

the mathematical detail that is lacking by following up the original articles which are referenced in a very thorough fashion. The Risø report fills a void which has existed for a long time.

Fast Reactor Cross Sections. A Study Leading to a 16 Group Set. By S. Yiftah, D. Okrent, P. A. Moldauer. Vol. 4 of Division 2, Nuclear Physics, in the Internat'l Series of Monographs on Nuclear Energy, J. V. Dunworth, gen. ed. 130 pp. Pergamon Press Ltd., Oxford, 1960. 35s. Reviewed by Eugene P. Wigner, Princeton University.

THIS is a short monograph but an interesting one. The fast reactors, with which it deals, are fission chain reactors in which the fission reaction is induced predominantly by fast neutrons, that is, neutrons of at least 100-kev energy. The authors attempt to calculate the nuclear characteristics (that is, the ability of the reactor to maintain a chain reaction) solely on the basis of fundamental data, such as fission cross sections, number of neutrons emitted per fission, elastic and inelastic-scattering cross sections, etc. The measurements of these quantities were collected, critically reviewed, and tabulated for each of their 16 neutron-energy groups. The first of these groups comprises neutrons the energy of which exceeds 3.67 Mev ($10/e$ Mev); the energy of the neutrons of the last group is between 0.5 and 2.1 kev ($10/e^{8.5}$ Mev). The calculation of the multiplication constants, danger coefficients, etc., is carried out by the so-called multigroup method, using as groups the 16 energy regions of the tabulation. The results of the calculation are compared with the critical properties of actual reactors (with exotic names such as Yezebel, Godiva, etc.) and subcritical assemblies. The disagreements, which are perhaps greater than optimists may have hoped, emphasize the significance of the comparison and also the gaps in our knowledge. These are also discussed in the booklet.

This small volume not only answers an intellectual challenge; it will also be useful for everyone interested in nuclear chain reactors. The results obtained should be useful also in the theory of thermal reactors inasmuch as they should make it possible to improve the calculation of the "fast effect", i.e., the contribution of the fast neutrons to the chain reaction.

Annual Review of Nuclear Science, Vol. 10. Edited by Emilio Segrè, Gerhart Friedlander, Walter E. Meyerhof. 617 pp. Annual Reviews, Inc., Palo Alto, Calif., 1960. \$7.00. Reviewed by D. Keefe, Lawrence Radiation Laboratory.

EIGHTEEN articles on cosmic rays, nuclear physics (at all energies), radiobiology, and radiochemistry are offered in the tenth volume of the *Annual Review of Nuclear Science*. The editors continue their usual policy of presenting a collection of articles self-contained and up to date with the valuable character-

istic that all can be easily read by the average nuclear scientist. This is a book you read not just for the reviews touching your own field but also to escape easily and profitably from your own compartment and find out what is new and interesting in other subjects.

F. Reines describes interactions of the neutrino—both the few which have been detected and the exciting ones predicted for the future. The history of the first twenty years of this Pimpnel particle has been reviewed many times but in recent years interest in its properties has been further aroused to the extent that new high-energy accelerators are being designed with this study in mind. Other aspects of high-energy physics are covered by H. Bradner who discusses the importance of bubble chambers, their design and construction, and the magnitude of the new data-processing problems posed, and by O. Chamberlain who summarizes the principles and design considerations underlying the construction of secondary particle beams at accelerators. In a group of three reviews on nucleon-nucleon scattering in the region up to 400 Mev, H. P. Stapp, M. H. MacGregor, and M. J. Moravcsik present a well-organized summary of the experimental situation in a field where several recent important advances have been made, and the corresponding theoretical analysis. They emphasize the phenomenological approach and the more satisfactory description in terms of dispersion theory, in contrast to some recent reviews on the same problem describing potential models and calculations based on meson theory.

A. Zucker treats the nuclear interactions of heavy ions from both the experimental and phenomenological points of view, and describes how scattering, transfer, compound-nucleus, and fission reactions may be analyzed. Certain complex nuclear reactions can only be studied by observing the angular and energy dependence of the recoiling heavy ion—the pertinent experimental techniques are discussed in B. G. Harvey's article on recoil techniques. The application of the shell model to the explanation of the energy levels of light nuclei, i.e., up to neon, is summarized by I. Talmi and I. Unna who discuss the theory of the single and many-particle states and go on to derive the energy levels; there is an extremely useful concomitant summary by Mrs. Selove and T. Lauritsen of the values of these energy levels, presented in diagrammatic form. E. L. Church and J. Weneser survey the present status of internal conversion and the information it can provide on nuclear structure, and consider the finite nuclear-charge, or static effect, the dynamical penetration effects, and in particular the important information to be derived from EO or monopole transitions.

