

BOOK REVIEWS

Progress in Elementary Particle and Cosmic Ray Physics, Volume 5. Edited by J. G. Wilson and S. A. Wouthuysen. 461 pp. (North-Holland Publishing Co., Netherlands) Interscience Publishers, Inc., New York, 1960. \$10.75. *Reviewed by D. Keefe, Lawrence Radiation Laboratory.*

THE fifth volume in this series adds five more excellent and well-produced review articles on topics in elementary particle physics. It is easy to deplore the long delay—about eighteen months—between the writing of the articles and their appearance in print, but comparable publication delays even of original papers and conference reports seem an inevitable feature of today. Whether by judicious editorial choice of matter or good fortune, the value of these reviews has not in any way been impaired by the time lapse.

A characteristic of this and the previous volumes is the extremely comprehensive bibliographies. On reading Arne Lundby's review of weak interactions one is again struck by the avalanche of experimental work triggered by Lee and Yang's paper of just four years ago. In the eighty or so pages allotted to him, Lundby has little space for the development of ideas but has contented himself with presenting all the important relevant formulas and summaries of the experimental results and techniques.

The various phenomenological theories of neutron-proton and proton-proton interactions in the energy region below 300 or 400 Mev are discussed in detail by J. L. Gammel and R. M. Thaler. This is a subject in which many precise and detailed comparisons can be made between theory and experiment and these are exhaustively treated, particularly the comparative predictions of the authors' and the Signell-Marshak theories.

Chapter 3 on the theory of antinucleons is by J. McConnell. His calculations some 13 years ago on the expected modes of production and annihilation of antiprotons led Rochester and Butler to make a cloud-chamber search for the predicted particles at mountain altitudes; if they failed in their primary aim, the discovery of V particles was no mean compensation. This is an opportune time for such a review in the breathing space, so to speak, before the intense antinucleon beams now available at the CERN proton synchrotron (and presumably soon at the Brookhaven AGS) are used to study the high-energy region. To date, virtually all the experimental data have been obtained from antinucleons produced at the Bevatron and are confined to energies below about 2 Bev. Despite the large body of theoretical work there is

still no satisfactory theory with which to compare the results except at the lowest energies.

Probably the most needed review in this volume is that of D. H. Perkins on cosmic-ray "jets" in nuclear emulsions, corresponding to energies several orders of magnitude greater than those made available by accelerators. In the direct study of nuclear interactions at 10^{12} to 10^{14} ev the emulsion technique is pre-eminent. The improvement in the last few years of high-altitude balloon techniques so that giant stacks can be flown for long periods has led to a rapid increase in our knowledge of how particles behave at those energies. The amount of detailed work necessary to analyze each individual event found is nevertheless very great, and the accumulation of statistics is a painstaking business. Paradoxically or not, many aspects of nuclear theory become simpler in this ultra-relativistic region and there is here a full and instructive discussion of how the results may be compared with present theories.

Recently there have been several careful experiments on the interaction rate of μ^- mesons in various materials, particularly with a view to elucidating the suspected anomaly in the region of the transition elements. Although some of the experimental data presented by R. M. Tennent in the final chapter on μ^- decay and interaction has now been considerably improved upon, this is still a valuable survey of the main problems in a very much alive field and is designed to review progress since the fine summary of Sard and Crouch in Volume 2 of this series six years ago.

The editors draw attention to the dichotomy in the field of cosmic-ray physics which has emerged since the series was begun, and it is intended to devote succeeding volumes alternately to cosmic rays and to elementary particle physics. The next volume will be a cosmic-ray volume.

The Scientific Papers of Sir Geoffrey Ingram Taylor. Volume 2, Meteorology, Oceanography and Turbulent Flow. Edited by G. K. Batchelor. 515 pp. Cambridge U. Press, New York, 1960. \$14.50. *Reviewed by R. E. Street, University of Washington.*

AT the turn of the century, with the introduction of the quantum theory by Planck and the principle of relativity by Einstein, the majority of research physicists turned to problems of the ultimate nature of matter which required the new laws of quantum theory and relativity, and neglected the still unsolved problems of classical mechanics which involve the properties of gases, liquids, and solids as

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observed from the macroscopic point of view. Today it is apparent that quantum mechanics is becoming more and more necessary to understand the laws of high-speed gas flows, and solid-state physics is becoming merged with the classical mechanics of solids. However, a few outstanding scientists such as Prandtl, von Kármán, G. I. Taylor, and others, in the tradition of Rayleigh, Love, and Lamb, by using classical mechanics alone, have increased our understanding of the flow of fluids and the mechanics of solids. As more physicists turn to problems which involve the properties of fluids and solids, they will find the availability of the collected papers of these men of the greatest value. In particular, the collected works of G. I. Taylor should serve as model and inspiration to workers in the field of fluid and solid mechanics for a long time to come. What is characteristic of Taylor's work as a whole is his apparent enthusiasm for the subject and the deft use of just the sufficient and appropriate mathematics to weave a theory and then the amassing of experimental evidence, usually with the aid of co-workers, to justify and confirm the mathematics.

