

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

technical language of the geologist which this reviewer found considerably difficult to follow. Such an article is almost unique in space literature and points out a field which obviously is going to be important not only in lunar exploration but in planetary exploration as well.

Moore and Greenwood in their article "Venus as an Astronautical Objective" argue that even though less is known about this planet than some others, it may yet be the first space-flight objective after the moon. All of the factual as well as speculative knowledge of Venus is carefully and interestingly reviewed. Similarly the following article by Hess on Mars as an astronautical objective covers the known facts about Mars as a planet, especially its atmosphere. Both articles indicate how sketchy our knowledge of these two nearest planetary neighbors of ours really is, and how necessary exploration of both by means of fully instrumented probes will be before manned flights can be undertaken. Newburn's article on Mercury, asteroids, major planets, and Pluto reviews the information on the remaining planets of the solar system. Manring considers the effects of interplanetary matter as well as means of detecting it in the next article.

"Structures of Carrier and Space Vehicles" by Alberi and Rosenkranz is an excellent and comprehensive survey of all aspects of this important technological problem. A very short survey of advanced nuclear and solar propulsion systems by Cooley serves to present the latest advances in this field. Similarly the last article on aspects of weightlessness by Campbell covers our present knowledge of this important factor in space flight.

As in the earlier two volumes, this latest one contains an excellent selection of topics, well written and emphasizing present knowledge and state of progress, attesting to the good judgment of the editor and his board of advisors.

The Third Law of Thermodynamics. By J. Wilks. 142 pp. Oxford U. Press, London & New York, 1961. 15s. Reviewed by R. H. Asendorf, *Hughes Research Laboratories*.

THIS book, the eighth in a series of monographs called the Oxford Library of the Physical Sciences, is generally descriptive and is designated as an introductory undergraduate text. It is intended primarily to give a comprehensive survey of the celebrated so-called Third Law of Thermodynamics and achieves its purpose well. Quoting from the introduction, the author says "... the Second Law merely postulates the existence of an entropy function, while the Third Law discusses its behaviour."

The author writes well and with assurance. The more mathematical parts of the book are the sections which deal with elementary statistical mechanics, and are very well presented. In broad outline, the book covers (not necessarily in this order) entropy and probability, statistics of a perfect gas, internal degrees

of freedom, the third law and its statistical basis, nuclei and entropy, chemical equilibria, and the unattainability of absolute zero. The author covers a wide range of topics in physics and chemistry, particularly the study of phenomena near absolute zero; topics discussed include the behavior of orthopara hydrogen, liquid helium, magnetic cooling, the graphite-diamond transition, and others. The book contains 41 figures and is well documented with 112 references to the literature.

Physics of the Solar Chromosphere. By Richard N. Thomas and R. Grant Athay. Vol. 6 of Monographs and Texts in Physics and Astronomy, edited by R. E. Marshak. 422 pp. Interscience Publishers, Inc., New York, 1961. \$15.50. Reviewed by E. J. Öpik, *University of Maryland*.

THE authors have published a great number of papers on the interpretation of chromospheric phenomena, especially those observed at the solar eclipse of 1952. The monograph summarizes and further develops these researches, making use also of work by others.

They are concerned only with the chromosphere, defined broadly as that part of the solar envelope comprised between photosphere and corona. The traditional concept of "reversing layer" is discarded, perhaps unfortunately; with the peculiar temperature distribution as described in the monograph, the concept could have been retained for the region " $-500 \text{ km} \lesssim h \lesssim +500 \text{ km}$ " where the temperature is below that of the photosphere; in that case the chromosphere proper, from $+500$ to some 7000 km up, would be characterized by a temperature rising outwards from 6100°K to values of the order of $5 \times 10^4 \text{ deg K}$. The still undeciphered clue to the structure of the chromosphere and even the corona is seen in the spicules, jets of denser gas (magnetically contained?) intruding into the chromosphere from below with velocities of the order of 30 km/sec ; they cover less than one percent of the solar surface, and are probably the source of chromospheric heating.

No attempt is made to trace the mechanism of the spicules nor of the source of heating. The treatment is restricted to the problems of radiative transfer and local equilibrium state of matter which is shown to depart considerably from local thermodynamic equilibrium, (L.T.E.) apparently as the result of mechanical heating. Of course, departures from L.T.E. in stellar atmospheres were known long ago and were termed "superexcitation" by H. N. Russell (whose name, however, is missing from the bibliography). The amount of detail in the treatment is contrasted by the large margin of uncertainty in the conclusions and proposed models; this, however, is the consequence of insufficiency of the observational data, and of an additional degree of freedom due to the spicules causing a deviation from spherically symmetric hydrostatic and radiative equilibrium which cannot yet be quantitatively assessed.