

mism. Shortsighted maneuvers by Congress pose a threat to our ability to maintain leadership in nuclear engineering, which is a development that can evolve in a satisfactory manner only by being able to attract competent technical personnel. "If low salaries, lack of tenure, and occasional intemperate attacks were the only things to be borne they would not in themselves raise such a serious question," says Mr. Lilienthal. "The difficulties, however, are more fundamental. They consist in the growing evidence that a tendency toward detailed Congressional supervision of this and other essentially technical undertakings makes the doing of a creditable job quite impossible."

Those who have in the past disagreed with Mr. Lilienthal and TVA are perhaps not likely to be won over suddenly by what he has to say here; but for those who do agree and who have followed his career with appreciation and respect, the book will be of interest as a careful statement in review of those principles which he believes to be most important to the healthful continuance of a functioning democracy. RRD

### Combustion Research

THIRD SYMPOSIUM ON COMBUSTION FLAME AND EXPLOSION PHENOMENA. 748 pp. Williams and Wilkins Company, Baltimore, 1949. \$13.50.

Anyone who has ever worked with internal combustion engines—whether of the reciprocating or turbine type—knows that the greatest problem facing the designer and the theoretical investigator is one of fuel combustion. Not only do the actual combustion and flame propagation present enormous difficulties but they lead to other complications in the method of injection and ignition of the fuel. Therefore there has been, and is, no real isolation of the problem.

The present volume, containing the collected papers of the third symposium on combustion flame and explosion phenomena (held at Madison, Wisconsin in September of 1948), represents a rather sweeping survey of the field, both theoretically and experimentally. A total of one hundred papers is included under eleven major headings, with the largest number appearing in the group, Kinetics and Mechanism of Combustion Reactions.

Exactly what happens inside a cylinder in which an explosion occurs has long been fascinating. Pictures have been taken and studied in minute detail but pre-ignition and unequal distribution of temperature and pressure still dog the footsteps of the investigator in this field. Despite the experimental evidence—which is all too sketchy—and the shrewd guesses of many theorists, the inside of any combustion chamber still remains a great mystery.

It is safe to say that carburetion and ignition gave more trouble to engine designers during the last war than other single items of design. When the reciprocating engine was deserted for the turbo-jet, ram-jet, and other types, the problems of combustion trotted right along. Keeping the fire going at an even rate is of fundamental importance, and is still to be completely settled. Whereas there were volumes written on compressors and turbines there was almost nothing written on combustion

chamber design and less on research in this field. Therefore the present volume takes on added importance because it puts another sorely needed book on a shelf which is too bare.

But lest the impression be given that combustion is important uniquely in the field of engine design we need only recall that combustion is of essential economic and physical (in the sense of health) importance to everyone who must use a source of heat other than the sun to warm his house. When on top of this it is remembered that liquid fuel supplies in the United States are dangerously low, then we see the added significance and need for knowledge concerning efficient combustion and flame propagation. Not only is this field of research of essential importance to many other fields but it also happens to be the field which, above any other known to the writer, has been most consistently neglected over the years. In an entirely different connection the necessity for greater knowledge concerning explosion and combustion phenomena is illustrated: namely in human safety. It is more than coincidence that many of the outstanding men in the combustion field are members of the scientific staff of the Bureau of Mines.

Obviously it is impossible to review a collection of one hundred learned papers in any space that a journal can reasonably allot. However, it might be of some interest and value to list the headings of the eleven divisions. They are: Flame Stabilization and Quenching; Flame Propagation in Explosive Gas Mixtures; Flames of Fuel Jets; Ignition of Gas Mixtures; Kinetics and Mechanism of Combustion Reactions; Flame Spectroscopy and Radiation; Burning Detonation of Explosives; Thermodynamics of Flame Gases and Thermochemistry; Experimental Techniques; Combustion in Engines and Rockets; and Gas Burners and Furnaces.

