NUCLEAR SCIENCE AND ENGINEERING: 24, 310-312 (1966)

Book Reviews

Classical Scientific Papers — Physics. Fascimile reproductions of famous scientific papers. Collection and Introduction by Stephen Wright. Published by American Elsevier Publishing Company, Inc., New York (1965). (Printed and made in Great Britain.) xix + 393 pages. $7.50.

Whenever an Englishman does come forth with a book, an idea, a practice, or an innovation, it is apt to be sufficiently refreshing, novel, and profound to deserve more than perfunctory attention. Wright's well-made book is no exception to this handy rule. What he has done is to collect under one cover the early, highly fundamental experimental papers—chosen mainly by a Ministry of Education Conference held at Oxford—that opened the door to our present-day knowledge of the inner nature of atomic nuclei, atoms, and molecules.

Wright begins his book with a seven-page introduction that traces, briefly but vividly, the history of atoms from Democritus (circa 400 B.C.) to 1890 A.D. Then follow the fascimile reproductions of 20 original papers and one chapter from a book. The authors of these papers spell out a breathtaking period in modern history; they are Rutherford, Soddy, Royds, J. J. Thompson, H. Geiger, Marsden, Nuttall, Moseley, Chadwick, Richardson, Compton, Doan, Cockcroft, Walton, C. T. R. Wilson, and Aston. Just 16 men whose experiments, carried out over a period of less than five decades after 1890, changed the whole course of scientific, economic, political, philosophical, and religious thought. All but three (Geiger, Compton, Doan) of the authors were subjects of the British Empire. The papers are all in English, and most of them were published in the *Philosophical Magazine* (good old Phil. Mag.!) or Royal Society (London) publications. Nearly half of the authors are still happily alive; unfortunately, the book fails to give biographical sketches for any of the sixteen.

Although such twentieth-century theoretical physicists as Planck, Einstein, Bohr, Gamov, and others are often mentioned, none of their celebrated papers is included in the book. Except for the two American papers by Richardson and Compton and by Compton and Doan, the papers originated from laboratories in the British Empire (McGill, Manchester, Cambridge). The book is meant to show the nature and spirit of the great discoveries of the electron, Rutherford's nuclear atom, natural and artificial nuclear disintegrations, and the neutron, by giving us a look at the original papers describing the discoveries. In a simple straightforward way the papers exhibit the great power of the experimental method; Aristotle and the later schoolmen were rendered obsolete almost overnight.

According to Mr. Wright, his book is intended for university students and "sixth forms." I am far from clear about just what sixth forms are, but it is fair to say that high school seniors in California, Idaho, and possibly Arizona should be able to read the whole book to their considerable advantage without great difficulty. It is worth noting that the English throughout the book is superior to and more direct than that used by most newspaper columnists and humanists.

The classical papers in the book cover the period from the discovery of the electron, proton, and alpha particle to the neutron. All manner of problems about matter and particles were opened up, including the question of why the electron doesn't fly apart. Present day researchers are following up the earlier findings, and large accelerators are increasingly successful in throwing light on the nature and structure of the several old and many newly discovered particles. Both theory and experiment are on a dim but fascinating path in a new frontier; the path is not covered with fragrant flowers. The 16 authors deserve our great appreciation for having found the first traces of the path.

All of the authors were born during the lifetime of (Alexandrina) Victoria (1819-1901) who, in 1837 and in her nightie, received official notice that she was to be Queen of the United Kingdom and Empress of India. Although she was provided with the security of a generous stipend, she decided to get married anyway; in 1840 she became the wife Francis Charles Augustus Albert Emanuel (1819-1861), or Albert for short, a healthy man much interested in the arts, sciences, and industry. Victoria's wedding outfit, like Mr. Wright's book, was of British manufacture throughout, even to her gloves. Before Albert appeared on the scene, British art, science, industry, and government were in a fossilized and soulless state. Thus, even for the Queen's palace, there was one crew that washed the windows on the inside, and another crew on the outside; since the two crews didn't clean the windows at the same time they were always dirty and almost useless. Then there was the castle scandal about young Lady Flora; the poor girl had liver trouble and hadn't been led astray at all.

But Albert, without much real authority but with considerable persuasive power, spurred the British into action along various constructive lines. Victoria had nine children in seriatim, the industries were induced to try new, improved techniques and products, and the arts and sciences were given much encouragement and incentive. After Albert's death in 1861, Victoria became quite straightlaced, but such prime ministers as Disraeli and Gladstone managed to keep the British on their toes. As a consequence of all the factors mentioned, Victoria lived in a period that saw the work of the poets, Tennyson, Wilde, and Kipling; the authors, Conan Doyle, Lewis Carroll, and G. B. Shaw; the mathematicians, Hamilton, Cayley, and Sylvester; and the scientists, Faraday, Maxwell, and Darwin. Victoria's period also saw the building of the Suez Canal, the discovery of the electron, the invention of the cloud chamber, and possibly the first Rolls Royce. Historically, Mr. Wright's book begins with the cloud chamber, but doesn't even mention Victoria or the Rolls Royce.

