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Book Reviews

Programming and Utilization of Research Reactors. Proceedings of a Symposium held in Vienna, October 1961, Published for the International Atomic Energy Agency, Academic Press, London, New York, 1962, Vol. 1, 328 pages, $9.00; Vol. 2, 528 pages, $15.00; Vol. 3, 503 pages.

When we first used neutrons, in 1935 at Heidelberg, working under Walther Bothe, our source had a strength of about 10,000 neutrons per second. Most of the 200-odd research reactors in the world emit more than 10^{16} neutrons per second from their surface, and it seems strange that a conference should be necessary on What to Do with My Reactor. Yet, the Symposium on Programming and Utilization of Research Reactors in Vienna, arranged by the International Atomic Energy Agency, with its three volumes of proceedings, was followed by smaller conferences on the same topic in Bankok, in Athens, and now in Brazil; and research-reactor programs are a problem not only in developing countries.

There are three main reasons for the research-reactor headache. First, the safe operation of the reactor, and the control and measurement of fluxes and radiations, pose a number of problems that are common to all reactors and require the attention of an operating staff that, in most cases, has not had too much previous experience. Second, the potential usefulness of the reactor, and the experimental techniques that are appropriate in applying it to problems in many fields, are not well known to most people working in scientific areas where the use of reactor radiations would be helpful. Third, it is not wise to put up a reactor station and then tell the director to make a program for it. A reactor is one tool in research. It does not produce its own problems: the problems should come from other fields, and be worked out by people who have specialized in those fields and know what is needed to promote them.

The proceedings of the Vienna Symposium are a great help in the first two of our three points, and we think they are of lasting value to everybody who is seriously interested in research reactors. Specialists, among them many leading experts from many countries including the Soviet Union, discuss reactor planning, reactor operation and uses under the following headings: Problems in Establishing Nuclear Research Centers and Staff Training; Organization of Reactor Centers; Experience in Utilizing Research Reactors (all of Volume 2); Reactor Engineering and Reactor Physics; Nuclear and Solid State Physics; Radiochemistry, Radiation Chemistry and Reactor Chemistry; Isotope Production and Research in Agriculture, Biology and Medicine. There is a multitude of ideas, viewpoints, and experiences on reactors of all sizes except the very big ones, and there are lively discussions in an international spirit. The reader, like the participants of the conference, has a rare opportunity to compare methods and ideas in various countries, and to get a feeling of a common cause.

The last chapters, which should settle our third point, must fail to achieve their aim even though they contain a wealth of interesting material. It is not possible to present a program in nuclear physics or in radiochemistry without going very deep into these fields. It would have helped if there had been more invited papers. But each of those, again, would have interested only a minority of the participants. The only good solution is to hold topical conferences where all the specialists in a field and those interested to enter the field discuss common problems.

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(About the Reviewer: Professor Heinz Maier-Leibnitz is director of Laboratorium für Technische Physik at Technische Hochschule Munchen, Germany. The Laboratory comprises a one-megawatt swimming pool reactor facility where doctorate students do work in basic research. R. L. Mössbauer of the Mössbauer effect, was one of his students there.)

Atomic and Nuclear Physics, Theoretical Principles. By H. D. Bush. Iliffe (London), Prentice-Hall, Inc. (Englewood Cliffs, N. J.), 1962. 218 pp., $8.95.

This is a good survey and introduction to modern physics for professional engineers entering nuclear technology. The material is generally aimed toward subsequent courses in reactor analysis, radiation protection and isotope utilization. Of the nine chapters, the first two cover the elements of atomic structure, through the Bohr theory and wave nature of matter; the next three give the important characteristics of the nucleus, radioactivity and nuclear reactions; the material on nuclear structure provides a basis for fission; neutron diffusion and slowing are analysed; finally, there is a review of radiation interactions with matter.

The writer's style is much appreciated — direct, incisive, factual and brief. Only occasional reference to the history of the subject is made. Examples, numerical data and tables are slanted toward nuclear energy.

There is evidence that the author depended heavily on other references. This tends to lead to greater detail than necessary on certain subjects. Little is added by the derivations of working formulas for the Aston spectrograph or the hyperbolic path and differential cross section of alpha particles in the field of the nucleus. Too much detail is given on atomic spectra and the Bohr explanation of the hydrogen atom. The material on neutron physics is almost pure Glasstone and Edlund, including concepts such as extrapolation distance that are not important in a survey of this scope. On the other hand, the abbreviation of the Bateman radioactivity equations is well done. The sections on nuclear reactions and structure are very compact and to the point. Many deliberate omissions are appropriate, for instance elliptical electron orbits, spin theory and the Zeeman effect. The opportunity was missed however to introduce easily a few relevant topics, such as the Bainbridge mass spectrograph, neutron diffraction, and neutron shielding.

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(About the Reviewer: Dr. Raymond L. Murray, Burlington Professor of Physics and Head of the Department of Nuclear Engineering, N. C. State College of the University of N. C. at Raleigh, just returned from a year's lecture-consulting world trip to Europe, Africa and Asia. Fellow of the American Nuclear Society and former Chairman of the Education committee, author of two texts -- Introduction to Nuclear Engineering, Nuclear Reactor Physics.)

Nuclear Physics. By Robert A. Howard. Wadsworth Publishing Company, Belmont, California. 578 pages.

Professor Howard's sprightly new textbook of descriptive physics has a number of worthwhile virtues: a lucid style, an abundance of well-chosen graphs and illustrations, an uncommonly good chapter on collision dynamics, a notable list of references with each chapter, a careful avoidance of underived or unreferenced results, a painstaking relation of experiment to theory and what is the most effective use of the historical approach of any book in its field.

To my dismay, however, Howard appears to regard the subject of low-energy nuclear physics much as did the author of a 1955 text — as a mixed and overflowing bag of largely unrelated topics that defy organization into a cohesive whole. But nuclear physics *has* begun to emerge from the woods as was forcefully noted in Weisskopf's Retiring Presidential (APS) Address of February, 1961 (see *Physics Today,* July, 1961). Nuclear spectroscopy, a fantastic tangle before 1955, now seems to be falling, if somewhat reluctantly, a victim of the collective model. And Howard does not mention the collective model, let alone recount its successes.

Perhaps a more grievous lack is the absence of any cogent discussion of the status of, or even the nature of, the nuclear-force question. It is not until the final chapter (long after "nuclear structure" has been disposed of) that the author notes — in the midst of a description of high-energy-physics experiments — that mesons may be involved in nuclear forces.

The author assiduously eschews any quantum mechanical formalism and perhaps this is why he does not serve up the pedagogically useful deuteron problem. Surely this is his prerogative, but I would argue his choice. A text that relegates the only *mention* of potential wells to the third appendix would not seem to be taking advantage of the superior preparation of science and engineering students today.

A less serious shortcoming, although a most annoying one, is the brief and inadequate index. Before deciding to read the book through, I thought I would look up a short list of topics to see what the author had to say. I chose "Age, Auger, giant resonance, meson, Mössbauer, neutrino, shell model, stopping power and weak interaction." All of these topics are discussed in the text but only two were cited in the index and one of them was cited incorrectly.

In spite of the remarks above, on balance I found Howard's book superior in enough respects to its current competitors that I would recommend