The volume is especially noteworthy as an example of excellent editing and publishing. All too frequently published collections of papers originally read at the meetings of learned societies give an impression of extreme haste and carelessness, as though the editor had placed the papers in the volume just as he had received them across his desk and without regard to their proper order within appropriate subject categories. No such charge may be made in this instance. Workers in this field, whether physicists, chemists, or engineers, will find this a useful book to have around. It may not answer all or even a majority of the questions likely to arise, but as a survey of the present state of knowledge it will be a valuable supplement to other kinds of research apparatus.

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### Guessing Game

STOCHASTIC PROCESSES AND THEIR APPLICATION TO THE THEORY OF COSMIC RADIATION. By Niels Arley. 240 pp. John Wiley and Sons, New York, 1948. \$5.00.

An English translation of a Danish thesis first published in 1943, this book deals with the important problem of providing a mathematical theory of some aspects of cosmic ray showers. When a primary electron enters a layer of matter it has a chance of emitting a photon

which in turn has a chance of producing a pair (electron and positron). The secondary electron, if sufficiently energetic, can again emit a photon and so on. The main problem is to determine the average number of electrons leaving a layer of given thickness and the fluctuation (second moment) of this number.

The problem in its full generality is prohibitively difficult. Since 1937 when the fundamental papers of Bhalha and Heitler and of Carlson and Oppenheimer appeared there were several attempts to treat the problem by postulating simplified models. None of these proved to be too satisfactory for heavy elements at low energies and the author proposes a new model which he claims gives in some cases good agreement with experimental data. Although it is impossible to give an understandable description of the author's model without going into great detail, it must be said that the model is much simpler than the rather formidable mathematical introduction would lead one to believe. In fact, the reviewer is somewhat puzzled by the inclusion of the first three chapters (Survey of the Theory of Stochastic Processes, The General Theory of One-Dimensional Stochastic Processes, The General Theory of Multi-Dimensional Stochastic Processes). The general theory presented in these chapters (mainly a review and some extension of the work of W. Feller and O. Lundberg) is by itself of considerable mathematical interest but in no way essential to the understanding of the author's model discussed in Part II. The second part of the book also contains a discussion of the older models, a readable account of the physical theory of cosmic radiation (dealing with the elementary processes of photon emission and pair production), and a final chapter comparing theory with experiments. There are two appendices: one on exponentiable matrices and one on numerical computation of the integral from zero to  $x$  of exponential ( $t^2$ ) dt.

The agreement with experiments, which is always the final test of every physical theory, is difficult to judge. It may, however, be of interest to report that quite recently R. R. Wilson of Cornell University attacked the problem of cosmic ray showers by a statistical method (referred to often as the "Monte Carlo" method) which consists of imitating by an artificial game of chance the stochastic process of shower formation. The results have confirmed many experimental facts but have also contradicted some of Arley's conclusions.

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### Books Received

THE STRUCTURE OF MATTER. By Francis Owen Rice and Edward Teller. 361 pp. John Wiley and Sons, Inc., New York, 1949. \$5.00.

ULTRASONIC FUNDAMENTALS. By S. Young White. 36 pp. Radio Magazines, Inc., New York, 1949. \$1.75.

TEACHING CONDITIONS AND THE WORK WEEK OF HIGH SCHOOL SCIENCE TEACHERS. Bulletin 1947-48. 18 pp. National Science Teachers Association, Washington, D. C., 1949. \$0.25.

HISTOPATHOLOGY OF IRRADIATION FROM EXTERNAL AND INTERNAL SOURCES. Edited by William Bloom. 808 pp. McGraw-Hill Book Company, Inc., New York, 1948. \$8.00.

INTRODUCTION TO STATISTICAL MECHANICS. By Ronald W. Gurney. 268 pp. McGraw-Hill Book Company, Inc., 1949. \$5.00.

LIGHT AND MATTER. By B. M. Sen. 69 pp. Longmans, Green and Company, Calcutta, 1948. Rs 2/8 (New York, 1949. \$1.00).

