wrong) or of any alternative recommendations for dealing with problems of this kind, which arise in almost every practical application of mass-transfer theory.

It would, however, be entirely unfitting to close this review on a critical note. The reviewer has therefore saved until the end an expression of his profound admiration for a work which is scholarly, lucid, and elegant. The authors have taken almost unprecedented pains to aid the student's labors; careful definitions, helpful notation, lively examples, and handsome printing make this work one of which the authors, and the publishing house, can take a well-justified pride. Students, teachers, and industrial scientists will be grateful to them for a long time to come.

Fluid Mechanics

Lectures on Fluid Mechanics. Lectures in Applied Mathematics, Vol. II. By Sydney Goldstein with J. M. Burgers. Interscience Publishers, Inc., New York, 1960. Cloth, xvi and 309 pp. $5.

REVIEWED BY JOSEPH H. CLARKE[5]

THIS volume contains the written version of a series of lectures which were given by Sidney Goldstein at Boulder, Colo., in 1957, and were designed to acquaint mature mathematicians with fluid mechanics. An arresting aspect is that Goldstein was to deal with the entire subject in only twelve lectures. Thus he has had to pass over all but what he regards as the essential ideas, achievements, and problems. Since he clearly accepted his assignment with some gravity, it is interesting to peruse what one of the elder statesmen of fluid mechanics saw fit to present in his account. The result is not a survey because the coverage is incomplete and the choice of material is, to a considerable extent, arbitrary and personal; and, while very succinct, it is no mere cataloguing of topics. The result *is* a satisfying and thoughtful series of lectures set forth with a definite point of view not to be found in more formal treatises. At times the mellow, reflective, and trenchant remarks conjure a setting in which the reader shares Goldstein's hearthside over sherry. The volume will certainly reward readers with many different points of view.

The classification of the subject and hence the chapter headings are conventional, except for the early point at which electromagnetic effects are introduced. The volume contains two tours de force. One is a new careful formulation of the field equations of magnetohydrodynamics, regarded as the electrodynamics of a moving medium. Subjoined to this are two detailed problems of magnetohydrodynamics provided by J. M. Burgers. The second is on an asymptotic solution to the Navier-Stokes equation for flow past a flat plate. The book contains an interesting discussion of the Newtonian stress-strain rate relations from the point of view of molecular relaxation or lag phenomena, as well as other comments on the relationship between the field and molecular formulations. There is a short chapter on the related matters of mixtures and chemical kinetics. Some absorbing remarks are offered on the theoretical question of whether the classical Helmholtz-Kirchhoff free-streamline theory can be regarded as the correct, if unstable, limit of the steady viscous flow as the viscosity tends to zero. Other interesting observations, not entirely looked for in such a development, are salted throughout the volume.

[5] Associate Professor, Division of Engineering, Brown University, Providence, R. I.

Thermal Stresses

Theory of Thermal Stresses. By Bruno A. Boley and Jerome H. Weiner. John Wiley & Sons, Inc., New York, London, 1960. xv and 586 pp. $15.50.

REVIEWED BY W. PRAGER[6]

THE PUBLICATION of this comprehensive text on the theory of thermal stresses is particularly welcome at a time when the design requirements in rocket propulsion and nuclear power have greatly enhanced the importance and extended the scope of this field. By devoting about two fifths of the book to a careful treatment of the fundamentals of thermoelasticity (Part I) and heat conduction (Part II), the authors have achieved a nearly self-contained presentation of their subject. The rest of the book consists of two parts dealing with the analysis of thermal stresses in elastic (Part III) and inelastic (Part IV) systems. The unequal development of these subjects is strikingly illustrated by the fact that Part II, which is almost twice as long as Part IV, discusses a large number of applications regarding thermal stresses in elastic beams, rings, trusses, frames, disks, and plates, and thermoelastic stability. Part IV, on the other hand, is primarily concerned with the basic formulation of viscoelastic and elastic-plastic behavior in the presence of temperature changes, and only a few specific applications are treated.

