

Gas Film Lubrication. By W. A. Gross. Wiley, New York, 1962. 413 pp. \$14.00.

With the current trend to high speed, high temperature, cryogenic temperature, radiation environment, long life, reliability, no contamination, etc., considerable interest has been focused on process fluid lubrication. Thus, a number of researchers have been working on the theory and practice of gas lubricated bearings.

In the last five years the open literature has had numerous contributions in the field of gas film lubrication. The First International Symposium on Gas Lubricated Bearings, sponsored by the Office of Naval Research in 1959, published many of the significant works of the time in a report ACR-49. More recently WADC Technical Report 58-495 on "Gas Lubricated Bearings, A Critical Survey" was issued. This book serves as a good reference up to 1961 and as such provides a very valuable contribution.

The author's purpose is to present, in unified form, the available work with slider, journal, and sector thrust bearings and this he accomplishes. The source of much of the material has been the published papers of engineering societies although some unpublished work of the author and his associates is included.

Wherever possible the book uses dimensionless parameters which makes the results more generally applicable. A familiarity with ordinary differential equations is necessary and knowledge of partial differential equations is desirable so as to enable maximum utilization of the book. An understanding of numerical methods is also profitable here.

While the book deals with both journal and thrust bearings it concentrates on the latter and does provide a number of useful results. The text is primarily devoted to compressible lubrication but it also includes incompressible results in a number of places. Unfortunately, only small portions of the book are devoted to unsteady films. The troublesome problems of instability (Half-Frequency Whirl—in the case of self-acting bearings, and Gas Hammer—in the case of externally pressurized bearings) are glanced over very lightly. Yet a better understanding of these problems is necessary in order to apply gas bearings widely.

While the book presents many equations, tables, and graphs, which the design engineer may use, it loses much of its value by not presenting the development of the fundamental fluid film equations. Since the technology is advancing very rapidly many of the references of as late as 1961 are already obsolete and only fundamental relations ensure the long term value of a book.

A handbook abstracts material from numerous sources and presents to the reader pertinent formulas, tables, graphs, etc. Unless all the limitations are clearly stated, there exists the danger that the information will be misleading and, therefore, misapplied. While the author undoubtedly knows the limitations imposed in the references, there seem to be a number of places where qualifying statements should have been made. When reading this text one is left with the impression that the author did not scrutinize the published literature but presented it as reference material for the reader to critically review. While this approach is satisfactory for a reference book it cannot help but detract from some of the book's value.

The appearance of this book is very timely and it will

provide valuable information to the researcher and designer.

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(About the Reviewer: Dr. Beno Sternlicht is Technical Director and Chairman of the Board of Mechanical Technology, Inc. which he co-founded in October, 1961. Prior to this, he was with General Electric Company's General Engineering Laboratories where he was concerned with the technical direction of the Bearing and Lubricant Center until 1958 when he was appointed a Consulting Engineer. He has taught graduate courses in applied mechanics, is a co-author of a theoretical book on hydrodynamics, and is a well-known authority on lubrication, hydrodynamics, and dynamics of machinery.)

The Challenges of Space. HUGH ODISHAW, ed. Univ. of Chicago Press, 379 pp. \$6.95, 1962.

"This book is not concerned with prophecy. It is largely an exposition of what exists today and what is scientifically and technically within reach. Its purpose is twofold: to outline the variety of activities—technical and scientific, domestic and international—that make up man's space endeavors, and to stimulate analysis of these activities." Thus the editor introduces the book.

The book deals with five aspects of space programs in more or less equal treatments by page count. The first of these sections concerns Applications of Space Research. All of the content here seems to be centered about the two key problems of communications and meteorology. The chapters on these subjects are excellent; but there is a definite lack of the space applications which are fallouts from the new technology. Some effort should have been devoted to presenting those advances in our standard of living and our health resulting from space research.

Secondly the book covers Space Research in an excellent collection of writings by top technical men. The first chapter on Biology and the Space Environment might better have been placed in the final part of the book. The chapter covers the technological problems of men in space and does not belong among the basic science oriented works. This might also have given the final chapter a more complete engineering orientation.

The third and fourth parts of the book deal with National Space Programs and International Space Cooperation. It is noteworthy that at this early time in space exploration these two chapters should require 43% of a text on the Challenges of Space. Although much of their content is out of place in this book, a good presentation is made in all aspects of these subjects, including the evolution and operation of existing organizational structures.