CHAMBERS SIX-FIGURE MATHEMATICAL TABLES. By L. J. Comrie. VOLUME I. 576 pp. VOLUME II. 576 pp. D. Van Nostrand Company, Inc., New York, 1949. Each VOLUME, \$10.00. Set, \$17.50.

HOT-TINNING. By W. E. Hoare. 112 pp. Tin Research Institute, Greenford, England, 1948. Obtainable from publisher. No charge.

IONIZATION CHAMBERS AND COUNTERS: EXPERIMENTAL TECHNIQUES. By Bruno B. Rossi and Hans H. Staub. 243 pp. McGraw-Hill Book Company, Inc., 1949. \$2.25.

SCIENTIFIC AUTOBIOGRAPHY AND OTHER PAPERS. By Max Planck. 192 pp. Translated from the German by Frank Gaynor. The Philosophical Library, New York, 1949. \$3.75.

ISOTOPIC TRACERS AND NUCLEAR RADIATIONS. By William E. Siri. 653 pp. McGraw-Hill Book Company, Inc., New York, 1949. \$12.50.

TITANIUM. By Jelks Barksdale. 591 pp. The Ronald Press Company, New York, 1949. \$10.00.

ENERGY AND MATTER. By R. L. Worrall. 144 pp. Staples Press, Ltd., London, 1948. 10/6.

BASIC ELECTRONICS. By Royce G. Kloeffler and Maurice W. Horrell. 435 pp. John Wiley and Sons, Inc., New York, 1949. \$5.00.

ELEMENTS OF PATENT LAW. By Fred H. Rhodes. 189 pp. Cornell University Press, Ithaca, New York, 1949. \$2.75.

INFRARED DETERMINATION OF ORGANIC STRUCTURES. By H. M. Randall, Nelson Fuson, R. G. Fowler, and J. R. Dargl. 239 pp. D. Van Nostrand Company, Inc., New York, 1949. \$10.00.

FUNDAMENTALS OF VACUUM TUBES. Third Edition. By Austin V. Eastman. 644 pp. McGraw-Hill Book Company, New York, 1949. \$5.50.

ATOMIC ENERGY LEVELS, VOLUME I. By Charlotte E. Moore. 309 pp. U. S. Government Printing Office, Washington 25, D. C. \$2.75.

ATOMIC MEDICINE. Edited by Charles F. Behrens. 416 pp. Thomas Nelson and Sons, New York, 1949. \$7.50.

ELECTRICAL ENGINEERS' HANDBOOK. Fourth Edition. By Harold Pender and William A. Del Mar. John Wiley and Sons, Inc., New York, 1949. \$8.50.

THEORY OF HEARING. By Ernest Glen Wever. 484 pp. John Wiley and Sons, Inc., New York, 1949. \$6.00.

MAN AND THIS MYSTERIOUS UNIVERSE. By Brynjolf Bjorset. 174 pp. Philosophical Library, New York, 1949. \$3.75.

PHYSICS WITHOUT MATHEMATICS. By Clarence E. Bennett. 200 pp. Barnes and Noble, Inc., New York, 1949. \$1.25.

PRACTICAL SPECTROSCOPY. By C. Candler. 190 pp. Hilger and Watts, Ltd., London, 1949. 21/.

INTRODUCTION TO THEORETICAL AND EXPERIMENTAL OPTICS. By Joseph Valasek. 454 pp. John Wiley and Sons, Inc., New York, 1949. \$6.50.

ELECTRONICS: EXPERIMENTAL TECHNIQUES. By William C. Elmore and Matthew L. Sands. 417 pp. McGraw-Hill Book Company, New York, 1949. \$3.75.

FLUORESCENCE AND PHOSPHORESCENCE. By Peter Pringsheim. 794 pp. Interscience Publishers, Inc., New York, 1949. \$15.00.