Book Review

Annual Review of Nuclear Science, Volume 23. By Emilio Segrè, Ed. Annual Reviews, Inc. (1973). 449 pp. $12.50.

In his review for this Journal of the preceding volume of this series, Wigner suggested that articles on subjects esoteric for most nuclear physicists "should be dealt with on a more elementary level." I am glad to report that the longest item in the current volume, that by Fox and Quigg on high energy (up to 50 GeV) two-body reactions, is at least partly written in such a manner. Still, for the most part, a knowledge is assumed of Chiu's article on Regge poles in Volume 22. That contribution was difficult for most nuclear scientists to follow. Wigner also suggested including definitions of the symbols used and brief introductory discussions of the relation of the material in the review to the total subject. Most articles in the current volume follow these suggestions, though to some extent unknowingly. However, I was surprised to find that the majority did not include "conclusions": what has been achieved and what is still missing!

Of the remaining ten articles, two, "Cerenkov Counters" by Witt and Meunier and "Flash-Tube Hodoscope Chambers" by Conversi and Brosco, deal with high-energy physics observation techniques. Four are on nuclear structure; three deal with the use of nuclear methods as tools; and one handles radiative problems of accelerators.

With such a variety of subjects, no single reader will be equally interested in the entire book, nor can a single reviewer cover it adequately. Here I shall make a few comments on the articles of possible interest to nuclear scientists and technologists.

The four items on nuclear structure, written by theoreticians, should be of interest to both theoreticians and experimentalists. Bohr and Mottelson discuss "The Many Facets of Nuclear Structure." This article is more of a very interesting overview than a review (there are only 11 references, but 19 figures!). It is an expanded version of a talk on nuclear physics delivered by Bohr on the occasion of the 50'th anniversary of the International Union of Pure and Applied Physics in September 1972. It describes briefly such topics of recent interest, as the following:

1. the second minimum in the potential energy function and the associated shape isomers, both arising from shell model corrections to the liquid droplet model of fissionable nuclei
2. heavy ion reactions, possibly leading to new transuranic nuclei
3. elementary modes of excitation and a unified description of nuclear dynamics
4. fine-grain structure of nuclear matter explored by high-energy probes
5. the compound nucleus and statistics of quantal states
6. strength functions and direct interactions
7. two-particle transfer reactions as a tool for the exploration of nuclear pair correlations
8. generalized rotational motion
9. phase transitions induced by rotational perturbations and yrast (literally dizziest, from Swedish yr, yrast line, i.e., states with lowest energy for given angular momentum)
10. connection to other fields (atoms, molecules, gases, liquids, and solids) which, like nuclear physics, are special cases of the general quantum-mechanical many-body problem.

Covering such a wide field, the authors can hardly be blamed for omitting some recent topics, e.g., Coulomb fission, suggested by Wilets and this reviewer. However, inclusion of more references, particularly of review articles and books, would have been useful.

Hecht reviews in some detail recent work on "Symmetries in Nuclei" related to the finite-dimensional vector spaces of the nuclear shell model. These symmetries are all associated with the unitary groups in g dimensions, $U(g)$, and their subgroups. A search for new useful symmetry groups and the use of symmetries as calculational tools are discussed together with the question of the goodness of the symmetries, which is all too often taken for granted. Koltun, in "Linear Relations Among Nuclear Energy Levels," discusses these relations in the context of the shell model. Such relations are a fairly new and sensitive tool for the study of effective interactions. Surprisingly, energy differences of 20 to 100 keV can be understood this way. However, there is a question about the speed of convergence of perturbation theory for the effective interactions. Mahaux, the author of "Intermediate Structure in Nuclear Reactions," discusses deviations from the statistics of the compound nucleus model due to preferential excitation of some single states and subsequent slow randomization. Giant dipole resonance, isobaric analog resonance, and subthreshold n-induced fission are the only convincing cases at present, but heavy-ion reactions probably should supply more examples. Doorway states play an important role. Lately, preequilibrium decay has been studied in some detail.

Goulding and Jaklevic's paper, "Photon-Excited Energy - Dispersive X-Ray Fluorescence Analysis for Trace Elements," relates to trace elements in an organic (carbon) matrix with a concentration of from less than 1 to 1000 ppm. It uses semiconductor detectors and can be an important tool for analytic chemists, since it is applicable

to problems of environment, biology, medicine, archeology, geology, and criminology. Ponomarev, in "Molecular Structure Effects on Atomic and Nuclear Capture of Mesons," discusses the fairly new field of mesonic chemistry. It is claimed that at present mesonic chemistry can reliably distinguish chemically bonded from free hydrogen. In the future it might be applicable to a variety of chemical structure problems involving hydrogen. In principle, it could also be used for a study of the electron cloud in molecules by improving the present experimental accuracy (10%). The arguments for a giant mesic molecule surely need further support. The violent change in the initial angular quantum number, l, distribution for nearby elements titanium and manganese is, contrary to the author's statement, natural. [cf., G. T. Condo, *Phys. Rev. Letters*, **33**, 126 (1973)]. Gentry, in "Radioactive Halos," refers to concentric light and dark circles, with diameters of 10 to 40 μm, centered on a tiny inclusion in thin samples of certain minerals, such as mica. Probably they are not just "attractive numerological oddities," but they form a record of radioactive decay in ancient rocks. They *might* even indicate some new presently unknown radionuclides. Rindi and Thomas review "Radiation Environment of High-Energy Accelerators," capable of producing π-mesons. It might surprise some readers that systematic studies of the radiation problems of accelerators started only 15 years ago! Now quantitative estimates of shielding, induced radioactivity, and radiation levels and damage can be made. A wide dissemination of such information is important in view of the increasing use of accelerators in industry and medicine (e.g., radiation therapy). There should be brochures for the general public, particularly for those who take radiation therapy and for those who apply it. Also, still more systematic studies of personal dosimetry of high-energy neutrons (above 20 MeV) are needed.

Summarizing, I found most of the articles rewarding reading.

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About the Reviewer: Eugene Guth is professor of physics at the University of Tennessee, engaged in both teaching and research, and was recently a visiting professor at Rice University. Dr. Guth completed his formal graduate studies at the University of Vienna and carried on post-graduate studies at the Federal Institute of Technology of Zurich and at the University of Leipzig. His scientific career has been broad and intense, and includes a research professorship at Notre Dame and 15 years as technical advisor to the director of the Oak Ridge National Laboratory prior to his retirement in 1971. He was one of the founders of the science of polymer physics. Professor Guth commented for us on Volume 19 of this series of Reviews; we welcome him back to these columns.