Planets and Satellites. Vol. 3 of The Solar System. Gerard P. Kuiper and Barbara M. Middlehurst, eds. 601 pp. University of Chicago Press, Chicago, Ill., 1961. $12.50. *Reviewed by E. J. Öpik, University of Maryland.*

THE editors and authors are to be congratulated for producing a volume of such complete and authentic basic information on the members of the solar system. The outer appearance, motions, internal and atmospheric structure, photometric and radiative properties of the planets and their satellites are covered in eighteen chapters which were contributed by outstanding competent authors; encyclopedic completeness of the topics is matched by the lucidity of presentation, up-to-date observational material and interpretations which are partly new, luxurious illustrations, and an extensive bibliography.

The backbone of the volume is formed by three fundamental contributions: Orbits and Masses of Planets and Satellites, by Dirk Brouwer and G. M. Clemence; The Stability of the Solar System, by Yusuke Hagihara; and Planetary Interiors, by Rupert Wildt. Besides fundamental information, from these we learn, for example, that "at present no reliable gravitational determination of the mass of Pluto is available"; that the oblateness of Jupiter and Saturn, as determined dynamically from the secular motion of the nodes and apsides of their satellites, essentially confirms the solid-hydrogen models for their internal structure; that the orbits of the planets may remain stable for up to 10^{11} years, but that mathematical methods fail to prove or disprove it; that our knowledge of the internal structure of the planets is on a sound basis, two main types of structure occurring: the terrestrial, dense and composed of silicates and iron, and the Jovian, of low density and mainly consisting of solid hydrogen and helium.

Four chapters deal with surface detail of the planets. The introductory chapter of the volume, by S. Fritz and H. Wexler, discusses our own globe as seen from space, on the basis of photographs taken with the TIROS I weather satellite in 1960; 22 plates containing 41 pictures serve as illustrations. In another, A. Dollfus surveys visual and photographic observations of planets and satellites, made at the favorably located and well equipped Pic du Midi Observatory, with 45 plates and a much greater number of single images; the technique of composite photographs is partly applied. M. L. Humason publishes 15 plates of photographs of Saturn, Venus, Mars, and Jupiter, taken with the 200-inch telescope of Mount Palomar, partly in red and blue light. W. S. Finsen presents, as a surprise, 10 color photographs and 5 ordinary photographs of Mars, obtained at the Union Observatory, Johannesburg, South Africa.

Specially astrophysical topics are thoroughly covered in nine chapters forming the heart and core of the volume: a complete review by M. Minnaert of observational and theoretical work on the photometry of the Moon; a specialized treatise on the photometry of lunar eclipses by D. Barbier; an extended review by D. L. Harris of all available data on the photometry and colorimetry of the planets and their satellites; polarization studies of the planets, by A. Dollfus; two separate contributions, by Edison Pettit, and by W. M. Sinton, on radiometric studies and temperature determinations of the planets and the Moon; a beautifully presented discussion of the radio emissions and radio temperatures of the planets, by C. H. Mayer; two competing articles on radio observations of Jupiter, by B. F. Burke and by R. M. Gallet (the one by Burke, unfortunately, contains many misprints in the formulae). There is an account of the search for a trans-Neptunian planet by C. W. Tombaugh, which led to the discovery of Pluto. The volume concludes with a discussion by G. P. Kuiper of the limits of completeness of our knowledge of the satellites (with 12 plates). The author has arranged special searches and, on the basis of his experience, concludes, e.g., that Venus cannot have a distant satellite exceeding 5 km in diameter, or a very close satellite of more than 12 km; for Mars the size limit of undiscovered satellites is 1.4 km, an order of magnitude smaller than its two known satellites.

In a volume of this size, some misprints and misstatements are unavoidable; their number, however, is small, and usually they are obvious and do not interfere with the understanding of the text.

The volume is an indispensable handbook for all astronomers, space scientists, physicists, and others dealing with the astronomical and physical properties of the members of the solar system.

Nonlinear Oscillations. By Nicholas Minorsky. 714 pp. D. Van Nostrand Co., Inc., Princeton, N. J., 1962. $16.75. *Reviewed by T. Teichmann, General Atomic Division, General Dynamics Corp.*

IN the years since the publication of Minorsky's well-known Taylor Model Basin report, there has been a tremendous growth of interest in nonlinear mechanics, stimulated largely by applications, but by no means restricted thereto. There has also been an accompanying increase in the number of books and publications, but these have generally restricted themselves to several important aspects of the subject (e.g., stability) and have tended to treat either the examples in a laconic, or the theory in a cavalier manner. This new review by Minorsky covers almost all aspects of the underlying mathematical theories in a comprehensive and perspicuous manner, and discusses numerous important examples in a helpful and adequately detailed way.

