for various astrodynamic calculations. Although the author makes the point that a long and tedious list of references does not serve the student, I have found that such material gives the student a valuable key to the literature which allows him to extend his research beyond the classroom. Nor does the author supply a comprehensive list of notation and symbols for the benefit of the student.

Some subjects that are included are as remarkable as those that are excluded. Chapter 8, for example, treats the dynamics of the rocket problem, a subject usually covered in texts on ballistics or propulsion. Attention is also given to thrusting transfer orbits and to stabilized platforms and accelerometers, again subject matter that is ordinarily treated in texts on space mechanics, optimization theory, and guidance and control. The introduction of such material, which many astrodynamicists may consider extraneous and outside the scope of the astrodynamics specialty, actually increases the value of the book. Such material shows the student the wide interdisciplinary nature of astrodynamics and demonstrates its interrelationship with the other astronautical sciences.

Despite the inadequacies noted in the foregoing comments, I intend to use the book as a reference source in the courses that I teach and to encourage its utilization by other instructors in astrodynamics. It also should take a place on the shelves of all practicing astronautical engineers and serious students of astrodynamics.

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Plasma Physics

Controlled Thermonuclear Reactions. L. A. Artsimovich. Translated from the first Russian edition (Moscow, 1961) by P. Kelly and A. Peiperl. A. C. Kolb and R. S. Pease, Translation Eds. Gordon and Breach, New York, 1964. xvi + 405 pp. Illus. $19.50.

This work, which appeared in Russian in 1961, is devoted to a complete and critical survey of experimental work in the controlled release of fusion energy. The author, for many years one of the leading figures in the Soviet controlled fusion program, is an experimental physicist with remarkably keen physical insight and a complete dedication to the new field of basic physics that has emerged from this program. The book strongly reflects his personal point of view, and emphasizes the physical knowledge and understanding yielded by controlled fusion research.

After a brief first chapter on thermonuclear reaction rates, and the conditions which a reactor generating useful power must satisfy, the next three chapters provide a simple, understandable introduction to plasma theory. The emphasis in these chapters is on the physical clarity of each topic discussed, rather than on the formal elegance of the deductive theory. The remaining four chapters deal with experiments.

Chapter 5 treats fast high-power discharges, in which the magnetic pressure is offset by the inertial reaction of the plasma. The author's views on "the technological hopelessness of power generation from thermonuclear reactions in short-term pulsed devices" may not be shared by all, but there should be general agreement that the observations and their interpretation are of independent value in plasma physics. The next chapter discusses slow electrical discharges, mostly those stabilized by strong solenoidal magnetic fields. The British Zeta and the Soviet series of Tokomak devices are treated in considerable detail.

The final two chapters deal with "magnetic traps," in which the confinement of plasma is carried out by an externally produced magnetic field and does not require any plasma currents. Chapter 7 discusses some of the physical principles underlying these traps, while chapter 8 describes the stellarator and magnetic mirror programs in considerable detail, with some attention also to other, less thoroughly explored, magnetic configurations.

Without question this book is a clear, balanced, and authoritative description of the controlled fusion program. In the 5 years since 1960, when the manuscript was virtually complete, the experimental picture has become much more detailed and complete. As a result, the broad area of plasma physics now forms a mature field of investigation, with that mixture of theory and observation which characterizes all good science. In much of the earlier work the contact between theory and observation was limited. However, the major concepts and programs today are still sufficiently similar to the description provided by Artsimovich so that the book will provide a useful reference for any scientist seriously interested in this field.

The book serves an additional useful function at the present time by stressing both the long-range character and the many difficulties of controlled fusion. It is evident from the many eloquent passages in the book that Artsimovich is at the same time a passionate advocate of controlled fusion research, with its goal of unlimited power for mankind, and also a convincing supporter of a long time scale for the program "which surpasses in difficulty all the technical problems to which the scientific advances of the twentieth century have yet given rise."

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Weighing and Its Instruments

Scales and Weights: A Historical Outline (Yale Studies in the History of Science and Medicine, vol. 1). Bruno Kisch. Yale University Press, New Haven, Conn., 1965. xxi + 297 pp. Illus. $15.

This volume presents for the first time in English a comprehensive outline history of weighing and its instruments, ranging from the earliest known examples, which date from the millennia before Christ to modern times. Of three early inventions of the human mind—counting, measuring, and weighing—Bruno Kisch, the author, not only describes weighing as the most recent and sophisticated but also points out that it was the last to be accepted and integrated by society, even in the field of the natural sciences. He approaches the subject as historian, metrologist, artist, and collector.

The author, a physiologist and cardiologist, has served for many years at the Yale University School of Medicine as curator of the Edward Clark Streeter Collection of Weights and Measures (which will be cataloged in volume 2 of this series). He is particularly well qualified to write this book, bringing to the task his considerable knowledge based on long experience and study in the field of scales and weights. This knowledge

