Book Reviews

Nuclear Structure, Vol. II: Nuclear Deformations. By Aage Bohr and Ben R. Mottelson. W. A. Benjamin, Inc., Reading, Massachusetts (1975). 748 pp. $37.50.

At last the long-awaited Vol. II of Bohr and Mottelson's *Nuclear Structure* has appeared. It deals with nuclear deformations, a field that has been pioneered by the authors and for which they, together with J. Rainwater, received the 1975 Nobel Prize in physics. It is a monumental work. The central theme is the complementary nature (shades of Niels Bohr) of the concepts of the independent motion of the individual nucleons and the collective behavior of the nucleus as a whole. It demands the utilization of the full arsenal of available theoretical tools. As in Vol. I on single-particle motion and the bulk properties of nuclei [reviewed by this writer in *Nucl. Sci. Eng.*, **40**, 355 (1970)], it starts from symmetry considerations that classify and restrict the possible modes of excitation. They are then fleshed out by comparison with the vast experimental material and the study of model systems. The coupling constants are determined from parameters of observed nuclear spectra, but not from first principles. The authors have succeeded in incorporating the microscopic theory of collective motion from the analysis of particle-vibration coupling (which includes rotation as a special case). With this feature, the two now-available volumes constitute a self-contained and comprehensive view of nuclear dynamics.

The picture that emerges is one of vast richness. The authors have condensed an enormous amount of material in their book. It is enlivened by numerous sidelights on other domains of physics where related phenomena occur, and by many historical footnotes that describe how the ideas gradually evolved. It also includes a discussion of fission which represents extreme distortions of the nucleus. In support, there is an extensive bibliography with over 1000 entries that also show the pages where the references are quoted.

Is this then the ultimate book on nuclear structure? It represents a comprehensive representation of the work of the authors' famous Copenhagen school, which has revolutionized nuclear physics during the last 25 years. Bohr and Mottelson have to be admired for their concepts and insights, their leadership, and the enormous amount of labor required for the completion of this encyclopedic work. They have served science well.

However, there is place for one caution. No holds are barred in the exposition. The reader must be thoroughly familiar with advanced quantum mechanics and be well acquainted with the phenomenology of nuclear physics. Even if he has these prerequisites, his job is not an easy one. Due to the "multidimensionality" of nuclear physics, it is hardly possible to order its development in a logical linear fashion. To overcome this difficulty, the authors have used the expedient of very extensive back and forth cross references. Thus, to get full value from the book, one has to study it again and again. As an introduction to the ideas and the main flow of thoughts, it is advisable to peruse the Nobel Lectures by Bohr and Mottelson, which have been published in *Rev. Mod. Phys.*, **48**, 345 and 357 (1976) and in *Science*, **193**, 203 and 287 (1976).

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About the Reviewer: In his long and distinguished career, Lothar Nordheim has witnessed and contributed to the development of quantum mechanics and the initiation and the fruition of nuclear energy. He has held positions in academia, at the national laboratories, and in industry. He is at present a consultant at the General Atomic Company in San Diego. He is a scientist rather than an engineer. As such, he is primarily interested in principles, philosophy, and fundamental methods, although he is well aware that meticulous regard for details is necessary in both types of endeavor. He is an alumnus of the Niels Bohr Copenhagen Institute and at least an acquaintance of the Aage Bohr and Ben Mottelson succession. He thus appears to be well qualified to review this book. He admits, however, that he found the going rather hard. It is quite likely that a younger generation of physicists will have an easier time. But anyhow, Mr. Nordheim acclaims this book as a milestone in nuclear science, although it may not be as useful for those primarily concerned with the practical applications of nuclear energy.

Of Acceptable Risk: Science and the Determination of Safety. By W. W. Lowrance. William Kaufmann, Inc., Los Altos, California (1976). 180 pp. $4.95.

Professional loss-prevention people have long recognized that important contributions to the literature on safety have come from individuals outside the safety field. The author of this book, *Of Acceptable Risk*, has made a major contribution to the subject of loss control. Of course, Lowrance was well advised, as he acknowledges having received inspiration and guidance from G. B. Kistiakowsky, Emeritus Professor of Chemistry at Harvard University. Dr. Kistiakowsky was the major figure in

the development of the chemical high-explosive components for the World War II Manhattan Project atomic bomb program.

Lowrance has recognized the introduction of new risks from the introduction of new technologies, but he reminds the reader that the undesirable effects must be viewed as the expense of decreasing our vulnerability to the hazards of nature. The book acknowledges that mankind is in many ways safer today than ever before. This trend will probably continue in the safer direction, since new technologies generally tend to supplant devices and techniques of greater risk. Furthermore, existing technology is so frequently challenged, investigated, legislated, and improved upon that even techniques of long standing are required to get safer. Anesthesia, electrical appliances, communications (in a sense of warning), and labeling are examples of classical technologies improving in safer directions.

