is now devoted to cosmic rays whereas, in the previous edition, the corresponding chapter included a section on strange particles. The chapter which in the second edition was entitled "Fundamental Particles" has been revised and is called "Fundamentals of Electricity and Matter." Most of the other chapters have been revised to some extent, and those chapters dealing with applications have been expanded significantly.

One does not expect to find much to criticize in a book by Glasstone and this is no exception. There are a few misprints and other trivial errors, but the intent of the text is clear, even to the cursory reader, in each instance. It seems certain that this book, in its new edition, is destined to remain the classic reference in its field.

William G. Pettus

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January 25, 1968

About the Reviewer: William G. Pettus holds a PhD in Physics from the University of Virginia. Since 1956, Dr. Pettus has been a senior experimental physicist with Babcock & Wilcox's Critical Experiment Laboratory in Lynchburg. His work has included experimental and theoretical investigations of neutron resonance absorption phenomena, Fermi age measurements in water and various metal-water lattices, and the development of neutron spectrum measurement techniques.

Servomechanisms. By L. J. Bulliet. Addison-Wesley Publishing Company, Reading, Mass. (1967). 276 pp. $9.95.

An interesting problem arises in the consideration of the type of education needed by the technician, operator, or maintenance engineer in some of our complex process plants. In nuclear-power-plant instrumentation and control systems, we want technicians to be able to fix things fast. To some extent, we are far less concerned with a technician's basic knowledge concerning why something works than we are with his familiarity with how it works. We want the technician to be familiar with all of the input-output symptoms of working and malfunctioning systems. Then, when something goes wrong, it would be very nice if he could reach into the cabinet and replace the right card or component in true serviceman tradition. This type of operation or maintenance function requires only knowledge of the specific devices on hand and a strict set of procedures, such as "measure this voltage first," etc. The theoretical background required by the fixer can be minimal.

Bulliet's book starts with the premise that our operators and maintenance engineers of the future will be graduates of junior colleges, technical institutes, or possibly two-year community colleges. On this basis, they can be given more than radio ham training or training in the application of simple mechanical skills such as those known to the automobile repairman. *Servomechanisms* is an attempt to go one step beyond the simple description of control devices in an effort to at least reach the maintenance supervisor. The assumption is made that he should be capable of designing simple servo systems, if not high performance ones.

The dilemma arises in the assumption of background knowledge. The book is beautifully simple and clear, but requires previous exposure to a very good high school physics course or a supplementary mechanics course. And although physical intuition is used in the derivation of the equations, the language requires a background of at least one year of calculus. Most of the text is based on an intuitive feel for variations in the parameters of second-order differential equations. Many of today's plant technicians simply do not have this background. If a student does have this type of background and physical feel, under normal circumstances he would be likely to go on and get an engineering degree. As an engineering text for the examination of design problems and principles, Bulliet must compete with fifteen or more texts on servomechanisms that are better suited to this purpose.

This book might be more valuable for those in other engineering fields who want a cursory view of the principles of servo systems without getting too involved. Bulliet's book reads fast and anyone with an engineering degree should have little difficulty working his way through it in a couple of nights. The elementary servo language is there as are the operating principles. Descriptive material is provided on synchro devices as followers and error detectors. A good explanation is given of the operation of magnetic amplifiers and saturable reactors. Problems are presented at the end of each chapter; many require descriptive rather than mathematical answers. The problem of the "hunting" servomechanism is emphasized, but the reader should not expect to be able to design his way out of any specific oscillating situation. The serious reader, however, would be able to discuss and describe very clearly the parameters of a servo problem to a design engineer. Well, maybe that is what we should expect of our technicians, the ability to describe a problem so well that the solution is at once apparent to someone skilled in the art.

M. A. Schultz

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November 4, 1967

About the Reviewer: M. A. Schultz was brought up as a radio engineer in the exciting days when Bode and Nyquist theory were coming in to displace the Routh stability criterion in the design of stable servomechanisms. His early experiences in the field were painful, particularly when told by the captain of a destroyer to stop tearing the mast down with a hunting radar antenna mechanism or get the blankety blank radar set off the boat. Possibly as a consequence, Mr. Schultz transferred his allegiance to the nuclear business in 1949 and became the author of the first servomechanism text in the nuclear field, Control of Nuclear Reactors and Power Plants.

Radiation Heat Transfer. By E. M. Sparrow and R. D. Cess. Brooks/Cole Publishing Company, Belmont, California (1966). 322 pp. $9.50.

The dramatic growth of interest and research activities in radiation heat transfer in recent years is best demonstrated by the sudden appearance of several books devoted solely to this subject. The aim of the present book, as stated by the authors, is to provide a contemporary account of radiation heat transfer suitable for use as a college text as well as a reference source for both research workers and practicing engineers. In view of the difficulties associated with writing a research-oriented text for an active and rapidly changing field, the authors have achieved their

aim exceptionally well. Except for a few debatable omissions of certain topics, the book as a whole is unique in its logical organization, in its concise but lucid presentation, and in its emphasis on a formal, analytical treatment of the subject.

The book is organized into three parts. Part One treats the basic aspects of thermal radiation and radiation properties, Part Two deals with radiant interchange among opaque surfaces, and Part Three pertains to radiant transfer through participating media.

Part One consists of two chapters entitled as follows: Thermal Radiation and Radiation Properties of Surfaces. Although a brief account of radiation characteristics of participating media is given in the first chapter, it would appear more logical to have an expanded discussion concerning radiation properties of participating media, particularly radiating gases, in a separate chapter. It would be highly helpful to have information regarding band and total emissivity of gases, particle scattering, and their relations to the transport analysis presented in Part Three. The coverage of surface radiation properties is quite adequate and up to date. One may argue, perhaps, that some brief background discussion on the Fresnel relations and the simple classical free-electron theory of optical constants might enhance the reader's understanding of basic physical mechanisms.

Part Two of the book presents a systematic, analytical treatment of radiant interchange among diffuse and/or specular opaque surfaces. Specific applications are given for radiative cavities, radiative-conductive fins, and systems involving interactions between surface radiation and convection. Emphasis throughout this part is placed on the exact, analytical formulations which are often in terms of integral equations, and on results obtained through numerical solutions. For practicing engineers who often encounter problems of complex boundary geometries and conditions, the method of surface subdivision or the so-called zone method is most useful. More discussions and a few illustrative examples concerning the use of this method would have strengthened this part.

The treatment of radiant transfer through participating media, as presented in Part Three, is focused on the use of the equation of transfer. Chapters in this part include basic equations, radiative equilibrium, combined conduction and radiation, and combined convection and radiation. Notably missing are topics dealing with approximate techniques highly desirable for complex physical problems, such as the concept of mean beam length and enclosure calculations involving participating media.

In general, the book is slanted toward the formal analytical treatment of the subject, but all the topics covered in the book are treated expertly and are well written. The book contains important and pertinent information in the literature up to about 1965. Except for the very recent work on nongray radiant transfer in participating media, the book can still be regarded as up to date. There are no examples and no problems in the book, and this may cause some inconvenience in classroom instruction.* The book is nicely printed and typographical errors are minimal. The relatively low price is another attractive feature of this excellent book.

C. L. Tien

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December 26, 1967

About the Reviewer: C. L. Tien is an Associate Professor of Mechanical Engineering at the University of California at Berkeley, and is currently on a research leave at the Miller Institute for Basic Research in Science of the same University. He received his BS from the National Taiwan University, MME from the University of Louisville, and MA and PhD from Princeton University. His main research interest lies in the various areas of heat transfer.

*Note added in proof: The authors have indicated that a problems manual will be ready soon.