In the writing of a work of this ambitious scope, decisions on emphasis cannot be avoided that are readily explained in terms of the authors' interests but may otherwise appear arbitrary. For example, throughout the book the elastic coefficients are treated as temperature-independent quantities, but no effort is made to justify this, whereas the effect of the mechanical coupling term in the equation of heat conduction is discussed at great length. On the whole, however, the authors have achieved a remarkable balance in the treatment of the fundamental aspects of the theory and its applications, and the book is bound to become a standard reference in the literature on this field.

Wave Propagation

Wave Propagation in a Random Medium. By L. A. Chernov. Translated by R. A. Silverman. McGraw-Hill Book Company, Inc., New York, N. Y., 1960. Cloth, $7^1/_2 \times 10$ in., viii and 168 pp.

REVIEWED BY J. LYELL SANDERS, Jr.[7]

THE BOOK is divided into three parts, the ray theory, the wave theory, and applications to focusing systems. The author's treatment of his subject is lucid and concise. Not too much specialized mathematical equipment is required of the reader, but some familiarity with the technological problems in the field is helpful. The book serves both as an introduction to the subject and a summary of recent results of Russian work in the field. The translation is good.

The book begins with a discussion of the relevant statistical characteristics of the medium, in particular the correlation function of the refractive index. Following this is a treatment of the problems of scatter and fluctuations in transit time and intensity in so far as the ray approximation is adequate. The subject of scattering is developed further by use of the wave theory and the method of small perturbations in a following chapter. Fluctuations in amplitude are then treated by the wave theory using both the ordinary method of small perturbations and Rytov's method.

[6] L. Herbert Ballou University Professor, Brown University, Providence, R. I.

[7] Associate Professor of Structural Mechanics, Division of Engineering and Applied Physics, Harvard University, Cambridge, Mass.

For most practical values of the parameters involved, Rytov's method is subject to fewer limitations and is therefore preferred.

A chapter is devoted to the subject of correlation and autocorrelation of amplitude and phase in space and time based on the wave theory. The third section of the book on focusing systems is an application of the wave theory to the study of the mean distribution and the fluctuations in intensity of an image due to inhomogeneities in the medium. A familiar example of the subject material is the twinkling of stars which the author proves to be more readily observable to the naked eye than with a large telescope.

Plastic Deformation

Ermittlung eingeschrankt plastischer Verformungen im Sand unter Flachfundamenten (Determination of limited plastic deformations of sand under shallow foundations). By Dr. Ing. Hans U. Smoltczyk. Ernst und Sohn, Berlin, 1960. Paper, 7 × 10 in.

REVIEWED BY J. BRINCH HANSEN[8]

THE first part of the book deals with the bearing capacity of foundations subjected to vertical or inclined (but centric) loads. After having given the well-known solutions for weightless soil, the author proceeds to the more complicated case of "heavy" soil. He uses here a variant of the method indicated by Lundgren and Mortensen (Proc. Third. Int. Conf. Soil Mechanics, Zürich, 1953, vol. I, p. 409) and extends it in an approximative way to inclined loads.

Like the majority of writers on plasticity theory, the author pays small or no attention to the compatibility of the deformations in the state of failure. Nor does he seem to be fully aware of the behavior of composite ruptures involving elastic as well as plastic zones. Consequently, his calculations can be severely criticized from a theoretical point of view, although his numerical results may possibly be approximately correct.

In the opinion of the reviewer, the main value of the book lies in its second part, dealing with the "elastic" (reversible) and "plastic" (irreversible) deformations of sand before actual failure. As typical examples, the author analyzes a direct shear test and a consolidation test and indicates simple empirical relationships between stresses and strains for the elastic and plastic components in both tests. It is interesting to notice that elastic shear deformations follow a similar law as indicated by Ritter for concrete, and that the logarithms of plastic shear deformations have approximately a linear relationship to the shear stresses.

By combining the obtained relationships with Fröhlich's pressure distribution below a foundation, the author finally develops a method for calculating the settlements and soil movements for any loading not producing failure in the soil. It is, however, questionable whether Fröhlich's pressure distribution is compatible with the nonlinear stress-strain relationships used by the author.

