partial differential equations would be very useful in "following through" on the material presented. This text is certainly far from elementary, and a reasonable level of mathematical sophistication will be required to take full advantage of it. The level, the emphasis on numerical methods, and the use of SI units make this a modern text.

Robert S. Wick (BS, mechanical engineering, Rensselaer Polytechnic Institute, 1946; MS, Stevens Institute of Technology, 1948; PhD, mechanical engineering, University of Illinois, Urbana, 1952) has been professor of nuclear and aerospace engineering at Texas A&M University since 1966. Before that he was at the Westinghouse Bettis Atomic Power Laboratories (starting in 1955), where he was associated with various reactor design projects.

Fermi-I: New Age for Nuclear Power

Editor	E. Pauline Alexanderson
Publisher	The American Nuclear Society, La Grange Park, Illinois (1979)
Pages	454
Price	$27.80
Reviewer	Lloyd R. Zumwalt

This book gives the first full account of the history of the Enrico Fermi Atomic Power Project (Fermi-I) and reviews its contributions to the development of breeder reactors. Eighteen authors with intimate knowledge and involvement in the project cover the initiation, development, operation, and decommissioning of Fermi-I.

The book abounds with historical detail, is well dated and referenced, with many direct quotations from important individuals involved; lists of committee members, their affiliations, and the corporations involved, and a complete story of the initiation and changes in the two corporate bodies of the project. These bodies were the Atomic Power Development Associates (APDA) and the Power Reactor Development Company (PRDC). The appendixes are particularly rich in documentary detail and include a complete listing of member companies, boards of trustees, and officers and committees of the PRDC and APDA. Also given are the supervisory staff of the Fermi-I power plant, the APDA and PRDC licensed reactor operators, and a list of all APDA numbered reports. In addition, the appendixes include excerpts or reprints of loan agreements, pertinent letters from the ACRS and the U.S. Atomic Energy Commission (AEC) and a summary list of the final decommissioning costs.

The general reader who is not a historian, former participant, or a nuclear "old-timer" may want to "speed read" through much of this detail. He will nevertheless be rewarded with the narrative of the dramatic events in the life of the first large fast breeder power plant from its preconception with the formation of the Dow Chemical–Detroit Edison Study Group in 1950, until its decommissioning, completed in 1975. The reader should be able to perceive an exciting story that took place in an age of great expectations for nuclear power. Furthermore, the story is one of solid achievement and valuable learning experience in the time frame from 1950 to 1975.

The story begins with the formation of Dow Chemical–Detroit Edison Study Group. This group was indicative of the enthusiasm that industry had for nuclear power when the technology was shrouded by a veil of secrecy imposed by the Atomic Energy Act of 1946. The group studied hard and rapidly grew by adding many industrial associates, and by December 1954 became the APDA, which was incorporated on March 10, 1955. In the meantime, the group played an important role in the enactment of the Atomic Energy Act of 1954, which permitted a substantial declassification of the technology. Also, the study group had come to the conclusion that, although the technology of breeder reactors was less advanced and difficult research and development were ahead, more would be gained by efforts on a breeder which, from a long-range viewpoint, was the most desirable type of reactor.

The story continues. In response to an AEC invitation regarding power reactor demonstrations, Walker L. Cisler (President of Detroit Edison at the time), representing a group of power companies (later the PRDC), submitted in March 1955 a proposal to design, construct, own, and operate a 100-MW(electric) breeder power reactor. The design accompanying the study was by APDA. The AEC announced acceptance in August at the first U.N. Conference on Peaceful Uses of Atomic Energy. About a year later, the AEC issued a construction permit for a reactor plant at Lagoona Beach, Michigan (~25 miles from Detroit). The PRDC was incorporated on August 30, 1955, and Cisler was president of both PRDC and APDA. Chapters 3 and 4 detail the organization, members, personnel, and actions of these two corporate bodies, respectively.

Chapters 5 and 6 cover the financing of Fermi, the law affecting the Fermi Project, and the role of Fermi in the evolution of the AEC regulatory process for the nuclear industry. Some of this may be a bit dry for the general reader, but the next chapter on the obtaining of the construction permit is not.

Chapter 7, although written in a matter-of-fact, objective way, indicates the political drama that took place over the Fermi construction permit. This involved the conflict of two strong, prominent men, Admiral Lewis Strauss, Chairman of the AEC, and Senator Clinton Anderson of New Mexico, Chairman of the Joint Committee on Atomic Energy. The issue was an ideological one, of private versus public power, the latter being favored by Anderson. The reader will learn that Cisler had, in 1955, incurred the disfavor of Senator Anderson by testifying against the Gore Bill, which would have provided that the federal government construct six nuclear power plants (a sort of a giant nuclear version of the Tennessee Valley Authority). Cisler was, of course, an ardent exponent of private investment in nuclear power.

