# BOOK REVIEWS

Selection of books for review is based on the editors' opinions regarding possible reader interest and on the availability of the book to the editors. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

*Title* Properties of Refractory Metals

*Author* Walter D. Wilkinson

*Publisher* Gordon & Breach Science Publishers, 1969

*Pages* 332

*Price* $27.50

*Reviewer* Charles H. Pitt

This monograph is one of a series developed through the joint efforts of the American Society for Metals and the U.S. Atomic Energy Commission for the purpose of emphasizing the role of metallurgy in nuclear technology. It is directed primarily toward technologists concerned with the applications of materials in the nuclear field. However, it could be of value as a reference for metallurgy students or to those engaged in research in the refractory metals field.

An in-depth treatment of the properties of refractory metals with particular emphasis on fabrication practices and the use of these metals in nuclear reactors is presented for the commonly used refractory metals; namely, V, Cr, Nb, Mo, Ta, and W. No treatment is made of the rarer and more expensive metals such as Re and Hf.

An introductory chapter is given on the relationship between the electronic and atomic structure and certain physical characteristics of the refractory metals. The section on irradiation effects and nuclear properties in this chapter should have been expanded considering the intended audience of the book.

Good use of references is made for the aid of the reader who wishes to delve further into the subject material. Much of the material arises from the author's own experience and technical reports made available through work at Argonne National Laboratory.

Chapters are included on corrosion, effects of interstitials, ductility and brittleness, mechanical and deformation characteristics, and heat treatment of the refractory metals. In certain parts of the book fundamental explanations of such things as dislocations and recrystallization are given, which are not necessary for the average reader.

In some parts of the book, particularly when discussing the metals and alloys themselves, the use of empirical data was plentiful which is of value to the individual concerned with working with the metals, but the reader may get the feeling that he is being deluged with data. However, attempts are made throughout the book to relate electronic structure to properties and some interesting correlations are made and explained.

All in all, the book is an excellent summary of the state-of-the-art of the commonly used refractory metals as of 1967 and contains information that cannot be readily found elsewhere. It should be of value to materials engineers and designers contemplating work with refractory metals and to scientists concerned with them. The book, as a whole, is well written and organized and is a worthwhile addition to the literature on refractory metals. A companion volume is planned by the same author which will have the title "Fabrication of Refractory Metals."

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*Title* The Careless Atom

*Author* Sheldon Novick

*Publishers* Houghton-Mifflin Company, Boston, Massachusetts, 1969

*Pages* 225 + front material

*Cost* $5.95

*Reviewer* John O. Mingle

In recent testimony on "The Environmental Effects of Producing Nuclear Power" before the Joint Committee on Atomic Energy of the

U.S. Congress, Glenn T. Seaborg, Chairman of the Atomic Energy Commission stated,

> "We who are involved in developing nuclear power to provide for future electricity needs are naturally disturbed by that public resistance which seeks to halt or slow down such development. However, along with our obligation to safeguard the natural environment we also have a responsibility to help supply our people with the power to run a technologically sustained society. In the years ahead today's outcries about the environment will be nothing compared to cries of angry citizens who find that power failures due to a lack of sufficient generating capacity to meet peak loads have plunged them into prolonged blackouts—not mere minutes of inconvenience, but hours—perhaps days—when their health and well-being and that of their families, may be seriously endangered."

The Deputy Administrator of the Rural Electrification Administration, Everett C. Weitzell, added,

> "Brownouts and blackouts can affect the economy of the nation and the health and safety of its people even more seriously than the environmental effects of power facilities."

While neither Dr. Seaborg nor any other competent nuclear scientist is unaware of the risks inherent in building and running nuclear power plants, they do put these minimal dangers into proper perspective. They realize, as evidently Mr. Novick does not, that no power plant, whether it be fossil fueled or nuclear powered, can be constructed or produce electric power without affecting the environment and the surrounding population to some degree. It is therefore the job of engineers, working with other scientists, to choose the system that will disturb the natural environment as little as possible.