Random Variables

Introduction to Probability and Random Variables. By G. P. Wadsworth and J. G. Bryan. McGraw-Hill Book Company, Inc., New York, N. Y., 1960. Cloth, 6 × 8 in., vii and 292 pp. $8.75.

REVIEWED BY A. CEMAL ERINGEN[9]

THIS BOOK consists of eight chapters. In the first chapter some preliminary mathematics such as the differentiation of a definite integral, the characteristics of gamma and beta functions, and the idea of permutations is introduced. The probability concept and laws of probability, from the standpoint of frequency rather than from the notion of measure, are given in Chap. 2 without loss in rigor. Chap. 3 deals with discrete random variables. Some elementary distributions (binomial, Poisson, etc.) are introduced and illustrated with good clarity. Chap. 4 treats continuous random variables. Gamma, beta, and normal distributions are discussed and illustrated with interesting engineering examples. The inclusion of more than a few sentences on the more sophisticated concept of the central limit theorem would have been desirable even at this level because of its broad implications. Joint distributions and some derived distributions from the normal, e.g., the chi-square distribution, occupy Chap. 5 and 6. Mathematical expectations and the concept of moments are given in Chap. 7. The last chapter is devoted to some statistical applications. The inclusion of a chapter on stochastic processes, even briefly, would have been most valuable to the beginning reader by providing an introduction to another important area.

The book is well illustrated and has a wealth of problems. The style is excellent. In its spirit and content the book is on a level with the excellent book by H. Cramer, "The Elements of Probability Theory and Some of Its Applications" (Wiley, 1955), but it contains more illustrative examples and problems. It is highly recommended for a first course in the field.

Fluid Mechanics

The Science of Fluid Mechanics. Physical Foundations From the Engineer's Viewpoint. Vol. 1, Hydro- and Aerostatics Motion of Perfect Fluids. By O. Tietjens. Springer Verlag, Berlin, 1960. Cloth, xvi and 536 pp. DM 66.

REVIEWED BY J. KESTIN[10]

IT IS trite, but nevertheless true, to say that every generation must anew relearn the old, basic truths. Professor O. Tietjen's Volume I of the Science of Fluid Mechanics does teach with a purpose, and admirably restates the fundamentals. The purpose is simple, and yet, owing to its simplicity, so seldom achieved by others, and probably by no one yet, to the same extent. The purpose is to provide a clear, easily understandable, well-grounded body of theoretical knowledge which does not contradict observational facts. To quote Professor Tietjen's quotation from Daniel Bernoulli's letter on d'Alembert to Leonard Euler: "His *pièce sur les vents* contrives to say nothing, and though I have read all, I still know as much about the *ventis*, as I did before." The reader, and particularly the young student, will advance no such complaint about Professor Tietjen's admirable exposition. He will learn much about winds, the navigation of clouds, balloons, as well as about flow fields, ideal and real fluids, the distinction between potential and rotational flows, the part played by viscosity, about capillarity, the distinction between fluids and solids, and many topics of similar importance. Even established specialists will know more about Fluid Mechanics, after studying the present book, than they did before. Every step has been thought out carefully and with purpose; at every step observation serves as the basis for theory and care is taken to discover just how far, and to what limits, any particular theory or approximation can be used to advantage, i. e., to represent the facts of nature.

Professor O. Tietjens is a mathematician by education, which guarantees the soundness of his mathematical apparatus. In addition, he matured under L. Prandtl's personal guidance and so acquired Prandtl's intense reverence and feeling for physical facts. In this he is a true inheritor of the best tradition of the natural philosophers of the eighteenth and nineteenth centuries.

The present Vol. 1 is devoted to the study of the physical

[8] Professor, Technical University, Copenhagen, Denmark.

[9] Professor, Division of Engineering Sciences, Purdue University, Lafayette, Ind.

[10] Professor, Division of Engineering, Brown University, Providence, R. I.