

medicine is increasing at a rapid rate. It has been well established from laboratory experiments and the therapeutic use of ionizing radiation that the immune system is exceedingly sensitive to irradiation. This sensitivity of the body's defense against infections presents a significant problem in medical management of patients exposed to high doses of therapeutic radiation as well as workers in the atomic energy industry who might be exposed accidentally to substantial amounts of radioactive materials. Also, it is worth recalling that this ability of radiation to suppress the body's capacity to reject foreign tissue can, and does, play a role in instances where this is desirable, i.e., in organ transplantation.

At present, the immune system of man, its regulatory mechanisms, and functions are still poorly understood. Most of our knowledge in this field originated from animal experimentation. It is not clear to what degree data obtained in various animal species may be transferred to conditions in man. In particular, the effects of ionizing radiation on the immune system in man are obscure.

In order to evaluate the possible immunological impairment caused by irradiation in man, a fuller understanding of the immune response under normal conditions is needed, in conjunction with studies conducted under stress conditions such as those following an exposure to ionizing radiation.

Recognizing this, the International Atomic Energy Agency convened a panel at the Foundation Curie in Paris with the co-sponsorship of the French Atomic Energy Commission on June 22-24, 1967, to discuss the effect of irradiation on the immune response and to make recommendations to the IAEA regarding further research in this area. The meeting was attended by 19 scientists from 14 countries and chaired by Professor G. J. V. Nossal from Australia. Representatives of the World Health Organization and the International Labor Organization also attended.

During the meeting 16 papers were presented and discussed in detail by the participants. The scientific presentations dealt with the induction of immunological tolerance to non-living antigens, studies of the primary antibody response induced *in vitro* by cells from normal ani-

mals, the transplantation of fetal hemopoietic cells into irradiated monkeys, structural and functional characteristics of gamma-ray irradiated human globulins, the capacity of the irradiated animal to recover its immunological competence following irradiation, and the mechanisms of action of irradiation as an immunosuppressive agent. The full text of these presentations and summaries of the discussions are included in the *Proceedings*.

At the conclusion of the formal presentations, the participants considered the following questions posed by the IAEA: 1) "What impairment of the immune response is to be expected in persons exposed to radiation hazards or being treated with any form of radiation?" and "What kind of control would be desirable and by what technique could it be achieved?" 2) "What type of research in radiation immunology should receive priority when granting research support?"

The general conclusions of the participants regarding these questions are included in the *Proceedings*. Currently, it appears that exposure to high doses of irradiation severely impairs but does not completely eradicate the immune system in man. Little attention has been given to a systematic evaluation of the immunological consequences resulting from low doses of irradiation in man. This lack of understanding of low-dose effects would make suggestions, for routine evaluation of individuals exposed to ionizing irradiation, premature. Clearly, more emphasis should be placed on defining the impairment of the immune response in humans receiving repeated low-level diagnostic or therapeutic exposure.

A major portion of the results included in the *Proceedings* have been published in appropriate journals. However, this publication may serve a useful function since it contains a considerable amount of data on the effects of irradiation on the immune system, between one set of covers. The general conclusions at the end of the book should be of interest to those concerned with the safety of workers or patients exposed to irradiation, particularly low doses of irradiation from internal or external sources, since the conclusions point out specific areas that require further research effort.

William R. Bibb, a member of the Medical Research Branch of the USAEC, was the US representative to the IAEA Panel on "Radiation and the Control of the Immune Response." Prior to joining the USAEC in 1965, he was on the faculty of the University of North Carolina Medical School. His research interests include the effect of ionizing radiation on the immune system and the abrogation of this injury with bone marrow transplantation. His PhD degree is from the University of North Carolina at Chapel Hill.

STRONGLY RECOMMENDED

Title The Encyclopedia of the Chemical Elements
Editor Clifford A. Hampel
Publisher Reinhold Book Corporation, 1968
Pages viii + 849
Price \$27.50
Reviewer W. Conard Fernelius

With the wide variety of books available today, the individual scientist is hard pressed to decide which of the available books he should purchase so that they will be available for ready reference. *The Encyclopedia of the Chemical Elements* is a must for this purpose.

