completely correct. For example, Whitworth's bench micrometer calipering machine is again called the "millionth machine," but no evidence that I have seen has convinced me that this machine could measure a hundred-thousandth, let alone a millionth, of an inch. For another example, the conventional implied conclusion that an error of "the thickness of a thin sixpence" in the diameter of a 72-inch cylinder is "monstrous" is misleading; and I question the author's suggestion that Frederick W. Taylor made metal cutting into a science.

The outright errors are few and inconsequential. The pictures are well-selected but their sources are not given in sufficient detail. The bibliography is adequate, but footnote references to sources are entirely too seldom given. The index is satisfactory.

This book is an example of the refreshing attitude of British industrial firms toward public relations. It was commissioned by Charles Churchill & Co. Ltd., machine tool builders, to whose contributions a paragraph and a sentence are devoted.

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The School Mathematics Study Group

SMSG: The Making of a Curriculum. William Wooton. Yale University Press, New Haven, Conn., 1965. x + 182 pp. $4.

This brief history of the School Mathematics Study Group was written by one who participated in its summer writing sessions from their beginning. It is based upon his own experience, the records of the SMSG office, and interviews with other participants, especially panel chairmen. From this material the author has constructed an interesting account of the operations and accomplishments of SMSG during the first 4 years of its existence from its founding in the spring of 1958 to the spring of 1962. I regret that he did not add an appendix summarizing the more recent activities of SMSG.

A brief description is given of the various movements affecting the elementary and secondary school curriculum in mathematics during the present century, culminating in the report of the Commission on Mathematics and the formation at several universities of groups to revise existing programs in school mathematics. The dissatisfaction among college and university mathematicians with the content of most high school courses and with the spirit in which they were being taught, the example of the successful accomplishments of the Physical Science Study Committee, and the widespread doubt about American scientific accomplishments following the launching of Sputnik I—all these caused the leaders of the mathematics community to recommend the establishment on a national scale of a group whose aim would be to improve the general level of mathematical instruction in the schools. With the financial assistance of the National Science Foundation this plan could be carried out.

A first decision of SMSG was to publish a series of textbooks that would serve as samples of what the group considered a suitable school curriculum. Although SMSG has other accomplishments to its credit and other publications, such as the New Mathematical Library, its most important product has been a series of 20 textbooks covering all grades from kindergarten through the 12th grade, with commentaries for teachers and some texts for non-college-bound students. Within 4 months of its formation, SMSG was able to begin on its task by arranging its first summer writing session with 45 college and high school teachers of mathematics in attendance. This indicates the support given by all levels of the mathematical community to the objectives of SMSG.

In addition to the problem of having textbooks written, the book describes the problems of reproduction of material, its testing at selected centers, and further revisions of the written material. The hope that the example of SMSG would lead to commercial publication of similar texts has not yet been realized. SMSG has now established a more permanent organization, whose bylaws state that the primary purpose of SMSG is to foster research and development in the teaching of school mathematics.

Reactions to the textbook produced by SMSG have been favorable, whether from teachers, students, parents, administrators, or university mathematicians. The chief objectors have been those who feel that the textbooks are not sufficiently oriented toward the physical sciences. The book should be of interest to mathematicians at all levels, and to those who plan similar curriculum revisions in other fields.

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Textbook on Astrodynamics

The Foundations of Astrodynamics. Archie E. Roy. Macmillan, New York, 1965. xiv + 385 pp. Illus. $10.95.

Roy's book is a good one. It has very few typographical errors (in fact, I did not note a single one). The organization, the exercises (together with answers!), and the clearly drawn and succinct figures are all indicative of a valuable textbook. As the author indicates in the preface, the book is ". . . aimed principally at university and technical college engineering students . . . ." The only areas that warrant improvement are the following: The book is short on illustrative numerical examples (these are a tremendous aid to the student as well as the teacher) and a number of areas of great interest to the practical astrodynamicist are neither mentioned nor discussed—for example, universal variables; radiation pressure constants; laser beam sensors, fixed cameras, and phase-comparison ranging systems; statistics of observations; analytical and difference equation generation of partial derivatives; electromagnetic, radiation pressure, and relativity perturbations (mentioned but not discussed); Runge-Kutta numerical integration; and modern filtering techniques for orbit improvement and navigation (of the highest importance at the moment). Today, in astrodynamics, we find an ever increasing use of matrices in analysis, but Roy provides no basic information about these techniques. The use of digital computer analysis is also becoming more and more important, and, although noted from time to time in the text, no guidelines are really developed for using these computing devices. This drawback goes hand-in-hand with the lack of attention given to matrix manipulations, and to singularities that often arise whenever the student attempts to develop computer algorithms

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