Don M. Yost

California Institute of Technology
Pasadena, California

About the Reviewer: We have again received, with gratitude, a review from our almost regular and always welcome contributor to this department of Nuclear Science and Engineering. *In pointing out that the preparation of a review is not strictly a one-man deal these days, Professor Yost acknowledges the assistance of Mrs. Yost, of their secretary, Mrs. Ruth Hanson, and of philosophical discussions with Mr. and Mrs. T. C. Vint of Tuscon and with Señora Lupe de Sinaloa of Palo Alto. As many of our readers know, Dr. Yost retired not long ago as Professor of Chemistry at California Institute of Technology.*

Two-Group Reactor Theory. By J. L. Meem, Gordon and Breach, New York, N. Y. (1964), 417 pages including 80 pages of Appendixes, $20.50.

This book was designed for use as a text at the advanced undergraduate or beginning graduate level with emphasis on the "engineering analysis of reactors rather than fundamental reactor physics." In part I, one-group diffusion theory is introduced, together with Fermi-age theory and elementary reactor kinetics. In part II, two-group theory is developed and applied to treat control-rod worth, heterogeneous reactors, and fast reactors. Detailed applications are made in the appendixes to a pool reactor, a natural-uranium graphite reactor, and a fast critical assembly.

The author states that the principal objective of his book is to assist the student in attaining proficiency in carrying out two-group calculations on a variety of reactors—including bare and reflected, water-moderated, heterogeneous, and fast systems. Personally, I would question whether such proficiency is important for the nuclear engineer. It would seem to me rather more important for the beginning student to acquire a physical understanding of the nuclear characteristics of various systems, together with an impression of the sorts of calculations that would be required for a realistic and detailed analysis. I would hope that it would suffice for him to go through a two-group two-region calculation one or fewer times in his life. However, even granting the author's premise that it is important for a student to become proficient in two-group calculations, the book invites a number of criticisms.

Some blame must surely be placed on the publisher for charging over $20 for a textbook numbering only about 300 pages, not including "appendixes." For such a price one might at least expect an outstanding publishing product, but I must report that there is not even a clear and consistent typographical distinction made between scalar and vector quantities.

In addition, the text is characterized by a casual syncretism that must surely baffle or mislead the student on many occasions. For example, on page 21, the student is told that the thermal-neutron scattering cross section of a hydrogen nucleus (bound in H_2O) is 95 b and that data to the contrary in BNL 325 should be ignored. It turns out that this incorrect value is recommended so that the student can use $\sigma_{tr} = (1 - \bar{\mu})\sigma_s$ together with the unbound value of $\bar{\mu}(2/3)$ and still obtain a reasonable value of σ_{tr}. Surely it would have been better to give simply a reasonable value of σ_{tr} without incorrect σ_s and $\bar{\mu}$. As another example, on page 36 shortly after a conventional definition of the (scalar) diffusion coefficient, we find the unelaborated statement "... the diffusion coefficient, D_z, in the z direction is not necessarily equal to that in the x and y direction." How can the student understand this? And so on.

In summary then, the reviewer regrets to report that he can find little to recommend in the present book.

George I. Bell

University of California
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

Received November 29, 1965

About the Reviewer: George I. Bell received his PhD degree in Theoretical Physics from Cornell in 1951. Since then, he has been a member of the staff of the Los Alamos Scientific Laboratory. He has also served as a visiting lecturer on Applied Physics at Harvard University (1962-63) and a Professor of Physics (part-time) at the University of New Mexico. In the field of reactor physics, he has contributed to the theories of cavity reactors, resonance absorption, stochastic multiplication, and neutron transport.

Fission Product Yields and Their Mass Distribution. By Yu. A. Zysin, A. A. Lbov, and L. I. Sel'chenkov. Authorized translation from the Russian. Consultants Bureau, New York (1964), 121 pages, $15.

This book, which covers the literature through 1962, is the most comprehensive compilation of fission product yields that has come to the reviewers' attention. Spontaneous fission, as well as fission by neutron, proton, deuteron, alpha particle, and ^{12}C irradiations in the energy range from around threshold to 100 MeV is covered; in the case of fission by gamma-ray irradiation, the energy range extends to 300 MeV. The fissioning nuclides include all those studied from Bi to ^{252}Cf. Independent fragment yields, are given in cases where they have been measured.

The book consists of 26 pages of introductory material covering various aspects of the fission process, 36 tables of yields, 166 schemes of decay chains, 155 references associated with material presented, and 88 supplementary references that are pertinent to the general subject matter. The introductory sections discuss the effects of excitation energy and the nuclear charge Z of the fissioning nucleus (i.e., the compound nucleus) on the distribution of fission products and average number of neutrons emitted. Symmetric fission is favored by low Z and by high excitation energy. Asymmetric fission is favored by high Z and by low excitation energy E_{ex} and is particularly pronounced in spontaneous fission. For example, ^{226}Ra irradiations produce three peaks of about equal height (two for asymmetric and one for symmetric fission) with 11-MeV protons (E_{ex} = 16 MeV), a large symmetric and two smaller asymmetric peaks with 21.5-MeV deuterons (E_{ex} = 29.3 MeV), two large asymmetric and a smaller symmetric peak with 31-MeV alphas (E_{ex} = 26 MeV), and a large very broad hump (covering the entire fission-fragment-mass range) with 43-MeV alphas (E_{ex} = 38 MeV). Closed-shell or "magic-number" effects on the fine structure are described in some detail.