The object of this volume is to present in a concise and authoritative manner information on the nature, properties, and behavior of each of the 103 elements. The emphasis in the articles about the individual elements is on the *elemental form*; this is just the kind of information lacking in most books on inorganic chemistry. This encyclopedia stresses recent advances and includes for each element material on its discovery and history, its prevalence, sources, derivation, physical properties, isotopes, nuclear properties, chemical behavior, the importance of the element and its compounds, applications of the element, and its biological and biochemical nature, including toxicological factors. In addition to the articles about the individual ele-

ments, there are about 20 articles of a general nature on related subjects such as "Periodic Law and Periodic Table," "Noble Gases," "Lanthanide Elements," "Transuranium Elements," "Isotopes," "Electronic Configurations," "Origin of the Elements," "Prevalence of the Elements," and "Electrode Potentials." A short reference list accompanies each article. An index facilitates the location of material not readily evident from the alphabetical arrangement of topics. The entries in the book have been prepared by 104 knowledgeable individuals of outstanding reputation in their respective fields.

Despite the large number of authors, there is a reasonable uniformity of treatment of each element. The book is recommended strongly.

W. Conard Fernelius is Associate Director of Research, Koppers Company, Inc., Monroeville, Pennsylvania. With a PhD degree (1928) from Stanford, he has taught in the chemistry departments at Ohio State, Purdue, Syracuse, and Pennsylvania State Universities and was department head at the last two institutions. He also served with the Monsanto Company as laboratory director of the forerunner of the Mound Laboratory during World War II. His research has been on various aspects of inorganic chemistry, including non-aqueous solvents, coordination compounds, and less-familiar elements.

EXPENSIVE EXPOSITION

Title Fast Breeder Reactors
Editor P. V. Evans
Publisher Pergamon Press, Inc., 1967
Pages vii + 951
Price \$37.00
Reviewer Joel H. Ferziger

The volume under review is of a type which seems to be displaying the highest rate of population increase these days—the conference

proceedings. In particular, it is the proceedings of the Conference on Fast Breeder Reactors held in London in May 1966.

The content is what might be expected: reviews of various national programs by officials in charge of the programs, experience with existing systems, systems planned for the future, and then detailed papers in the important problem areas, i.e., physics and fuel sodium technology. Reflecting, I suppose, the British bias for sodium cooled reactors, this reactor type receives much more attention than all others combined.

One question I have been unable to resolve is that of for whom a book of this type is intended. The price puts it out of the range of most potential individual purchasers, and the content is such that only a few academic libraries will find a need for it. This leaves then only the libraries of laboratories and industrial groups currently working with fast reactors. Furthermore, since fast reactors are currently progressing at something like the pace of thermal reactors ten years ago, the material will be out of date within a few years. One wonders whether such a book merits a printing job designed for a considerably longer lifetime, especially when this results in a price that destroys some of its current usefulness.

There are far too many papers to attempt a review of each here. Rather, I shall limit myself to a few general comments and, reflecting a personal bias, some specifics on the papers in the physics and design areas. All of the papers are reviews; most of them review progress in a given area made within the author's country, and several are written by authors from more than one laboratory (one has authors from five separate groups). The quality of the papers (and I will admit to not having read all of them) is generally very good, and, since in a short review one cannot give many details, I merely say that they are amply provided with references in which the interested reader can find further information.

In the physics papers, one finds a considerable amount of duplication in the various national programs. The topic of major current interest is the effect of fluctuations in the cross sections on a fine energy scale and heterogeneity on gross reactor behavior. Since the codes needed to

handle this problem are rather expensive to develop (especially the cross-section libraries for them), greater emphasis on international cooperation would seem to be indicated. Perhaps conferences of this sort will promote the needed cooperation.

The impression that one gets is that the gross characteristics and design features of fast reactors are reasonably well understood and agreed upon and that work now centers on specific physics effects, detailed design, and hardware development. As with thermal reactors several years ago, fast reactor development is rapidly becoming a question of technology rather than physics.

Joel H. Ferziger (PhD, University of Michigan, 1962), is associate professor of nuclear engineering at Stanford University, where he has been since 1961. His main interests are in neutron transport theory and the kinetic theory of gases. He has been involved with fast reactor physics and design through consulting work with General Electric.

BWR BURNUP METHODS

Title Fuel Burnup Predictions in Thermal Reactors
Publisher United Nations Educational, Scientific and Cultural Organization, 1968
Pages 243
Price \$5.00
Reviewer George A. Sofer

Besides being the biggest collection of nuclear codes name dropping, the book offers the reader the broadest and deepest insight published to date on burnup calculation methods in thermal reactors. Of paramount interest to the American reader is the comprehensive dissertation by R. L. Crowther on large BWR burnup methods. This is perhaps the best that has been published on BWR core physics since the 1963 San Francisco Conference.