spontaneous ionization is taking place. The understandings developed in this region at the time the book was written (1972) have not changed significantly since then. Chapter 7 discusses the electrostatic probe and spectroscopic measurements of plasma temperature and density distribution in the thermionic plasma. Chapters 8, 9, and 10 discuss the plasma properties for various modes of thermionic converter operations. Topics such as the effects of magnetic field, the inert gas additives, and transient operation are also included.

Miscellaneous engineering problems such as the thermionic reactor and space application, the use of hot pipes, isotope-heating thermionic converters, and thermionic topping power plants are discussed in the last chapter.

Extensive reference lists at the end of each chapter include not only the Russian work but also a relatively complete listing from the West.

The English translation was edited by Lorin K. Hansen, who did a commendable job in unifying the nomenclature and symbols used in the international thermionic community.

David T. Shaw (BS, mechanical engineering, National Taiwan University, MS and PhD, nuclear engineering, Purdue University) is professor of electrical engineering and director of the Laboratory for Power and Environmental Studies at the State University of New York at Buffalo. He has served as a visiting professor at the University of Paris VI; visiting scientist at the Centre d'Etudes Nucléaires de Fontenay-aux-Roses Commissariat à l'Energie Atomique; a visiting scholar at the California Institute of Technology; and as a consultant to the Jet Propulsion Laboratory of the California Institute of Technology, General Electric Research Laboratory, Schenectady, New York, and Bell Aerosystems, Inc., Buffalo, New York. He was also an appointed member of the U.S. delegation to the International Atomic Energy Agency Liaison Group on Nuclear Energy Conversion in 1974 and 1975; to the French Commissariat à l'Energie Atomique, Paris, for the establishment of a cooperative program in energy conversion in 1974; and to the USSR for a similar assignment in 1975 and 1977.

Dr. Shaw is best known for his work on particulate emission control for advanced coal-fired power plants and the transport and control of radioactive aerosols related to light water reactor and liquid-metal fast breeder reactor plants. He is the editor of Fundamentals of Aerosol Science *and* Recent Developments in Aerosol Science *and a coeditor of a book series on energy and environment.*

MHD Instabilities

Author	Glenn Bateman
Publisher	MIT Press (1978)
Pages	264
Price	$22.50
Reviewer	F. L. Cochran

Glenn Bateman's book *MHD Instabilities* is a welcome addition to the books now available in the nuclear fusion field. The MHD (or magnetohydrodynamics) model is the simplest fluid model that can be used to study plasmas, and as such, it can be used to study macroscopic instabilities in complicated geometries. This book also serves as an excellent introduction to tokamak physics, and there are several instances where tokamak phenomena are discussed in detail. Tokamaks are toroidal magnetic fusion devices, which have enjoyed a certain amount of success in recent years and are currently among the most promising methods of achieving scientific breakeven in the near future. From a mathematical point of view, the level of the book is not very high and concentrates on the physical aspects of the problems discussed. One of the nicest features of the book is the many fine questions scattered throughout the text. References are also generously given at the end of each chapter.

The book begins with an introduction that explains basic tokamak principles and some of the phenomena that occur in these devices. These include the disruptive instability, Mirnov oscillations, and sawtooth oscillations. The MHD model is next introduced, and is followed by a general discussion of the validity and usefulness of this sytem of equations.

As is true throughout the entire book, the emphasis is placed on tokamak-like configurations. Chapter 3 presents a discussion of the Rayleigh-Taylor instability. Since this instability is simpler to understand than some of the more complex modes covered later in the book, this section serves as a good introduction to the concept of instability and the mathematical methods used to study them.

The equilibrium state of magnetically confined plasmas is left until Chapter 4. Here the notion of flux surfaces and their importance are introduced. Again, emphasis is placed on toroidal devices that have at least one ignorable coordinate. A derivation of the Grad-Shafranov partial differential equation in one unknown is also given. This important result is used to describe equilibria of axisymmetric toroidal systems.

The linearized MHD equations and the energy principle are presented next. This chapter and the following two chapters (on circular cylindrical instabilities) form the major substance of the book. In these chapters the reader is introduced to the basic methods and nomenclature involved in the study of MHD instabilities. There is a particularly good section in the chapter on cylindrical instabilities that gives a physical picture of the current driven instabilities. Chapter 7 also provides a section that discusses flux coordinate systems. These coordinate systems are an important tool that must be mastered if one is to be able to study the stability of toroidal systems.

