

for massive support of biomedical science, both because of the great social value of the improved general health it is likely to make possible and because of the way in which the biomedical sciences interact with and enrich the physical sciences and the social sciences.

In the fourth and last collection of essays grouped under the heading "The Institutions of Big Sciences," Dr. Weinberg considers the relations between the large federal laboratories and the universities, and the roles appropriate to each type of institution. Dr. Weinberg is at his best in discussing the missions of the federal laboratories, how they choose their goals, obtain their support, and organize their effort. Their task is to organize a multi-disciplinary attack on the complex technical or social problems of society. Examples of today's goals are nuclear energy, fusion, manned space flight, control of disease. Appropriate goals for the future suggested by Dr. Weinberg are production of fresh water from the ocean, control of atmospheric pollution, civil defense, urban renewal, mass transportation. In the federal laboratories, the mission is dominant, and individual sciences and scientists cooperate in accomplishing the mission.

In the universities, Dr. Weinberg contends that the individual disciplines are dominant, that science is pursued primarily for science's sake, and that there is little interaction or cooperation among disciplines. This reviewer agrees that this judgment is occasionally valid, but wishes to cite one example of university activity which is not undesirably fragmented. Mission-oriented departments of engineering schools, such as departments of aeronautical or nuclear engineering, are as good examples of cooperation among diverse disciplines pursuing common goals as can be found in any of the federal laboratories. Dr. Weinberg makes the sound judgment that the primary aim of the university is education, and that the justification for research at a university must be its contribution to education. He points out how federal laboratories and universities can assist and strengthen each other by engaging in joint endeavors and sharing staff, and concludes by expressing the hope that the "Universities and federal laboratories, instead of competing, will continue mutually to reinforce each other to the great advantage of the society that supports them."

In his Preface, Dr. Weinberg writes: "I hope that my essays contribute to clarifying the issues and . . . that they help catalyze the debate both among those that agree and among those who disagree with me on the relation between modern society and modern science." This reviewer concludes that Dr. Weinberg's hope has been admirably achieved in this well-written and thought-provoking volume of essays.

Manson Benedict

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About the Reviewer: Manson Benedict is Professor of Nuclear Engineering at the Massachusetts Institute of Technology and Head of the Department. His association with nuclear energy has been long and varied, beginning with the technology of gaseous diffusion in 1942, to which he made very significant contributions. He has been chairman of the Atomic Energy Commission's General Advisory Committee and President of the American Nuclear Society. Dr. Benedict's graduate studies were at MIT.

Erwin Schrödinger: An Introduction to His Writings. By William T. Scott. University of Massachusetts Press, Amherst (1967). 175 pp. \$6.50.

Most physicists today have come into physics after the full development of quantum mechanics and take this development for granted along with the rest of physics. This book gives them the opportunity to experience something of the spirit of the decade of the twenties (when matrix and wave mechanics were being discovered), through a searching analysis, both critical and sympathetic, of the scientific papers and books of one of the key figures of this startling decade.

The first part is an excellent biographical sketch of the man, Erwin Schrödinger, a delightful human being, as well as a scientist and a philosopher. The reader is then introduced to his thought and achievements through an introduction to his writings. The great Boltzmann had the most profound influence on the young Schrödinger, and his early work was devoted to a variety of papers on the statistical mechanics of gases, solid state applications, specific heats, and the like. Next, there is a review of the development of wave mechanics from Bohr and Sommerfeld through Heisenberg, Dirac, and DeBroglie, followed by a description of Schrödinger's by-now famous series of 1926 papers on wave mechanics. These papers cover the Schrödinger equation; the hydrogen atom, oscillator, and rigid rotator solutions of it; steady-state and time-dependent perturbation theory; and the important *Zitterbewegung* of the Dirac electron.

The remaining sections of the book are devoted to an illuminating survey of the interpretation of quantum mechanics in which Schrödinger was an active participant, and to his philosophical writings on nature, the self, life, and the relations of science and the humanities. For both of these topics, the author shares with his subject a breadth of understanding and interest unusual in the majority of physicists. This circumstance, combined with the historical approach, makes unusually valuable and perceptive the chapter on the interpretation of quantum mechanics in terms of the relation between waves and particles, the fate of the wave function when a measurement is made, configuration space, indeterminacy, etc. The last chapter, which deals with much broader philosophical questions, was for this reviewer the most interesting and provocative of all. It makes valuable reading for those in any field of science, and brings out the great breadth of interest and the capacity of both mind and spirit which marked Schrödinger.

This book is an important contribution to the history of twentieth century science. The author was unusually well fitted for writing it, and has certainly done a great service in undertaking the task. It makes rewarding reading and is highly recommended.

