BOOK REVIEWS

Théorie relativiste des Fluides à Spin. Recherches sur la Dynamique du Corpuscule tournant relativiste et l'Hydrodynamique relativiste des Fluides dotés d'une Densité de Moment angulaire interne. No. 10 of Les grands Problèmes des Sciences. By Francis Halbwachs. 294 pp. Gauthier-Villars, Paris, 1960. Paperbound $12.50. *Reviewed by Nandor L. Balazs, Princeton University.*

WE all know how relativity theory brought together seemingly unrelated phenomena and provided an elegant framework to express these relationships. For example the Lorentz force, which originally was unrelated to the electric force acting on a charge, turned out to be simply connected to the electric force acting on a charge at *rest*; indeed, it was the same force viewed from a moving frame of reference and as such it was also a simple consequence of the relativistic transformation laws of the electromagnetic field. Also, the fact that in any theory only Lorentz invariant objects can figure, suggested natural ways to extend results which were only known in the nonrelativistic limit, as the development of relativistic mechanics and hydrodynamics shows.

Since 1925 we have been prone to think of the spinning electron as a small rigid sphere endowed with an intrinsic angular momentum about its center of mass. During the past thirty years a body of literature grew up to give this model a relativistic form. The difficulties were great, since relativistically a rigid body does not exist, and in relativistic dynamics the mass center and angular momentum turn out to be very sophisticated concepts. Therefore the relativistic model finally adopted turned out to be a fluid carrying an intrinsic angular momentum density. If one wishes, one can treat this fluid as an object of interest of its own, or as a representative fluid related to the wave function of a spinning particle, as has been done by Madelung in the past, and more recently by Bohm and Vigier, the author of this book, and others.

The present book develops in an admirably clear manner the whole theory of fluids endowed with an intrinsic spin. First, the author describes the relativistic dynamics of a spinning point particle; here, he provides a careful discussion of the difficult concepts of relativistic centers of mass, spin tensor, spin four-vector, etc. Next, he treats the relativistic hydrodynamics of the representative fluid constructed from the wave functions of a particle. Finally, he discusses the classical relativistic hydrodynamics of a fluid composed of spinning point particles. The diverse treatments and methods which appear in the literature are clearly presented, and they emerge here as special cases of a unified treatment. (The only objection I have is that no reference is made to the works of Kramers, *Collected Scientific Papers,* North-Holland Publishing Co., Amsterdam, 1956, pp. 677, 683; Synge, *Relativity: The Special Theory,* North-Holland Publishing Co., Amsterdam, 1956; and Bargmann, Michel, and Telegdi, Phys. Rev. Letters, **2**, 435 (1959) all contributing greatly to this subject.) As an additional gift, the author gives an excellent summary of ordinary relativistic hydrodynamics in Appendix B, and a lucid discussion of the relativistic conservation laws and their relation to the invariance properties of the Lagrangian in Appendix C. (The printing of the book is excellent, which in itself is an achievement considering the abundance of symbols with many indexes in relativity.)

This book should be read by everybody who likes clarity and elegance in the presentation of a difficult subject.

Theory of Thermal Stresses. By Bruno A. Boley and Jerome H. Weiner. 586 pp. John Wiley & Sons, Inc., New York, 1960. $15.50. *Reviewed by Ellis H. Dill, University of Washington.*

THIS book is concerned with the analysis of a solid body when it is subjected to specified heating conditions: the determination of the temperature distribution and the stress distribution. It is primarily of interest to the research worker and the practicing engineer, but it is also suitable for a graduate-level text. As a reference work, it is the only good treatment available. The authors should be especially commended for the completeness and for the numerous references to the technical literature; in this respect, the book ranks as a treatise.

The first of the four parts contains a complete and elegant presentation of the basic theory. It begins with a statement of the thermodynamical and mechanical foundations of the subject and proceeds to a complete formulation of the coupled boundary-value problem for the isotropic elastic and linear viscoelastic solids. Indicial notation, the summation convention, and vector representation are used. It then deals with the formulation of the uncoupled quasistatic thermoelastic problem, formulation of the thermoelastic problem in either stress or strain, and two-dimensional problems.

The second part is devoted to the formulation and solution of the uncoupled temperature distribution problem, i.e., to the Fourier heat conduction equation. Solutions to basic problems are presented and the

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principal methods of solution of complex problems are completely discussed and many examples given.