In recent years very elaborate and costly experiments have been set up in several countries to attack the problems of extensive air showers in the atmosphere; apart from the cosmological problem there are several features of the atmospheric development process which are still baffling. K. Greisen recounts the latest information obtained in this field on the size and structure

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PEACETIME USES OF OUTER SPACE

Edited by **SIMON RAMO**, Thompson Ramo-Woolridge, Inc. Available in August, 1961.

This remarkable volume brings together outstanding scientists, educators, politicians, and businessmen for an examination of the coming space age. Emphasizing the peacetime, non-military aspects of space technology, the book seeks to heighten public responsiveness to the full impact of science and technology in shaping our future. Contributors include: Leston Faneuf, J. H. Doolittle, Lloyd V. Berkner, Congressman Overton Brooks, Ralph J. Cordiner, Willard F. Libby, Vice Admiral John T. Hayward, Joseph Kaplan, Morris Neiburger, Brigadier General Don D. Flickinger, Leo Goldberg, Edward Teller, and Frederick R. Kappel.

THERMAL REGIMES OF COMBUSTION

By **L. A. VULIS**; translated from the Russian by **GLENN WILLIAMS**, Massachusetts Institute of Technology, and others for the project **SQUID**, Princeton, N. J. Available in July, 1961.

Of primary interest to chemical and mechanical engineers and to chemists and physicists interested in kinetics, this timely translation offers a detailed mathematical discussion of the consequences of applying simple thermal combustion theory and simplified (first order) kinetics to over-all combustion problems. This material is not available in comparable detail in any other English source.

PROCEEDINGS OF THE SIXTH SYMPOSIUM ON MAGNETISM AND MAGNETIC MATERIALS

Edited by **J. A. OSBORN**, Westinghouse Electric Corp. 408 pages, \$10.00.

A compilation of recent work in the field of magnetism and magnetic materials, this book contains a collection of technical papers presented at the annual symposium sponsored by the American Institute of Electrical Engineers and the American Institute of Physics. Topics include ordered spin systems, computer devices, metallic films, nuclear hyperfine fields, ferromagnetic resonance, high coercive materials, exchange interactions, fine particles, magnetization processes, anisotropy, domain walls, microwave devices, and oxides.

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measurements of the various shower components and also describes the recent Russian work on the new technique of observing the Čerenkov light from showers. The world-wide correlation of information organized during the International Geophysical Year between different experimenters using a variety of techniques to observe the same phenomenon, is described by E. P. Ney in an article on cosmic-ray results obtained during the IGY. He gives a valuable résumé of how balloon and satellite flights, the Argus experiments, and radio observations have led, in this united effort, to a spectacular increase in our knowledge of the nature of the radiation belts and of solar cosmic rays.

J. G. Beckerly gives an interesting account of nuclear methods in subsurface prospecting, largely by gamma-ray and neutron techniques, and draws attention to how difficult it is to extract useful information under actual field conditions, namely, faced with a borehole four inches across and perhaps a few miles deep. The labeling of organic compounds by recoil methods is the subject of A. P. Wolf's review; after a nuclear reaction the recoiling radioactive atom travels some distance and then frequently enters into organic combination, thus allowing organic compounds to be labeled with, for example, carbon-14 or tritium.

Finally there is one article on cellular radiobiology and two on vertebrate radiobiology. The first, by T. Alper, includes a discussion of dose-effect relationships, the influence of various types of radiation, the effects of treatment before, during, and after irradiation, biochemical investigations and speculations on the mechanisms involved. R. C. Thompson considers the consequences of the entry of radioisotopes into the body, for example, by ingestion or inhalation, and details the metabolic properties of specific internal emitters according to their chemical properties. J. B. Storer and D. Grahn examine in their review the late effects of radiation on man and experimental animals, such as life-shortening, congenital abnormalities, and genetic effects. These are problems which, regrettably, have become of increasing importance in recent years, and an up-to-date presentation of what is still a rather cloudy picture is always welcome.

Variational Principles in Dynamics and Quantum Theory (2nd ed.). By Wolfgang Yourgrau and Stanley Mandelstam. 180 pp. Pitman Publishing Corp., New York, 1960. \$5.75. Reviewed by J. Gillis, *The Weizmann Institute of Science*.

THIS very timely monograph contains a most interesting and illuminating account of variational principles, the ideas behind them, and their applications. The essentially theologico-philosophical basis of all such theories is made clear in an interesting historical prologue which takes us from the Ionians to Fermat. However, as the authors make clear, it is with the enunciation by Maupertuis in 1744 of his principle of