The reader will discover this struggle led to the first public intervention relative to the issuance of a construction permit. At the urging of Senator Anderson, at the end of August 1956, and led by the United Auto Workers and Walter Reuther, several labor unions and their officers intervened in less than 30 days of the issuance of the Provisional Construction Permit. The grounds for intervention were the questions of reactor safety and of the financial qualifications of the PRDC. However, as appears

to be the case for almost all later permit interventions, the deeper reason was ideological. The reader will be interested in comparing the ideological conflict of 1956 with that of today's pro- and anti-nuclear advocates. Details of testimony and an editorial by the *Wall Street Journal* (Appendix I) on the significance of the hearings are of considerable interest. After a long legal battle, in June 1961, the U.S. Supreme Court reversed the Court of Appeals and confirmed the AEC construction permit.

In the meantime, the reader will find that design and construction proceeded—this is covered with excellent graphics and photographs in Chaps. 8 and 9. Chapter 10 describes testing and preoperation. In October 1962, the ACRS notified the AEC that Fermi would be operated safely up to 1 MW(thermal). Next, there was a sodium-water reaction due to a small leak in the No. 1 steam generator. The 1-MW(thermal) license was finally issued in May 1963, and, finally, a license for operation up to 200 MW(thermal) was issued December 1965. Operation at 100 MW(thermal) began in July 1966. After some successful long runs at 100 MW(thermal) [22 MW(electric)], a fuel-melting incident occurred on October 5, 1966.

The fuel-melting incident, its prologue, aftermath, diagnosis, repair, consequences, and cost are given in Chap. 11. This account gives the reader an unusual nuclear detective story of the search for the cause of the difficult-to-detect meltdown. It is left to the reader to discover the cause and be apprised of the lessons learned.

In about four years, Fermi-I was put back into operation and went to a power level twice that at which the accident occurred (Chap. 12). However, by this time technology had made its relentless progress—a uranium-plutonium oxide fuel core had been found best for fast breeders. The uranium-molybdenum alloy fuel core of Fermi-I was obsolete and costly to retrofit.

The difficult decision of decommissioning was made as described in Chap. 13. Four more chapters of the book give an excellent account of safety at Fermi, nuclear and nonnuclear research and development, and also the educational contributions of Fermi.

The book ends (Chap. 18) with a review of the significance of Fermi. The project set many precedents and provided extended (12 years) experience with the maintenance of large sodium systems.

One of the principal purposes of the project, from the beginning, was to provide training. This was extended to more than 250 U.S. and foreign personnel.

The reader may perceive that the published results of the project and the training of scientists and engineers of other countries were perhaps the greatest contribution of Fermi-I. This was in consonance with the goal of President D. D. Eisenhower's 1955 Atoms for Peace program. It now seems that it is up to these men and their colleagues to carry on with breeder reactor development.

This reviewer found few typographical errors. The format, printing, and figures are of excellent quality. This book is recommended for any reader who is interested in the history of the early days of nuclear power and the eventful story of a bold reactor project from beginning to end.

Lloyd R. Zumwalt is professor emeritus of nuclear engineering at North Carolina State University. His nuclear career began with the Manhattan Project in 1942. He was in pioneering work on the application of radioisotopes to industry and was associated with high-temperature gas reactor research and development for many years. Dr. Zumwalt's activities with the American Nuclear Society include having been a member of the Board of Directors and a founding member of both the San Diego and Eastern Carolina local chapters. His current interests are nuclear fuels and cycles, irradiation effects, nuclear waste disposal, and environmental effects of various energy sources.

Kinetics of Ion-Molecule Reactions

Editor	Pierre Ausloos
Publisher	Plenum Publishing Corporation (1979)
Pages	508
Price	$49.50
Reviewer	R. J. Woods

Studies of the kinetics of reactions between ions and electrically neutral molecules are relatively recent, although the reactions themselves have been known for over 60 years and have been recognized as important steps in organic reaction mechanisms in the liquid phase for almost as long. Ion-molecule reactions also play an important part in atmospheric and interstellar chemistry, radiation chemistry, the chemistry of discharges and gas lasers, and in combustion and, in the gas phase, have recently come under intensive investigation by a variety of sophisticated techniques. The present volume represents the proceedings of a North Atlantic Treaty Organization (NATO) Advanced Study Institute on the Kinetics of Ion-Molecule Reactions held at La Baule, France, September 4-15, 1978. An indication of the rate of advance in this area can be gained from the fact that this is the second NATO Advanced Study Institute on ion-molecule reactions in the space of four years.

The 22 papers and panel discussions included cover a wide range of topics concerned with the kinetics of ionic processes in the gas phase. Theoretical papers deal with quantum chemical computational techniques for the potential energy surfaces of ion-molecule reactions, the calculation of ion-permanent dipole capture rate constants, factors influencing thermal ion-molecule rate constants and collision processes, and the thermochemistry of polyatomic ions. New experimental techniques are reviewed in the final chapter while individual chapters deal with molecular beam studies and drift tube experiments. Experimental data are reviewed in the areas of ion-molecule collision complexes, charge transfers at thermal energies, internal energy partitioning, and the photodissociation of ions. Separate chapters cover ion-molecule reactions in low-temperature plasmas and their role in the formation of interstellar species and reactions in the atmosphere, in flames, and in lasers.

Of particular interest to physical organic chemists are chapters dealing with the reactions and properties of polyatomic, organic ions in the gas phase. These can be compared with the extensively studied and very much more familiar reactions of organic ions in liquid organic media