Physics of Nuclear Kinetics. By G. Robert Keepin. Addison-Wesley Publishing Company, Inc., Reading, Massachusetts; (1965), 435 pp, Price $12.50.

In the opening paragraph of his preface Dr. Keepin expresses a concern for the appropriate timing of this book. This reviewer commends him for an excellent choice of timing. The simple fact that 561 references are listed (some duplicated) indicates that an authoritative digestion is needed. The scope covers the nuclear physics, reactor measurements, and the theory of reactor kinetics. In the study of reactor transient characteristics, where rapid development in understanding and application can be foreseen, this book should prove valuable for its stimultaion, even though the probability of obsolescence for this part of the book is higher.

The first five chapters essentially convey a physical understanding of the process of fission, manifesting the energetics that relate the fission fragments, neutrons, and gamma rays associated with fission. The sections on delayed neutrons are, of course, those written most intensely. It is interesting that the fitted six-group period and yield data are recommended for reactor kinetics application in preference to five- or nine-group fitted data or radiochemical data. Photoneutron production is included, since it is often significant in reactor kinetics. The emphasis on physical understanding and the digestion of available data are the essential features of these chapters.

The second group of five chapters is devoted to applications, and discusses both theoretical and experimental methods in various aspects of reactor kinetics. The relation of reactivity, and of various types of changes in reactivity, to kinetic responses is developed in these chapters, the last chapter being devoted to system stability. These sections emphasize approaches developed at Los Alamos and these are, of course, largely applicable to the highly enriched fast reactors in use there. Many aspects of the kinetics problem in large (power) reactors or the required approaches are not mentioned. In particular, stability is discussed as a safety problem, while it is more likely to be considered an operating problem or limitation.

For those working in the field of reactor science and engineering, it is inevitable that *Physics of Nuclear Kinetics* will be a valuable and authoritative source of data. The many tables and charts are presented in excellent, useful fashion. They cover both the data of "fission physics," once a fission has been initiated, as well as the digestion of these data into the form most directly useful to the reactor physicist. The appendix includes tabulations of several functions, such as reactivity vs period and the zero-power transfer function for three fissile isotopes.

The great contribution of *Physics of Nuclear Kinetics* lies in its value as a reference work. It is likely to be considered definitive in the presentation of nuclear data basic to reactor kinetics. Although students of nuclear engineering will find this a very valuable addition to their libraries, it is not well suited to stand as a text, since the theoretical treatments in the chapters on reactor kinetic behavior are in some cases sketchy. Despite this shortcoming, it is probably the best book available for use as a text in reactor kinetics.

W. Rudolph Kanne

Atomic Power Equipment Department
General Electric Company
San Jose, California

About the Reviewer: W. Rudolph Kanne received his PhD in physics at the Johns Hopkins University in 1937. Before joining the General Electric Company in 1946, he was associated with the University of Wisconsin, the Illinois Institute of Technology, the University of Chicago and the DuPont Company. He is presently Manager of Core and Fuel Engineering at the Atomic Power Equipment Department of the General Electric Company in San Jose, California.

Carbides in Nuclear Energy. Volumes I and II, edited by L. E. Russell, B. T. Bradbury, J. D. L. Harrison, H. J. Hedger and P. G. Mardon, Macmillan and Co., Ltd., London, England; St. Martin's Press, Inc., New York is U S distributor for this book, 966 pp, $42.00, (1964).

These volumes constitute the record of the proceedings of an international symposium on the technology of uranium, plutonium and thorium carbides held at Harwell in November, 1963. Sixty-seven papers were presented and discussed at the symposium, and these have been faithfully recorded and presented, with abstracts in three languages. Twenty-five of the papers have to do with the subject of synthesis and fabrication of carbides, nineteen deal with phase relations, eighteen are concerned with physical, chemical and mechanical properties, and five introduce the subject of irradiation damage to carbides. The symposium was arranged to bring together scientists and engineers from laboratories throughout the world which have been engaged in research efforts on these carbides as nuclear fuels. As a result, some of the papers represent studies just recently completed, and other papers fall in the category of research in progress. The over-all effect is to provide an excellent cross-sectional view of the-state-of-the-technology of nuclear carbides as it existed in November, 1963.

A great variety of new physical, mechanical, chemical and constitutional data on nuclear carbides was presented for the first time at this conference. In addition, some controversial areas of knowledge were apparently cleared up. For example, the formation of uranium sesquicarbide (U_2C_3), which has a large and complex unit cell, is shown to occur by a "nucleation and growth process," which can be described by conventional time-temperature diagrams and which is characterized by long "incubation periods" at temperatures as high as 1400°C. Likewise, three separate investigations produced results showing convincing evidence that uranium monocarbide (UC) can form a solid solution containing up to 35 to 37 mole% of the hypothetical phase, "UO."

On the other hand, some new areas of controversy became apparent. Uranium-plutonium carbides are of considerable interest as fuels for fast reactors; but conflicting views were presented with regard to the magnitude of the problem of volatilization of plutonium during fabrication of these fuels. A number of less serious controversies became apparent in connection with the large amount of constitutional information that was presented. The existences of a number of new phases such as UC_{1-x} and $UNiC_2$ were proposed, and it quickly became clear that more information about the exact compositions, structures and temperatures of stability of these phases was needed.

A number of pleasant surprises with regard to correlations between the results of different investigators came to light at this conference. For example, J. J. Norreys found that departure from stoichiometry and alloying with tung-