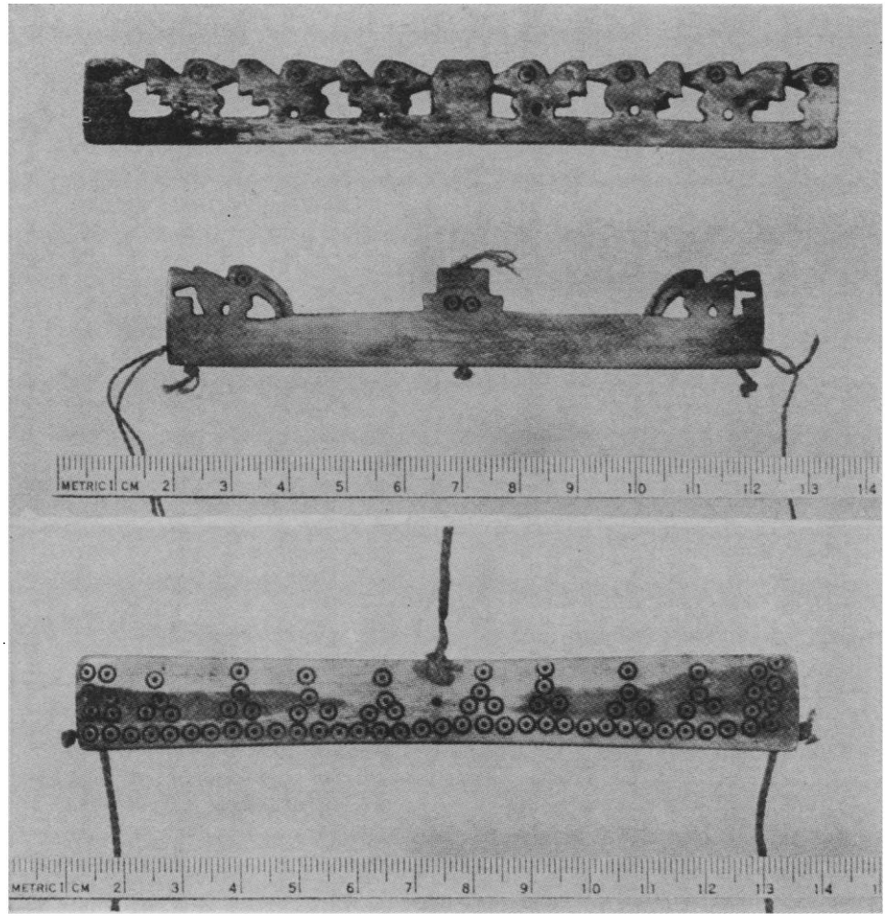

Fig. 1. Peruvian balance beams from the pre-Columbian period.

and the results of his own research combine to provide a sound foundation for this work.

The material is organized chronologically, with the divisions wisely chosen and developed to provide maximum interest for the casual reader and maximum usefulness for the scholar and student. There are two major sections. The first covers the use of scales and weights, the introduction of standards, and the history of various forms of weighing devices designed for specific purposes. The second section presents a detailed history of the manufacture of scales and weights, with a study of the most important groups of the "mastersigns," or marks, of the makers in the major centers of production (see the mastersigns of the weight makers of Antwerp illustrated on the cover of this issue of *Science*).

The history of each of the various materials employed in the construction of scales and weights is well documented with dates and localities of their introduction. The author brings to light the simultaneous evolution of certain types of scales and weights by peoples separated in time and space—for example, the beam balance with fixed fulcrum, which was invented independently by the Egyptians and Peruvians (see Fig. 1).

Particularly useful are the numerous charts and tables which provide a wide range of supplementary data, such as symbols for Greek, Roman, and Chinese standard weights and measures, special appendices of ancient weight units, and weight standards with gram and kilogram equivalents. Textual descriptions are supplemented with numerous fine illustrations assembled from the major collections throughout the world. There are 14 pages of bibliographic references and a thorough index.

Kisch has packed a vast quantity of carefully considered information into this work. Readers may be somewhat disappointed, however, not to find some account of the role of weighing and its instruments in the technical work of the metallurgist, the chemist, and the physicist. Conspicuous by their absence are references to the accomplishments of s'Gravesande, Desagulier, Ramsden, Ludlam, and others prior to the introduction of the precision balance. Furthermore, one may regret the author's decision not to present more details on the makers of the early scales and weights. Such data would have provided additional richness for this volume. It may be hoped that their absence here is token of a separate study in the future.

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NEW BOOKS

Biological and Medical Sciences

Drug Presentation and Prescribing. W. R. L. Brown and J. W. Hadgraft. Pergamon, New York, 1965. 126 pp. Illus. Paper, $2.95. The Commonwealth and International Library.

Histology. Arthur W. Ham. Lippincott, Philadelphia, ed. 5, 1965. 1057 pp. Illus. $13.50.

Hypnotic Susceptibility. Ernest R. Hilgard. With a chapter by Josephine R. Hilgard. Harcourt, Brace, and World, New York, 1965. 448 pp. Illus. $9.50.

An Introduction to Plant Biology. Dale C. Braungart and Ross H. Arnett, Jr. Mosby, St. Louis, 1965. 434 pp. Illus. $8.50.

Lectures on Gas Chromatography 1964: Agricultural and Biological Applications. Based on papers presented at the 1964 Cornell University Pesticide Workshop (Geneva, N.Y.), April 1964, and the 1964 Canisius College Gas Chromatography Institute (Buffalo, N.Y.), March and April 1964. L. R. Mattick and H. A. Szymanski, Eds. Plenum Press, New York, 1965. 264 pp. Illus. $12.50. Sixteen papers.

L-Forms, Episomes, and Auto-Immune Disease. Phyllis Evelyn Pease. Livingtone, Edinburgh; Williams and Wilkins, Baltimore, 1965. 91 pp. Illus. Paper, $4.

Life in the Laboratory. Donald G. Humphrey, Henry Van Dyke, and David L. Willis. Harcourt, Brace, and World, New York, 1965. 276 pp. Illus. Paper, $4.50.

Light: Physical and Biological Action. Howard H. Selinger and William D. McElroy. Academic Press, New York, 1965. xii + 417 pp. Illus. $12. American Institute of Biological Sciences and U.S. Atomic Energy Commission Monograph Series on Radiation Biology; the series is directed by John R. Olive.

Lignin Biochemistry. Walter J. Schubert. Academic Press, New York, 1965. 141 pp. Illus. $8.

Mach Bands: Quantitative Studies on

(Continued on page 250)