1965 and a 7-page appendix devoted to references that appeared in 1964.

Polyethylene, a book by Raff and Allison, was published in 1956. Developments since that time have been so extensive that the version which supersedes the earlier book is the work of 38 authors, appears in two parts, and is entitled *Crystalline Olefin Polymers*. The first part contains eight chapters devoted to polymerization and an equal number to structure. The second part contains chapters on brittleness, stress-cracking, electrical properties, and permeability, as well as chapters on chemical modification, degradation and stabilization, processing, and applications. Polyethylene in its various forms receives the major emphasis of course, since it has received by far the greatest commercial development.

This monumental treatise should prove to be of the greatest value to all who are interested in these polymers. As a group effort of American research workers (one chapter is by Dutch authors) it demonstrates the intense activity, and the importance, of the recent developments in this area. On the whole it is well organized and well written. Extensive indexes, arranged by authors, by subjects, and by patents, are provided for each part.

Polymers containing both metallic and organic groups are the subject of *Metalorganic Polymers*, an English translation of a Russian book by K. A. Andrianov of Moscow's Institute of Elemento-Organic Compounds (the name given these polymers in the Soviet Union). The author is well known as the holder of a Soviet patent (1937) relating to organosiloxane polymers. From literature published up to 1961, he has reviewed the synthesis and properties of polymers in which the backbone is formed by coupling the electronegative elements oxygen, nitrogen, or sulfur with elements of slightly lower electronegativity such as silicon, germanium, tin, lead, boron, aluminum, phosphorus, arsenic, antimony, or titanium. Carbon, if present, is only in side groups and not in the main chain. Of these polymers, the polyorganosiloxanes are by far the most highly developed and receive the greatest attention. The polyaluminoxanoorganosiloxanes (based on a skeleton of aluminum, silicon, and oxygen atoms) are next in importance. Most of the remaining polymers considered also contain silicon and oxygen with the other inorganic elements just mentioned replacing the aluminum in the skeleton.

The book is particularly complete in its summary of the work of Andrianov and his collaborators, which has previously been available only in several hundred separate papers. Like the book edited by Neiman, it includes many references to non-Russian papers but very few to books or reviews, and it is not indexed.

As a group, these books demonstrate the remarkable diversification and specialization that has occurred in the field of polymers during the past 30 years. Staudinger could hardly hope to have comprehended, or even to have been interested in, all the details covered in these books, but he should have been deeply moved by the massive structure of scientific knowledge that has developed from the fundamental ideas that he introduced 40 years ago.

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History of Technology

A Short History of Machine Tools. L. T. C. Rolt, M.I.T. Press, Cambridge, Mass., 1965. 256 pp. Illus. $7.50.

Although the standard symbols of the Industrial Revolution are the steam engine and the textile machine, it is evident to those who have a technical background that machine tools are required to build machines of metal. It can be argued fairly that machine tools are of central importance to an industrial complex and that in order to understand how we came to be where we now are we should be well informed about the development of machine tools. Nevertheless, this book is the first comprehensive history of machine tools to appear since Joseph W. Roe's pioneering book *English and American Tool Builders*, which was published in 1916. Rolt, an English author who has written more than a dozen competent books on technological history and who served an apprenticeship in a machine shop, has brought together in this book practically all significant published findings of scholarly work in the field. The work is one of synthesis, and with few exceptions it is based on books and articles.

The modern conception of a metal-cutting machine tool appeared unmistakably in 1775 in the boring mill of the Englishman John Wilkinson. By making possible the boring of the first satisfactory steam cylinder, this mill supplied the crucial ingredient to the success of the Boulton and Watt steam engine. The steam engine, as it hastened the industrialization of the United Kingdom, helped to encourage the development during the first third of the 19th century of the modern lathe, planing machine, milling machine, and drill press. During this period nearly all of the significant developments that we know anything about occurred in England.

This early period, which occupies half of the book, lends itself to biographical treatment of the tool builders. For example, Henry Maudslay, a craftsman of exceptional skill, dominated English tool building until his death in 1831. Some of his pupils, most notably Joseph Whitworth, who became the leading English tool builder of the following generation, adopted and extended Maudslay's ideas on precise measurement, standardization of screw threads, and general integrity of design and workmanship. In following the lives of the builders, however, Rolt never strays from his central subject, which is the internal development of the tools.

In the latter half of his book Rolt turns his attention, for the most part, to American contributions, which included the turret lathe, grinding machine, and many special-purpose machine tools especially adapted to the sequential operations required for mass production of interchangeable parts.

The book is well written, but the reader who does not have full command of mechanical nomenclature will find it heavy going in the many detailed descriptions of machine elements and assemblies. Such details are necessary, but simple sketches, keyed to the text, would have made the reader's task easier. Unfortunately, text descriptions are not keyed to pictures even when the latter are provided. On page 172 there is a long description of a machine and a photograph of that machine is given on page 185, but on neither page is there a reference to the other. At the very least, an illustrated glossary should be supplied.

In spite of the author's unusual qualifications, he has not questioned a considerable number of conclusions that for years have needed examination. It is disconcerting to have so able an author repeat standard phrases which, although not completely wrong, are far from

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