BOOK REVIEWS

Hydrodynamic and Hydromagnetic Stability. By S. Chandrasekhar. 652 pp. Oxford U. Press, London and New York, 1961. $16.80. *Reviewed by J. Gillis, Institute for Space Studies.*

IT is now at least half a century since it became clear to applied mathematicians that it would henceforth be prudent, before ever publishing any of their research, to check first whether it had not already been done by Rayleigh. The time has come to amend this rule to read "Rayleigh or Chandrasekhar". The latter's newest book, representing only one facet of his many-sided work, will stand for a long time as a text on problems and methods, a reference work of results, and a monument to the scientific power and erudition of its author.

After a short introduction, the book gives a complete discussion of the Bénard problem in its most general form. The Pellew-Southwell paper on this subject in 1940, which cleared up so many of the earlier approximations and inaccuracies, seemed at one time to have settled the problem once and for all. However, in the hands of Chandrasekhar it turned out to be merely the starting point for an entire field of research. We have the discussion here of the complete problem, taking into account also the effects of rotation and of magnetic fields.

This is followed by a comparatively short section on fluid spheres after which the author proceeds to Couette flow and related problems, treated with the same thoroughness as the Bénard group. The next set of problems dealt with are those relating to superposed fluids. These fall naturally into two sub-groups, the Rayleigh-Taylor problems for static fluids and the Kelvin-Helmholtz problems for streams.

The next chapter, on jets and cylinders, includes methods for handling pinch problems and will be of particular importance to those interested in thermonuclear work. And the last specific set of questions treated are those of gravitational equilibrium and stability, questions fraught with cosmological significance.

There are a number of appendices on mathematical methods, all of which should be studied with care. Indeed it would be no exaggeration to suggest that the book as a whole could by itself make a very fine graduate course in applied mathematics. Apart from the interest of the material itself, the range and power of the mathematics and the clarity and conciseness of the exposition make it something like a liberal education in the subject.

The problems raised are dealt with so thoroughly that the uncompleted questions stand out very clearly; in fact, in most cases they are pointed out by the author as possible starting points for additional research. Included among these are many which involve the question of over-stability. For some of the more complicated stability problems it may well be that such questions cannot be solved by analytical methods, even with the aid of hand computing, but can only be cleared up by high-speed electronic computers. Even in the now classical problem of narrow-gap Couette flow we have only a semi-heuristic argument, bolstered by experiment, to convince us that over-stability does not occur.

This evokes the thought that there are very few scientific fields, if any, on which the "book to end all books" can be written; a book in which the basic problems of a subject and the results to-date are clearly formulated, all the known analytical methods for solution demonstrated, and many of the outstanding questions explicitly set out can only serve to stimulate activity in the subject concerned. And it is a little saddening to think that the next book on this topic, when it eventually appears, will almost certainly have to lean much more heavily on numerical analysis.

One characteristic of Chandrasekhar's work is the combination of mathematical analysis with physical insight, and this appears in almost every section. There is a report of the extensive experimental work that has been conducted, in great measure inspired by the author. The remarkable agreement between experiment and theory is both a tribute to the skill of those who designed and executed the experiments and a reassurance of the validity of the linear-perturbation approach to the stability questions treated in this book.

Progress in Solid Mechanics, Volume 2. I. N. Sneddon and R. Hill, eds. 331 pp. (North-Holland, Amsterdam) Interscience Publishers, Inc., New York, 1961. $11.75. *Reviewed by Ellis H. Dill, University of Washington.*

THIS series of monographs containing review articles which summarize and unify the most recent work on various aspects of mechanics of solids is certainly worthwhile. The emphasis in the series has been on the principles and mathematical techniques of continuum mechanics, but articles on experimental work of a fundamental nature are promised. The first volume was reviewed earlier. Volume 2 contains the following articles: Large Elastic Deformations, by J. E. Adkins; Elastic Waves in Anisotropic Media, by M. J. P. Musgrave; Elastic Inclusions and Inhomogeneities, by J. D. Eshelby; Plastic Waves, by J. D. Craggs; The Measurement of Dynamic Elastic Properties, by K. W. Hillier; Discontinuity Relations in Mechanics of Solids, by R. Hill; The Stability of Elastic-Plastic Structures, by M. R. Horne.