After dealing with "qualitative" aspects of the theory (topology, geometry, and stability), which incidentally can yield quite a bit of numerical information about characteristics of a nonlinear system, if not about the detailed motion itself, the author gives a description of the various quantitative methods, including both the standard ones (averaging, linearization, asymptotic and perturbation expansions), and the more modern techniques of stroboscopic analysis and the use of Nyquist diagrams. These methods are then applied to a variety

of almost linear systems, and the book concludes with a discussion of discontinuous problems, such as relaxation oscillations, and again describes recent contributions (the topological theory of Vogel, the asymptotic methods of Cartwright and Littlewood, and the piecewise linear method) as well as the by now classical work of Van der Pol and Haag.

The format is clear and attractive and there do not appear to be any significant misprints except for the title page. The style and presentation are clear and complete, and make for interesting and informative reading, while the contents are so comprehensive (geographically and temporally) as to make it a very valuable survey (handicapped, however, by a rather skimpy index). This book will undoubtedly become the standard reference on nonlinear oscillations in the coming years.

Shock and Vibration Handbook. Cyril M. Harris and Charles E. Crede, eds. 2029 pp. McGraw-Hill Book Co., Inc. $47.50. *Reviewed by H. M. Trent, US Naval Research Laboratory.*

THE subject of mechanical vibrations has been a significant part of physics ever since Lord Rayleigh devoted such a large fraction of his two-volume treatise on sound to the subject. However from the appearance of Rayleigh's books until the outbreak of World War II not too much attention was paid to the subject. On occasion some physicist might worry about creating a vibration-free environment for some critical experiment and infrequently an environment might be so obnoxious that even the man on the street might complain about it. These instances were rare, however, and as a result few papers appeared dealing with the subject, and few textbooks were published.

Early in World War II Great Britain suddenly awakened to the fact that she was in danger of losing the war through the loss of shipping. The trouble here arose from noncontact underwater explosions and, interestingly enough, these explosions did not necessarily sink the vessel under attack. Instead vital equipment inside the ship was rendered inoperative by the mechanical shock induced by the explosion and thus the vessel could no longer fulfill its mission. Since that time, the number and severity of problems that have arisen as a result of mechanical vibrations and shock has been on an increase, a situation which reflects our ever increasing speeds of travel and our ever more powerful propulsion devices. Indeed, no physicist today can consider conducting an experiment concerning, say, the Van Allen radiation belt without being prepared to deal with the vibration environment existing in a modern rocket.

Professors Harris and Crede have assembled an imposing list of seventy authors who have joined with them in writing the three volumes of the *Shock and Vibration Handbook.* As a handbook, it must be viewed as representing the state of the art at the time that the various articles were written.

The first volume devotes eleven chapters to a summary of those theoretical techniques which are available now. The remaining nine chapters describe those instruments which have been developed for observing and recording vibration and shock phenomena.

The second volume takes up several subjects. For example, the first three chapters discuss the question of data analysis, the next three cover test specifications together with machines for performing the tests, and the next three concern scaling techniques and methods of analysis, both analog and numerical. The remainder of the volume is devoted to pertinent aspects of the isolation problem with two chapters being devoted to theoretical concepts, one to the design and use of isolators and five to descriptions of various isolating devices and materials.

The final volume is devoted almost exclusively to a presentation of what is to be expected in a wide variety of environments. Two of the chapters are worthy of special comment for they provide the only known self-contained sources of information on machine-tool vibration and on the effects of shock and vibration on man. This volume will be of particular interest to any physicist who is anticipating running an experiment in a severe environment such as in a rocket.

The editors have done a good job in assembling a lot of pertinent information and in keeping errors to a minimum. It must be realized, however, that any compilation such as this, which concerns a rapidly expanding field of science and technology, will be out of date in some respects by the time it appears in print. On the other hand, it will be valuable for several years to come for it provides, in one place, access to most of what is known about the subject.

Experimentation: An Introduction to Measurement Theory and Experimental Design. By D. C. Baird. 198 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1962. $6.00. *Reviewed by J. Arol Simpson, National Bureau of Standards.*

HOPE springs eternal in the human breast. For years now I have been reading the new books on precise measurement and experimental design in hopes of finding the magical formula which would make all *my* measurements precise and my experiments successful.

My search is over. Professor Baird has not, unfortunately, given me the formula but has convinced me that further search is in vain. Of course, this result does not surprise me, really, but I do wish I had had the opportunity to study this book as an undergraduate so that my false dreams would have been strangled at birth.

What we have here is a text designed for first- and second-year laboratory courses for scientists and engineers which includes among its chapters a realistic study of the nature of measurement, the propagation of uncertainties, and the nature of experimenting, as well as experiment planning, experiment evaluation, and writing the scientific report.