The final part of the book deals with Space Technology. There is a chapter on space vehicles and two chapters on propulsion schemes. This is the weakest part of the works, not due to the contributions of the authors, but due to its many light treatments and oversights. Technological developments are key challenges to accomplishing the future space missions. Neither the missions (flight technology) nor the technical subjects such as structural developments, guidance, control, life support, shielding, and other prob-

lems of a systems nature were given adequate space in the 15% of the book allotted to Space Technology.

In summary, the book did not achieve its purpose in outlining the technical and scientific challenges to space. It provides an excellent history and status of governmental programs and international activities in space and similarly an excellent discussion of the more basic scientific problem areas of interest in space. It is not recommended for reading on the engineering aspects of space technology.

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Law and Administration. (*Progr. Nucl. Energy, Ser. X, 3.*) JERRY L. WEINSTEIN, ed. A Pergamon Press Book, Macmillan, New York, 19, 1962. 483 pp. \$20.00.

Progress in Nuclear Energy, Series X on "Law and Administration," has as Volume 3 this comprehensive summary on nuclear liability.

For the most part, this is somewhat heavy reading; however, in total, it is extremely intriguing. For here in one volume one finds legal and administrative problems and a status report on the still preliminary effort towards resolving the knotty questions of nuclear liability that make current day questions of nuclear design and materials seem relatively straightforward and soluble.

Here is a new industry that has exploded into being, as compared to the gradual evolution of all previous major industries, which involves certain risks quite unlike those with which we have long been familiar. For whenever radioactive materials are present a potential hazard may be said to exist. It is still too early to establish the extent of the potential hazard (conceivably catastrophic), who is responsible for its control, or even at the time of an accident determine its ultimate extent because the effects of exposure to radiation may be delayed many years. Add to these uncertainties the complexities of private versus public control, international participation, land and water shipment of potentially hazardous materials, nuclear ships as well as land based stations, multisupplier participation, limited insurance coverage, etc., and you have a plot that thickens as you read.

The editor, in the introduction, defines the problem well, including an explanation of the nature of liability, licensing and safety, personal liability, transport of radioactive materials insurance, state responsibility, national legislation, the Paris Convention, and nuclear ships. This is followed by sixteen articles by recognized authorities

covering each of the major topics identified in the introduction. In conclusion, the volume includes six appendices which present the existing legislation on nuclear liability in the United States, the Federal Republic of Germany, Switzerland, the United Kingdom, Sweden, and the OECD Convention.

The volume provides a comprehensive discussion and analysis of probable or possible application of law and legal principles to various activities involving nuclear materials. It presents a summary of the growing body of national and international law designed to adopt existing or establish new rules of liability to meet the unique risks and characteristics associated with the production and utilization of atomic energy.

For persons engaged in, or associated with, atomic energy activities, the legislative treatment of liability in connection with operation of nuclear reactors, supplying components, transportation of fuel elements, and handling of reactor wastes is particularly interesting and illuminating.

The articles dealing with liability aspects of international transactions and operation of nuclear-powered ships give the reader a good insight into the problems involved and the solutions attained or in process through international conventions. On reflection, it is somewhat staggering to encompass the amount of effort and time which has been devoted over the past several years in fitting nuclear energy into society's laws and customs—or perhaps adjusting society's laws and customs to atomic energy.

Undoubtedly, the hazards associated with some nuclear activities demand the comprehensive licensing and regulation programs of the United States and other countries which are described in this volume. The paradox of this and the extensive treatment of the measures taken to provide for "liability" is that in the more than 20 years experience of nuclear operations the safety records in nuclear installations are better than most other industries. The articles reviewing nuclear incidents and summarizing concepts and procedures in safety evaluation do a good job of bringing this fact into focus.

In the light of this, there is cause to be concerned whether society may overlegislate in a manner which will stifle the full development of atomic energy, and whether it is in the over-all best interest of society to have the atomic energy industry and its associated activities relegated to such severe legal duties in order to protect against very remote possibilities of harm or damage.

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(About the Reviewer: Sam R. Sapirie has had thirty years experience of working for the United States Government, the last seventeen at Oak Ridge. His nuclear experience started in 1946 as Assistant Director of Operations of the Manhattan District (having previously been on war engineering and construction with the Corps of Engineers in the Milwaukee District and in Western Canada and Alaska). When the Atomic Energy Commission received custody of the program in January 1947, he became Director of Production and Engineering and later Deputy Manager before becoming Manager, Oak Ridge Operations, in February 1951.)