The solution of the uncoupled thermoelastic stress problem is discussed in the third part. In addition to the basic problems concerning the stress distribution in infinite solids, plates, beams, and cylinders, methods of analysis for beams, plates, and various built-up structures are presented; thermoelastic stability of rods and plates is also discussed.

The last part contains a fine presentation of the state of knowledge of inelastic behavior in the presence of elevated temperatures. This includes a discussion of plasticity, viscoelasticity, and combined effects. In the final two chapters, the formulation of viscoelastic and plastic problems is discussed and extensive references to existing solutions are listed.

The reviewer can offer only a slight criticism: the book is unnecessarily long because the authors have, unfortunately, found it desirable to write the second and third parts in a different notation than that used in the other two parts. This is presumably justified by the desire to make the material of parts three and four available to people of a "practical" background. It is supposed, correctly, that using a notation familiar to the reader will cause the book to be accepted as a work of unusual clarity. It does indeed allow the reader to avoid learning something new and, no doubt, the authors will be rewarded by the gratitude of many readers. But in the end, as J. Barzun observes in *The House of Intellect*, concerning thought-clichés, this can only serve to weaken attention, curiosity, and the critical sense.

Infrared Radiation. By Henry L. Hackforth. 303 pp. McGraw-Hill Book Co., Inc., New York, 1960. $10.00. *Reviewed by Stanley S. Ballard, University of Florida.*

INFRARED has come to be more than just the name of a section of the electromagnetic spectrum. During the last ten or fifteen years, the word "infrared" has achieved increased connotation as a new field of applied physics and technology. Much like two other regions of the electromagnetic spectrum, microwaves and x rays, infrared now stands for a whole technology, and is often used as a noun rather than as an adjective. The present-day uses are concentrated in the wavelength range 0.8 to 15 microns, but there is work under way at longer wavelengths, extending to a millimeter or more. Of course, infrared spectroscopy and spectrophotometry have been practiced for a good many years by both the physicist and the chemist. The new field of technology may be considered by some to include these "classical" techniques, but the chief emphasis in modern infrared technology is on military applications, which were given great impetus during World War II. These techniques, instruments, and systems are now emerging from the security ban much as radar did shortly after the war.

Hackforth's book is the first one in the English language to give a rather complete account of the extent of the new field of infrared physics and technology. It is an excellent review; it covers both the basic principles of infrared radiation and their employment in practical applications; it includes a long recitation of the many applications of infrared, extending from the spectrographic laboratory through uses in the sciences, in industry, by the military, and finally in space technology. There are many good diagrams and several halftone illustrations. To be sure, the treatment is rather superficial, as would be expected when so much varied information is crowded into a book of only 300 pages. Nevertheless, many references are given to the literature and there are additional listings, both at chapter end and in the appendix, of books on infrared radiation and related subjects.

Other texts now in preparation will go deeper into selected aspects of infrared physics, engineering, and technology, but Hackforth has done the important job of surveying the field in its broadest reaches. Nevertheless, I question the statement in the preface that the text has been written for use in junior college and university courses. I do not believe it would be a successful textbook on this level; I believe it will find its greatest use in what might be called "after-dinner reading" by persons who want to become aware of the nature and extent of this new technology which is attracting so much attention in industrial and military circles.

Although the general format and appearance of the book are beyond criticism, there are a number of details which should have been given closer attention. The form of quoting literature references is far from that normally employed by American physicists, and even references to a given journal vary in form from place to place. I would think that the publisher would pay attention to these details, and would also protect the reader from the incorrect spelling of the names of such prominent physicists as Richtmeyer (sic) and Bridgeman (sic). Among the 171 literature references are many to house organs of manufacturers of infrared equipment, but this cannot be helped in a field which is as yet so poorly documented in the archival literature. At the same time, it would be useful to give standard literature references when they are available—for instance, reference 29 on p. 68 is to "paper at Fourth Congress of International Commission on Optics . . .", whereas a more useful reference would be J. Opt. Soc. Am. 47, 491–498 (1957). One wonders how familiar the author is with our academic and professional systems, and whether he has not been educated and spent most of his professional life elsewhere, particularly when one sees references such as those on pp. 174–175 to "Harvard University, United States" and "Johns Hopkins University, United States"! Again, one wonders why the all-American publisher did not catch these points.

Nevertheless, your reviewer heartily recommends *Infrared Radiation* as a general introduction to this vigorous new field of physics and technology.