One of Novick's chief failings in his book is that he presents these environmental problems as an isolated subject. He never acknowledges the growing need for more and more power for both industrial and home use. As serious as this omission is, however, the author, in addition, commits the worst sin of scientific reporting: he distorts the facts by liberally quoting out of context and arriving at a conclusion rarely reached by the quoted author. One typical example of a distortion of real fact is Novick's discussion of the reason for the recent slowing of orders for nuclear power generating facilities. The author's conclusion is that the main cause is the nuclear industry's difficulty in ensuring safety and reliability in nuclear plants. This statement can be contrasted to the actual situation well known to the technical community: increasing costs of borrowed money and a saturation of production facilities for a key reactor component, the pressure vessel, have made nuclear power less competive from an economic standpoint.

Another example of this lack of accuracy occurs in Chap. 3 as well as on the cover leaflet where Dr. Edward Teller is quoted out of context as saying, "In my mind nuclear reactors do not belong on the surface of the earth." This statement is from a letter that Dr. Teller wrote to Mr. Oliver Townsend of the New York Atomic and Space Authority and the complete text of this letter is published in *Survive*, 2, *3*, 20 (1969). The letter was a discussion of the merits of underground containment and not a categorical rejection of nuclear power. Unfortunately, this type of misrepresentation is typical of the book.

In addition to quoting out of context, the author also uses as documentation sources nearly impossible for even the scientific reader to verify. For example, in Chap. 3 this quote occurs:

> "Since it is quite impossible to design a power plant to survive without damage the large permanent ground surface displacements that might occur if earthquake fault slippage occurred on the site, this possibility must be given special considerations."

The indicated reference for this quote is The Northern California Association to Preserve Bodega Head and Harbor while the text attributes this statement to a Pacific Gas and Electric Consultant. In other words, Novick is quoting a statement out of context, made by a man hired by an organization with "an axe to grind," appearing in a privately published document generally unavailable to the public.

This statement does represent, however, important safety considerations, a point Novick emphatically states, yet little mention is made of the technology design considerations that were used to meet these specifications. The author only indicated that the technology for this situation had already been developed by the military in conjunction with the missile silo program. It is noted that the author throughout the book is unwilling to accept any technology that was developed for military purposes. Thus, it is not surprising that Novick referred to this concept as only a "novel design." In fact the very careful and detailed considerations that both the reactor design company and the U.S. Atomic Energy Commission have taken into account when considering earthquake possibilities show a very safety conscious industry indeed. Novick, however, appears to present just the opposite viewpoint.

In writing for a technical audience it is permissible to eliminate a definition of common terms, but if Novick's intention is to inform the general public, this omission cannot be excused. In Chap. 6, the author states that "Concentration of radium-226 in algae in one river were as high as 3560 picocuries per kilogram" implying that a very large amount of radioactivity was present whereas in fact it is extremely small. Only a very limited fraction of the technological community, let alone the lay public, would know what pCi/kg implies, and Novick's only explanation is that the Public Health Service has set 3 pCi/liter for a drinking water standard. The implication is, of course, that (a) people drink the water and (b) the concentration of algae in the river is high. In fact, neither conclusion may be valid. An interesting sidelight on this is that the concentration of $^{40}K$ in the human body is ~2600 pCi/kg, a figure that man cannot in any practical way alter. Continuing his discussion of $^{226}Ra$-contamination, Novick states that "people drinking water from the Anines River received three times the maximum permissible exposure from radium-226 and strontium-90 (from fallout)." The addition to the discussion of $^{90}Sr$ from a different source than the $^{226}Ra$ with no indication as to what

fraction of the dose was received from either constituent completely negates the previous discussion of $^{226}Ra$. (Again the implication is that the "one river" being discussed is the Anines River although the implication is far from clear. This is typical of the author's unscientific use of scientific information.)