High-beta tokamaks are currently of intense interest and an entire chapter is devoted to them. The final section of this chapter concentrates on the important ballooning instabilities. These modes are similar in nature to the Rayleigh-Taylor instability and may be the most important MHD instabilities that occur in tokamaks in the context of reactor design. While a good physical picture of this instability is given, this portion of the book could have been expanded with more mathematical detail.

There is a brief chapter on nonlinear instabilities, which for the most part consists of a general discussion with little mathematics. The final two chapters are concerned with resistive instabilities and comparison with experiments. The last chapter on comparisons is well presented and makes use of results from earlier chapters to explain various tokamak phenomena.

Overall, this book provides an excellent introduction to

MHD instabilities and macroscopic properties of tokamaks. The presentation is done at a fairly low level of mathematics and could easily be used as a textbook for an advanced undergraduate or beginning graduate level course.

F. L. Cochran (PhD, plasma physics, University of Maryland, 1978) has been at the University of Arizona since January 1979. His interests are in MHD theory and computational hydrodynamics. At present, he is working on the development and application of hybrid numerical simulation codes for the treatment of various nuclear fusion systems.

Superheavy Elements
(Proceedings of the International Symposium on Superheavy Elements)

Editor	M. A. K. Lodhi
Publisher	Pergamon Press, Inc. (1978)
Pages	583
Price	$55.00
Reviewer	Glenn T. Seaborg

This volume consists of the 50 papers presented at the International Symposium on Superheavy Elements held at Texas Technological University, Lubbock, Texas, in March of 1978.

Superheavy Elements (SHE) is the name that is used to denote elements that are well beyond the upper limit of the present Periodic Table and are expected to have their nuclei stabilized (i.e., have their half-lives for radioactive decay increased) by the advent of closed proton and neutron shells. The consensus is that the most hopeful region, termed an "Island of Stability," is located in the neighborhood of 114 protons and 184 neutrons. Calculations based on the extrapolation of known nuclear energy levels and various theories of nuclear structure indicate increased half-lives in this region that would make it possible to detect such radioactive nuclei (through their decay via high-energy alpha particles or spontaneous fission) provided they could be produced by transmutation reactions (through the use of heavy ions). Some predictions have even suggested half-lives as long as 10^8 yr, sufficient to allow the presence of SHE in nature.

The volume starts with an excellent overview paper by O. Lewin Keller, Jr., that describes the history and perspective of the search for SHE and includes a discussion of SHE's predicted chemical properties and place in the Periodic Table. This is followed by papers that describe the thus far unsuccessful attempts to synthesize and detect these elements through the use of heavy-ion accelerators at the GSI Laboratory in Germany and the Lawrence Berkeley Laboratory in the U.S.

Numerous papers describe the unsuccessful searches for SHE in nature. Of special interest are the papers that concern themselves with the somewhat mysterious long-range alpha-particle emitters, including radiohalos, associated with various natural radioactive sources. The question has been raised as to whether these phenomena might be associated with SHE, a possibility that this reviewer thinks is unlikely. This volume presents the best available single source of information on this interesting field of investigation.

Several papers deal with the predictions of half-lives for SHE. The best predictions appear to be those that suggest that these are too short to allow the presence of SHE in nature. Interesting predictions include the possibility of peculiar shapes for the nuclei of SHE, such as toroidal, spherical bubble, or crystalline, that might enhance their stability.

Most of the predictions suggest half-lives sufficiently long to allow their detection if reactions for their synthesis with sufficient yields could be found. Fusion reactions of moderately light heavy ions (such as ^{48}Ca) with heavy target nuclei (such as ^{248}Cm), or deep inelastic transfer reactions involving the heaviest available heavy ions and target nuclei (such as ^{238}U and ^{248}Cm) perhaps offer the most hope. However, the high bombarding energies required for the fusion reaction (resulting in loss of the product via the fission reaction) and the limited exchange of nucleons apparently possible (and the loss via fission) in the deep inelastic transfer reaction reduces our optimism for success.

Whether or not SHE are ever found, the stimulus of this concept has resulted in much worthwhile research and many interesting results. This volume presents a good picture of the present status of this research.

Dr. Glenn T. Seaborg is professor of chemistry and associate director of the Lawrence Berkeley Laboratory at the University of California, Berkeley. In 1940 and 1941, plutonium became the first of ten transuranium elements to be discovered by Dr. Seaborg and his coworkers. In 1951, at the age of 39, Dr. Seaborg was awarded the Nobel Prize for Chemistry (with E. M. McMillan) for his work on the chemistry of the transuranium elements. In addition to the Nobel Prize, Dr. Seaborg has received numerous awards and honors for his contributions to scientific discovery, education, the public understanding of science, government service, and international cooperation.