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July 28, 1967

About the Reviewer: Bill Pollard is a physicist, an administrator, and a theologian. His active academic career, as professor of theoretical physics at the University of Tennessee, was interrupted when the war took him into research on uranium isotope separation by gaseous diffusion; he stimulated the formation of Oak Ridge Asso-

ciated Universities, and has been Executive Director since its inception. He is a priest serving St. Stephens Episcopal Church in Oak Ridge.

Dr. Pollard did his graduate work at Rice and has authored many papers and books, the latest being *Man on a Spaceship*.

The Technical Applications of Radioactivity. By Engelbert Broda and Thomas Schönfeld. Pergamon Press (1966). 336 pp. \$15.00.

This volume is the English translation of the third German edition of *Die technischen Anwendungen der Radioaktivität*, Band I. The first and second German editions (1956, 1957) relied heavily on the papers from the 1955 Geneva Conference. The third German edition, essentially rewritten, appeared in 1962, and included material from the 1958 Geneva Conference along with work from the Paris (1957) and Copenhagen (1960) Conferences. It is perhaps unfortunate that the English translation has been delayed (copyright 1966). In many fields, this delay would have meant that the work was hopelessly outdated. In this case, there have been no major breakthroughs in technology or applications, and the usefulness of the work does not necessarily suffer from this delay.

The first 70 pages are devoted to a survey of fundamentals and measurement. This offers only the advantage of having this material included in the same volume as the applications themselves since the approach is conventional. This is followed by about 40 pages of laboratory-oriented techniques in chemical analysis. The remaining 220 pages sketch in a hurried fashion a very broad spectrum of applications to industry. Chapter headings include mining and oil production, metallurgical, engineering and electrical industries, chemical industry (70 pages), agriculture and forestry, and hydrology. Appendixes include a list of important isotopes and a page of conversion units.

The striking feature of the book is the reference list containing over 2500 papers. Since many references are papers presented to conferences held in Europe, or were included in their bibliographies, the book contains multitudinous references to Russian and other European literature. This offers the advantage of having references to applications which are not often seen in US bibliographies. However, the unavailability of these papers in the US means that there is little to be gained except the statement that a given technique was used to attack a particular problem.

The other salient feature of the book is the brevity with which each of the applications is mentioned. It has such a wide coverage that several techniques, each with its references, are included in a single paragraph. The effect produced is that of an annotated catalog of uses. Little description of the methodology of the technique is included except in the general sections of the first few chapters. A comparison with the standard US reference by Kohl, Zentner, and Lukens (*Radioisotope Applications Engineering*) shows considerably more emphasis on methodology by the latter authors.

The book is very useful for cross-fertilization purposes since it does list such a wide variety of applications. It belongs in the library of any radioisotope worker in industry or one who has interests in industrial isotope uses. Although not a book that he would use regularly in his ordinary practice, it will be a useful addition to the

reference volumes of any serious worker who wants a broad-band treatment of the field.

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About the Reviewer: An early worker in the radioisotope and radiation field, Ralph Overman has been active in a variety of research and educational activities in the nuclear field. He was associated with the thermal-diffusion uranium-isotope separation project and the Oak Ridge National Laboratories during and after World War II, and in 1948 established the Training Division of the Oak Ridge Institute of Nuclear Studies. Dr. Overman now heads his own consulting firm in Oak Ridge. He is a Fellow of the American Nuclear Society and a member of the Editorial Advisory Committee of Nuclear Science and Engineering, and has published two books in the field of radioactivity and experimental radiochemistry.

Proceedings of a Symposium on Neutron Monitoring for Radiological Protection. Sponsored by the International Atomic Energy Agency and convened in Vienna, August 29-September 2, 1966. Printed by the IAEA in Austria (January 1967). Available thru the National Agency for International Publications, Inc., 317 East 34th Street, New York. 702 pp. \$14.50.

The text is timely and important, particularly to individuals concerned with radiological protection, because it focuses on a highly specialized area where certain difficulties exist both from the standpoint of theory as well as instrumentation and measurement techniques. The reviewers feel that the book would be useful to the application specialist as well as to the erudite researcher who is desirous of finding answers to uncertainties existing in neutron dose assessment.

The very broad range of papers categorically fall under the following topic headings:

- 1) Physical Aspects of Neutron Dosimetry
- 2) Liquid Dielectric and Scintillation Detectors
- 3) Semi-Conductor Detectors, Single Sphere and Multi-sphere Systems
- 4) Dosimetry Experience and Problems in Various Installations
- 5) Developments in Personnel Monitoring
- 6) Dosimetry Studies for Accidents
- 7) Standardization and Calibration.

The major portion of the text is devoted to work presented by representatives of the Soviet Union, United Kingdom, Norway, Sweden, France, Federal Republic of Germany, Czechoslovakia, Canada, Italy, Poland, Yugoslavia, and the United States. About 25% of the total work reported in the text represents a fair approximation of what one may consider as "new developments." However, the chief advantage of the text is that it embodies within a single document the status of the art and descriptions of available