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Book Reviews

Accelerators of Charged Particles. By B. S. Ratner. Moscow (1960). Translated by L. A. Fenn, Pergamon Press (1964). 120 pp. $3.50.

Assuming essentially no knowledge of mathematics or physics, this book reviews in a rather interesting and simple manner a few of the highlights of the history of the development of understanding of the structure of the atom and the nucleus up to the discovery of fission. It then treats in a similar manner the development of accelerators, mentioning in turn linear, Cockroft-Walton, Van de Graaff, linear resonance, cyclotron, betatron, phasotron (synchro-cyclotron), synchrotron and synchrophasotron (bevatron type) machines. A few classic experiments including the discovery of the neutron and the anti-proton, and the determination of the proton size by electron scattering are briefly described.

Simple explanations of some interesting physical phenomena including the dependence of α-particle scattering on nuclear size, magnetic and electric focusing of beams in accelerators, and phase stability are given. There are 54 easily understandable sketches and eight photographs, mostly of Russian accelerators but including one of the Berkeley bevatron.

A final chapter briefly mentions some more or less new ideas including accelerators with wedge shaped magnets, orbits of alternating curvature, clashing beams, storage rings, relativistic electron beam stabilization and the coherent method proposed by Veksler of accelerating a small number of protons by collision with an intense relativistic beam of electrons.

An amusing graph shows that with the present trend in machine energy and current, by 1990 an accelerator for 10^{16} electron volts will be constructed to produce two protons per hour. It is explained that this extrapolation has led to attempts to increase currents.

Although an errata sheet of about 14 items is included there are many errors which escaped this list, some of which are probably errors in translation. There is some unclear and misleading writing, an example of which is the following on pages 26 and 27: "An energy of 1 eV is not very great, i.e. it is equal to 1.6×10^{-12} ergs. However, it is sufficient to communicate to an atom an energy of a few electron volts, in order to tear off one of its external electrons." It would be easy for the non-technical reader to confuse the subjective phrase of the first sentence as the antecedent of the word "it" in the second sentence. On page 40 the discovery of fission is credited to experimental physicists rather than to the chemists, Hahn and Strassmann. On page 42 only heavy water and graphite are mentioned as moderators for nuclear chain reactors, which may be a provincialism or a portent of the future rather than an error.

There are other errors which are apparently the result of poor proofreading. For example on page 57, the square root sign is missing in the equation for the relativistic dependence of mass on velocity. On pages 61 and 62, Wideröe's name is only half-way translated from the Russian, into "Videroy," as is Yukawa's on page 72, which becomes "Yukava." On page 88 the word "focusing" (in a linear accelerator) is used where defocusing is meant. On page 89 the large linear accelerator on the West Coast is said to be at "Stamford." On page 97 the bevatron is located at the "California Institute" rather than at the University of California, Berkeley. On page 103 Hartland's last name is erroneously spelled "Sneider" instead of Snyder.

Not surprisingly, many of the important discoveries mentioned in the book are those of Russian physicists; some discoveries which were probably made essentially simultaneously in Russia and elsewhere are also credited to Russian physicists; a number of other discoveries of probably equal importance which were clearly made by United States scientists are cited but left anonymous, such as Anderson's cloud chamber observations of the positron and the μ-meson. On the other hand MacMillan is properly credited with the independent discovery of auto-phasing in accelerators somewhat later than Veksler. In short, the over-all impression is that the attempt to give proper credit has been a reasonable although not an outstanding one.

The list of references is disappointing for its shortness, consisting of only nine items. Of the 12 authors in this list, six were United States citizens, two of them so naturalized.

An appendix provides an interesting dating of the book. It gives for example the maximum energy of the electron linear accelerator "a few beV" (Stanford expects 10 to 15 beV) and for the "high voltage accelerator" a maximum energy "10 MeV" (tandem machines now operate in the vicinity of 20 MeV). The latter conservative number may possibly be consistent with the facts since the appendix also gives for the limitation on energy: "discharge." Perhaps this all comes out right if the modern, higher energy tandem machines are thus logically eliminated because they require the "discharge" of negative ions to produce their 20 or so MeV.

The book is intended for a wide audience and will be interesting to essentially non-technical persons who want to gain some feeling of what the accelerator business is about.

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About the Reviewer: E. Creutz worked on nuclear physics and materials problems on the Manhattan Project at Princeton, Chicago and Los Alamos. He was a member of the Steering Committee for the "Rochester Meetings" during those confused but exciting days when there were more big accelerators (including the one at Carnegie Tech whose design and construction he directed) than there were named kinds of mesons. After a period as scientist-at-large on the Sherwood Project, he became Director of the John Jay Hopkins Laboratory for Pure and Applied Science of General Atomic.

Uranium, Vol. 8, Metallurgy of the Rarer Metals. By J. H. Gittus. Butterworth's, Bethlehem, Md. 623 pp. $24.75.

This book is the latest member of a series concerning the less familiar metals published by Butterworth of London and edited by H. M. Finniston. The chosen format, a volume of modest size to include the vital information about the element from the location of the ores to the metallurgy of the important alloys, presents any author with a formidable task. The topic for this book, Uranium, is properly characterized as one of the rarer elements, but it is not one of the less familiar. The literature concerned with uranium is more extensive by factors than that for the other elements reviewed in this series. The required selection of the pertinent information from such a vast accumulation puts a great burden on the author of a relatively short review. Granting the difficulty of the task, this book on uranium by Gittus still does not completely measure up to what might have been expected. In some parts of the book the selection of the material to be emphasized is less than skillful, and there are many more errors than should be tolerated. In other parts of the book, the selection of material is good and the text is largely error free.

On the dust jacket, the publisher claims to have presented at the time of printing (1963) the most up-to-date work available on the topic of uranium, in a concise manner suitable for both the general reader and the specialist. However, from the references used in the book, it would appear that nothing of interest could be found in the literature after early 1960. In comparison, the work *Uranium Metallurgy* by W. D. Wilkinson published about a year earlier makes use of many more recent references.

In the first four chapters of Gittus' book, those on "Ores," "Detection Exploration and Mining," "Ore Concentration" and "Manufacture of Uranium Metal and Its Compounds," a style is used which can be confusing even to a specialist. These chapters are essentially the recitation of information from the literature in condensed form. The condensation process has resulted in sections which are often difficult to read. Abbreviations are used and then defined pages later. Processes are described and significant variables omitted. Too, many mistakes are present both in fact and in language. From chapter five on, the book is concerned with the metallurgical properties of uranium. There is a remarkable change in the style of the book with the introduction of the new subject matter. The selection of subject material is good. The text is clear and relatively easy to read even when complex topics are discussed. The author is obviously dealing here with information with which he is very familiar.

There is a very good discussion of the problems associated with the production of reactor fuel elements based on metallic uranium. Both the practical aspects of fuel element problems (the nature of the production processes, the equipment involved, the limitations of the product) and the theoretical aspects (the nature of the uranium crystal, the interrelation of this crystal with the processing and end use environments) are skillfully presented. There are good reviews of radiation damage in uranium and the corrosion of the metal under conditions which are of interest to reactor designers.

The alloys of uranium are discussed in an effective and concise manner. Phase diagrams are given and the metallurgical properties of the alloys