The author's description of the reason nuclear reactors need to be refueled reveals a real want of technical understanding. His description from Chap. 6 is,

> "The fragments of fissioned atoms, radioactive wastes, slowly accumulate in reactor fuel. After a period of time, enough wastes accumulate to extinguish the chain reaction going on in the fuel, as ashes may smother a fire. Before this point is reached, the fuel must be removed from the reactor and the radioactive ashes extracted."

The only correct statement is the first sentence; the others represent an incorrect analogy for fuel burnup. The fuel is reprocessed because the cumulative radiation exposure of the fuel element causes sufficient structural changes to warrant it. Only a few percent of the fissionable fuel atoms have been "used up" at this time. Thus, the author's interpretation that fission products are strong poisons, i.e., absorb many neutrons and thus make it impossible to maintain a critical reaction with this fuel is a gross technical error. In fact, a selected few of the fission products are strong neutron absorbers but this poison effect is quite small during continuous reactor operation and does not significantly affect criticality.

Some confusing statements are made in Chap. 7 where Novick is discussing the operation of a fast reactor. One of these is "the fast reactor seems to be the sort of mechanism in which the devices employed to forestall one sort of accident simply precipitates another." This gross oversimplification of technical considerations is typical of Novick's extrapolation of one single event into a general statement that has little technical meaning. Another statement is, "because it is so much more compact, the fast reactor must be cooled by a more efficient cooling medium than water; liquid sodium is usually used." This situation is an incomplete interpretation of technical information since, in actuality, the reason for using sodium as a coolant is to use a material that will degrade the neutron energy spectrum as little as possible in order to keep the reactor in the fast neutron energy range. Naturally, heat transfer characteristics are also important as are low operating pressure considerations, an important point the author does not even mention.

Another glaring omission of this book is the subject of modern gas-cooled reactors and the various advantages they have in regard to high thermal efficiency and the consequent reduction in "thermal pollution." In addition, their advantage in not having water present is important as far as possible metal-water chemical reactions are concerned, a subject the author continually brings up about water reactors.

In reading this book for the first time voluminous notes were recorded concerning individual statements; however, in rereading these notes, the reviewer obtained the overall impression that Novick had recorded a history of the nuclear industry with an accent upon the difficult problems it has had to overcome. Thus, if certain passages in the book were reworded it could document to a reasonable degree how nuclear technology has met the many problems inherent in the emergence of a new technology. In this regard the book has some merit as a historical treatment.

This discussion of examples from *The Careless Atom* could go on almost indefinitely but those noted give a cross section of the type of writing Novick has produced. In summary, the quote from the last sentence of the book, "We can hope that advancing science has not left democracy behind," is an important statement but one that requires the public to be fully informed about nuclear power – a task that still remains to be accomplished as Mr. Novick's book has definitely not *fully* informed the public.

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*Title* Methods in Subnuclear Physics, Vol. III (Proceedings of the International School of Elementary Particle Physics, Herceg-Novi)

*Editor* M. Nikolić

*Publisher* Gordon & Breach Science Publishers Inc.

*Pages* 862

*Price* $69.50 Clothbound
$38.00 Paperbound

*Reviewer* Thomas H. Fields

This book is based on lectures delivered at the 1967 Herceg-Novi (Yugoslavia) Summer School on the physics of elementary particles. The 26 lecturers whose articles are included are active research workers whose summaries of various topics, mainly in electromagnetic and weak interactions, are well suited for the summer school participants (themselves mainly young experimental workers in this field).

It can be correctly inferred that this book is likely to find an appreciative audience among persons with an active involvement in particle physics research, and among some workers in closely related fields. There is, of course, a lack of overall continuity and completeness, and a noticeable but not severe obsolescence of the experimental data since 1967. But such are the shortcomings of most volumes of review articles. As compensation, one finds a diversity in style and content among the articles which is a good reflection of the instantaneous state of the art. Many of the articles include extensive bibliographies.

Topics in weak interactions form the largest group in the book (10 lectures). They range in approach from phenomenological summaries of the experimental situation for particular decay processes to R.