happily that helium is still inert. And this year saw the OMRE join the late LMFRE and HRE projects. But these studies have not been in vain; old reactor concepts never die – they just enter a cataleptic trance, to be resurrected later in modified form. The last OMRE gasps concerned replacing APM cladding with Zr, aluminum-clad against hydrogen pickup. Recalling an earlier bitter lesson with embrittlement from pickup of oxygen (p. 82) from sodium, it is interesting to note the good performance of Zr in the combined evils – H_2O! The next transmigration may involve the D_2O-moderated organic-cooled version.

Things often get complicated before they become simple, and while reactor control is still in its complicated stage, Freund's book serves as a valuable companion and guide. All parties concerned in its preparation are to be commended for their contribution to this neat package. For special honors we of course single out the author who, for his many hours of toil, will gain little fame and even less fortune.

Frank Kerze
Division of Reactor Development
U.S. Atomic Energy Commission
Washington 25, D. C.

(About the Reviewer: Except for a four-year teaching interlude, Frank Kerze of the AEC's Division of Reactor Development has worked in the nuclear field since 1940 on the development of processes, materials, and components.)

Reactor Safety Hazards Evaluation Techniques, Volumes I and II. Proceedings of the Symposium on Reactor Safety and Hazards Sponsored by the International Atomic Energy Agency and Held in Vienna 14-18 May 1962. 1088 pp., $10.00.

These are the Proceedings of the First International Symposium held to discuss reactor safety. The Proceedings are in two volumes, each consisting of 544 pages, and contain 65 papers with an additional 11 summarized in abstract form. The papers have been grouped into sections having the titles: "Review of Reactor Accidents and Incidents"; "Some Examples of National Practices and Principles"; " Safety Through Good Design and Construction"; " Safety Through Good Siting and Containment"; " Safety Through Control Devices and Instrumentation"; " Safety Through Good Administration"; "Hazards Evaluation"; and "Safety Assessment."

The title "Reactor Safety and Hazard Evaluation Techniques" and the section headings in this reviewer's opinion have been excellently chosen. The title and headings imply an important distinction between safety analysis and hazards evaluation. Hazard evaluations generally refer to the evaluation of the consequences of an already established uncontrolled radiation source while safety analysis covers a much broader problem including an assessment of the degree of safety against the establishment of an uncontrolled radiation source. The section on "Hazards Evaluation" occupies some $3\frac{1}{2}$ times as much text as any other single section. That this would be the case is not surprising in view of the significance presently being attached to the problem of site selection and in particular, the problem of evaluating the consequences of a prescribed accident in terms of dose levels. The papers covering hazards evaluations and site analysis reflect considerably more substance than papers bearing on the same subject in past meetings. The improvement in content seems to derive mainly from the availability of experimental evidence as to the behavior of a radioactive cloud in the atmosphere. Among the significant experiments reported in this field were those performed on radioactive aerosols released in a hypothetical big reactor accident. These experiments have helped to establish information on the dose accumulation in various parts of the body. In addition, there have been some important observations implying a stronger role of secondary sources. For example, in one study, reported radiation exposure from ground surface was found to be more important than that from cloud immersion.

One outstanding feature of the Proceedings is the incorporation of the discussions that followed presentation of the papers. The questions and answers contained in these discussions are very effective in conveying the different points of view existing in the various countries for performing common tasks. An encouraging note reflected in the Proceedings was that more thinking and effort is being directed towards performing safety analyses on a more quantitative basis by use of probability techniques. This is particularly observed in the section entitled "Safety Through Control Devices and Instrumentation." These papers apply probability techniques to questions of reliability, instrumentation design, and reactor safety system optimization. While none of these have advanced to the point where one could assuredly use these techniques as a formalism for conducting safety assessments, there does seem to be a basis for such models to evolve.