The first volume of Taylor's works contains his papers on the mechanics of solids. Two more volumes of his papers on fluid mechanics are yet to come. Apparently, the last two will contain the papers on laminar flows, shock waves, and sound, as the volume at hand has as its theme the topic of turbulence in incompressible flows alone. From the very first paper, "Eddy Motion in the Atmosphere", and continuing through the volume, one sees the development of Taylor's ideas on eddying flow which culminated in his statistical theory of turbulence, twenty years later. Included are the most famous papers, such as "Diffusion by Continuous Movements", "Waves and Tides in the Atmosphere", "The Transport of Vorticity and Heat through Fluids in Turbulent Motion", "Statistical Theory of Turbulence" in five parts, "Mechanism of the Production of Small Eddies from Large Ones", and "The Spectrum of Turbulence" among others. Some of the papers are short gems of keen insight and clear analysis.

One well-known physicist is supposed to have said that he would die happy if he could first understand quantum mechanics and turbulence. The prospects do not appear bright, since the problem of turbulence remains today a most difficult one. Other minds have ventured into the field and new and fertile concepts have been proposed, many of which owe a debt to Sir Geoffrey Taylor as well as Prandtl and von Kármán. A complete theory is yet unknown, and, until it is, this volume will be almost indispensable to the worker in the field, especially the newcomer who will find this collection into one volume most convenient for study.

There are other papers on fog, tidal friction, tidal oscillations, waves, and tides in the atmosphere which are not so intimately tied up with the turbulence concept, but which illustrate Taylor's wide interest in natu-

ral phenomena of the fluid dynamical type. Although G. I. Taylor retired from his position at Cambridge as Yarrow Research Professor of the Royal Society in 1951, his writing and research have continued unabated and three of the papers in the present volume were published since then. Like so many great scientists, G. I. Taylor was also an outstanding teacher, and there are today at Cambridge, as well as all around the rest of the world, former students who are carrying forward his pioneering work. One of these is the editor of these four volumes, Professor G. K. Batchelor, who, while he had the assistance of Taylor himself in finding, sorting, and correcting the papers, has done an excellent and obviously time-consuming job of preparing and editing this volume as well as the other three. To him as well as the Syndics of the Cambridge University Press we offer our thanks for a volume which is pleasing to the eye and hand as well as to the mind.

Advances in Spectroscopy, Volume 1. Edited by H. W. Thompson. 363 pp. Interscience Publishers, Inc., New York, 1959. \$12.50. Reviewed by Stanley S. Ballard, University of Florida.

ONE might perhaps be pardoned for feeling that there are already quite a few "Advances in . . ." and "Progress in . . ." series, and for questioning whether still another is needed. It does appear, however, that the new series *Advances in Spectroscopy* will indeed be a welcome addition to the literature of this field, which is currently enjoying such a vigorous renaissance. To quote from the editor's introduction to the series, ". . . spectroscopy now occupies a leading place among the modern physicochemical techniques, not only in pure and applied research, but also for many routine scientific operations. The applications in physics, chemistry, and biochemistry cover a wide range; they bear upon questions of atomic and molecular structure, of qualitative and quantitative analysis, and they lead to data about the energy levels of atoms, molecules, ions or aggregates which are useful in relation to physical and chemical properties of materials." Thus the editor undertakes to cover in this series "all important aspects of spectroscopy, pure and applied, atomic and molecular, emission and absorption, relating to physics, chemistry, biology, astrophysics, meteorology and general technique".

Dr. Thompson is well known as an active worker in spectroscopy and as a chemist with very broad scientific interests. On the advisory board for this series are academic and industrial chemists and physicists of wide reputation: R. R. Brattain of the Shell Development Company, G. H. Dieke of Johns Hopkins University, and R. C. Lord of MIT; G. Herzberg and R. N. Jones of the National Research Council of Canada; W. C. Price of King's College, London; and P. Swings of the Astrophysics Institute in Liège, Belgium. One can have confidence that this group of acknowledged experts will choose timely subjects for discussion in the volumes to