The first article is concerned with an ideally elastic material described by a strain-energy function. The second is a survey of the more important features of the subject, using modern terminology; and the third is concerned with the construction of solutions to two related problems in the three-dimensional theory of elasticity: A region (inclusion) in an isotropic, homogeneous elastic medium is subjected to a strain; A body subject to certain uniform stress at infinity contains a region of different elastic constants, while each part is itself isotropic and homogeneous. Craggs has collected considerable material on the propagation of stresses large enough to cause yielding and inelastic behavior in metals and on applications to beams, plates, and shells. Many types of experiments that have been successfully used to determine accurately the material properties for an elastic material subjected to dynamic loading are described in a qualitative manner, and the elementary theory used to integrate the observations is derived by Hillier. A general study of surface of discontinuity is presented by R. Hill: the general compatibility relations on the jump of functions and their derivatives across singular surfaces are derived, and the basic theory is applied to classical elasticity and to rigid-plastic solids. Horne presents a largely qualitative survey of the state of knowledge regarding application of the theory of perfectly plastic materials to rigid frames used in building design.

In all cases, an extensive list of references to original sources is provided. The volumes in this series are certainly of immense interest to those who are active in research or applications in mechanics of solids.

Ballistic Missile and Space Vehicle Systems. Howard S. Seifert and Kenneth Brown, eds. 526 pp. John Wiley & Sons, Inc., New York, 1961. $12.00.

Basic Physics of the Solar System. By V. M. Blanco and S. W. McCuskey. 307 pp. Addison-Wesley Publishing Co., Inc., Reading, Mass., 1961. $7.50. *Reviewed by T. Teichmann, General Atomic, Division of General Dynamics.*

THE literature of "space" is now becoming sufficiently complete that most works no longer attempt to cover all aspects of space exploration and science (at whatever level), but are beginning to limit themselves to certain restricted, if major areas. The two volumes under review here, unrelated though they are, cover in large part the two more significant categories of space science and engineering in a generally complementary fashion, and taken together provide a useful and informative picture of the field, and of the more important questions which arise in it.

Ballistic Missile and Space Vehicle Systems discusses the primary elements of missile and satellite systems. Though it is more specialized and somewhat deeper than the earlier collection of articles put out by the same publisher under the title *Space Technology,* this very fact seems to make it more readable and understandable except perhaps to the complete novice. The possibility of discussing important details, and of eschewing complete generality enabled more time to be spent explaining and clarifying the operation of the various subsystems. A large part of the work is devoted to various types of propulsion, vehicle-dynamics guidance and control, structural-statics and -dynamics performance and systems analysis. In addition, there is some discussion of countdowns (of various types), launching, and auxiliary subsystems. One interesting point which becomes clear (even if inadvertently) is the extent to which "systems engineering" is an empty concept without close attention to the component parts. This is brought out particularly by the first chapter, which is the one vacuous section in an otherwise interesting and informative volume. As a whole, the book seems valuable enough and to have a sufficient lifetime to have warranted reproduction by letterpress instead of photographically, which yielded a clear, but somewhat unfinished looking job.

Blanco and McCuskey discuss the environment in which missiles and space vehicles are likely to find themselves, with special reference to its application rather than for its intrinsic interest, which becomes evident, however, even when it is not explicitly spelled out. After an introduction describing various astronomical quantities and their relations, the various physical properties of the planets and their satellites are discussed, and a separate chapter is devoted to celestial dynamics in a manner designed both to provide a useful introduction and to make applications possible. Although not all derivations are given, the important perturbation equations for drag and oblateness corrections and for gravitational torque motions are given. The final chapter discusses the sun and interplanetary space. Each chapter is followed by a number of examples and a relatively comprehensive list of references. In addition, there are a number of relevant astronomical tables and a lunar map. This should prove to be a useful book both as an introduction and as a reference for the applied space scientists.

Advances in Space Science and Technology, Volume 3. Frederick I. Ordway, III, ed. 482 pp. Academic Press Inc., New York, 1961. $14.00. *Reviewed by R. E. Street, University of Washington.*

APPROPRIATELY the word "technology" has been added to this latest volume of the series as two of the articles are more concerned with problems of engineering than with the strictly scientific aspects of science in space. In fact the over-all impression of the book is that it is probably more useful to the technologist than to the scientist; it presents in review form the available knowledge of certain aspects of the planetary system which are necessary for the engineer concerned with the design of space probes and manned space vehicles.

The first article on the role of geology in lunar exploration by Green and Van Lopik is couched in the