With symposiums being what they are, it would be a unique situation for the Proceedings to convey all available knowledge on a given field. Reactor safety is no exception; therefore, it is expected that certain subjects will be unavoidably neglected. Missing from the Proceedings was a good representation of papers synthesizing the results of current research and development in reactor

safety. It would have also been desirable to see more papers interrelating engineering safeguards (design) and site evaluations.

The International Atomic Energy Agency should be commended for having organized in a very methodical manner these Proceedings. They contain a great deal of information bearing on the field of reactor safety and have been clearly presented. It is rather apparent that the Proceedings will serve as a very useful reference to all members of the reactor community and particularly to those of us involved in performing safety evaluations.

B. John Garrick

Holmes and Narver, Inc.
Los Angeles, California

About the Reviewer: B. John Garrick is Director of Holmes and Narver's Nuclear Division. He has worked in the field of reactor safety since 1952, first at the National Reactor Testing Station in Idaho for Phillips Petroleum Company and later for the U. S. Atomic Energy Commission in the Reactor Hazards Evaluation staff. Since 1957 Mr. Garrick has been responsible for all technical work performed at Holmes and Narver in their Nuclear Division.

Advances in Chemical Physics, Volume V.
I. Prigogine, Editor,
Interscience Publishers (1963).

More articles of interest to physical-inorganic chemists are contained in this volume than in previous volumes of this series. The intention of the authors, as stated in the Introduction, is to present their point of view on their subject so that it is comprehensible to research workers who are not expert in their particular field. The bibliographies alone are worth the price of the book.

New Developments in the One-Electron Theory of π-Electron Systems, H. Hartmann (17 references)

An extension of Hückel's theory for π-electron systems is given. For readers unfamiliar with this theory, a readable account is given in "Quantum Chemistry" by Daudel, Lefebvre, and Moser.

The paper explains the observation of Scheibe that, in all molecules with π-electron systems, the difference between the ionization energy and the energy of the first excited state, of the same multiplicity as the ground state, is nearly the same. The method for developing the explanation is to add to the 2 p states used by Hückel in forming the molecular orbitals higher atomic states of the same symmetry. The formal development of the theory is then carried out in such a way that Hückel's assumptions about the Coulomb, resonance, and overlap integrals are retained.

Resonance energies, charge densities and bond orders are also discussed.

Convex Molecules in Gaseous and Crystalline States, Taro Kihara
(24 references)

"A body is called convex if any line segment whose end points are inside lies entirely in that body." The theory developed in this article is therefore applicable to a broad spectrum of molecules which we are used to thinking of as octahedra, tetrahedra, etc.

The geometry of convex bodies is first developed. The pertinent parameters of surface area, S, volume, V, and mean curvature integrated over the surface, M, are given for several commonly occurring molecular bodies. After discussing diffusion coefficients, the second virial coefficient is developed in terms of S, V, and M using the Lennard-Jones 6-12 potential. The parameters for the Lennard-Jones potential obtained from the second virial coefficient allow a calculation of the cohesive energy per molecule at the minimum nearest-neighbor distance for crystalline states. The effects of multipole interactions in crystals are then discussed.

Spectroscopy of Transition-Group Complexes, Chr. Klixbüll Jørgensen (270 references)

The most imposing aspect of this review is a thirty-six page table of absorption spectra of transition-group complex ions. The author's discussion gives, however, a most useful skeleton outline of crystal-field theory and molecular-orbital theory as applied to d and f transition-metal complexes. The pertinent quantum-mechanical development is first given for atoms and molecules with particular emphasis on the use of group theory. The energy levels of a very large number of individual complexes of d and f groups are discussed in a detailed and critical manner.

Theories on the Magnetic Properties of Compounds, Shoichiro Koide and Takehiko Oguchi
(103 references)

This review, which in many respects complements that of Jorgensen, covers the literature on the 3 d group metals very thoroughly. Energy levels are discussed theoretically considering the various electronic/electronic and electronic/nuclear interactions. A most interesting analysis of the effect of molecular vibrations in allowing $d \rightarrow d$