Lowrance shows his scientific detachment in analyzing risks and then mixes with these scientific viewpoints a personal response to hazards when he speaks of rural America in 1900. Among the rural hazards, he lists "tetanus-inducing rusty nails." In my early years I, too, was warned of "rusty nails" and "lockjaw." It took many years before I became aware of the germ theory of disease and learned that it really wasn't the rust or iron oxide to be afraid of, it was the pathogen.

The author pursues another social entrapment when he speaks of the known success of dramatic crusades in reducing abestosis and black lung and includes in the same paragraph "eye-saving standards for factory lighting." The extraordinary increase in lighting levels in the last generations probably was influenced at least as much by cheap power, improved technology, an affluent society, and artistic enhancement as by health and safety interests.

Lowrance understates the potential accomplishments of safety by direction when he avers that the goal of having workers "at no greater risk in carrying out their labor than they are off the job" is merely an admirable goal and has probably never been very closely approached in any country. Many, perhaps most, safety people feel that risk on the job can readily be made less than risk off the job and that indeed this has already been done in many industries. This can be attributed to enlightened and capable management determined to take the responsibility for reducing occupational accidents.

Of Acceptable Risk examines the broad issues of safety by analyzing social change, measuring risk, judging safety, and trying to come to grips with acceptable risk, public problems including legislation and the courts, the workplace, education, regulation by law and by consensus, costs, and examination of risk-benefit concepts.

The author is an able writer, and the tightly written prose permits the reader to enjoy the book despite the necessary discontinuity of the separate chapters and subchapters. The reader may open the book to any chapter or page and find some fruitful discussion. Lowrance issues challenge after challenge and with equal strength invites challenge again and again. It is the foundation of safety—challenge, not for its own sake, but for reexamination of existing methods and hardware and of changes proposed in the name of safety.

Lowrance states that scientists, engineers, designers, architects, physicians, and public health experts do have special responsibilities to the rest of society with respect to personal safety. My enthusiasm for this book suggests an extension of the author's view. I believe that at the senior or graduate level, students in those disciplines enumerated above should be subjected to a short course (five sessions, perhaps) with *Of Acceptable Risk* as a text.

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About the Reviewer: Roy Reider has been engaged in accident-prevention activities since 1936, serving as safety director of the Los Alamos Scientific Laboratory since 1948. Mr. Reider is an engineering graduate of the Rensselaer Polytechnic Institute and has authored more than 50 papers on a variety of safety subjects.

Environmental Aspects of Nuclear Power. By G. G. Eichholz. Ann Arbor Science (1976). 657 pp. $29.50.

This book pulls together a vast amount of information on a wide variety of topics related to nuclear power. It covers such subjects traditionally associated with its title as radiation effects, waste heat dissipation, in-plant treatment and environmental dispersion of radioactive effluents from power plants, radioactive releases in various parts of the fuel cycle and in transport accidents, and radioactive waste disposal. But its coverage also extends to such diverse subjects as energy sources and usage, power plant siting, and technological assessment. Most treatments are in considerable depth, including detailed descriptions of relevant equipment and processes. All in all, the book has 14 chapters with 123 figures and 183 tables containing an impressive wealth of information, plus about a thousand references.

As an example of the depth of coverage, the chapter on waste heat dissipation includes tables on cooling water requirements for various types of systems, cooling water requirements in various geographical areas versus time, heat rejection rates of common activities, representative natural and man-made power densities, properties of water, chemical wastes from a power plant, lethal temperatures for various fish, temperature ranges for successful fish egg hatching, water temperature standards for various states, costs and land requirements of cooling ponds, seasonal temperature variations of isotherms in ponds, toxicity of elements used in cooling tower operations, detailed breakdown of cooling device costs, comparative costs of alternative cooling systems, and business volume associated with various thermal pollution effects. It contains formulas with extensive symbol definitions for Stokes' law, evaporation rate (as a function of wind speed, etc.), heat conduction, equilibrium temperature with insolation, temperature profiles along heated water jets, the densimetric Froude number of a discharge, zone of equilibration on a river, concentration of radioisotopes versus time, duty coefficient of a natural draft cooling tower, and dimensions of the fog plume from a cooling tower. The chapter covers 52 pages and has 12 figures, 52 references cited in the text, and 16 additional references.

The book has some aspects of an encyclopedia. The amount of material covered is so large and varied that no single author could be intimately familiar with a large fraction of it, so one frequently recognizes quotes or paraphrases from documents; however, far from detracting from the value of the discussion, this introduces the reader to (or reminds him of) the pertinent documents. The