Part 1 concerns "Primary production," by which is implied the production of the most basic raw materials. The late C. N. Bromehead contributed an analysis and description of "Mining and quarrying to the seventeenth century." This is followed by an excellent history of "Metallurgy," by R. J. Forbes, undoubtedly the leading expert in this field and period. Finally, E. M. Jope has written on "Agricultural implements," which, as part of the broader history of agriculture, complements other chapters in both volumes I and II.

Part 2 treats of "Manufacture." Forbes has contributed a chapter on "Food and drink." John W. Waterer writes on "Leather," to which is appended "A note on parchment," by H. Saxl. "Spinning and weaving" is treated by R. Patterson. Description of the manufacture of furniture and ceramics is subdivided by periods: Cyril Aldred writes on "Furniture: to the end of the Roman Empire," and R. W. Symonds discusses "Furniture: post-Roman." Gisela M. A. Richter analyzes ceramics in the earlier period, and Jope contributes the articles on medieval ceramics. "Glass and glazes" are described by D. B. Harden. The late F. Sherwood Taylor, well known historian of science, and Charles Singer have written an extremely valuable history of "Prescientific industrial chemistry," in which they complete the account of what is known of both high- and low-temperature processes and cover phases not specifically treated in other chapters. To this chapter is appended "A note on military pyrotechnics," by Hall, which I found awesome and intriguing. In addition to such well known combustible products as naptha, bitumen, resins, and later, gunpowder, Hall discusses the infamous, secret "Greek fire" in detail. It was undoubtedly because of the use of "Greek fire" that the Byzantine Empire, for example, successfully withstood the Muslim attacks of the 7th century and later.

Part 3 concerns "Material civilization," and includes "The medieval artisan," by R. H. G. Thompson, "Building construction," by Martin S. Briggs, and "Fine metal-work," by Herbert Maryon. To the latter is added "A note on stamping of coins and other objects," by Philip Grierson.

In part 4, devoted to "Transport," R. G. Goodchild and Forbes discuss "Roads and land travel, with a section on harbours, docks, and lighthouses" in masterly fashion. All that is known to date concerning, for example, the famous Roman roads and the lighthouse at Alexandria—one of the wonders of the ancient world—is beautifully summarized, with a detailed bibliography which will lead the interested reader to scholarly literature dealing with special problems. In this same section, "Vehicles and harness" are described by Jope, and "Shipbuilding" is described by T. C. Lethbridge.

The final part 5 deals with "Practical mechanics and chemistry." Forbes again contributes a chapter, on "Power," and there is an appended "Note on windmills," by Rex Wailes. It may surprise some readers to find that the earliest authentic mention of a windmill in the Western world dates from no earlier than circa 1180. This is followed by an excellent chapter on "Machines," by Bertrand Gille. To this is added "A note on ancient cranes," by the famous historian of technology, A. G. Drachmann. It is followed by three chapters: "Hydraulic engineering and sanitation," by Forbes; "Military technology," by Hall, and "Alchemical equipment," by E. J. Holmyard.

After all these solid contributions, to which I cannot do justice here, we find an "Epilogue: East and West in retrospect," by Charles Singer. Since, from the earliest planning stages, the editors understandably found it impossible to bring, within the compass of five volumes, a history of *world* technology that would be both responsible and comprehensive, the decision was forced on them to restrict their history almost exclusively to what we know as Western civilization. Yet they are well aware of the fact that the West did not live in technologic isolation. Indeed, Singer finds that, during the span of the last millennium covered in the present volume, "technologically, the west had little to bring to the east. The technological movement was in the other direction. Not seldom, and especially under stress of persecution and war, there were emigrations of eastern craftsmen to the west. These taught their methods to European pupils and apprentices, and so added the technical traditions of their own lands to those already being practiced in Latin Christendom. . . . Thus from Persia and China, and to some extent from India, materials, wares, techniques, and ideas filtered through the main approaches to the west" (pp. 757–758).

The epilogue is therefore designed to suggest adjustments in our historical perspective, and the design is admirably carried out. If one studies carefully only two pages (770–771), which consist of a chart that shows the "Transmission of certain techniques from China to the West," one cannot help but realize the magnitude of our often forgotten technologic debt to the Far East.

The only misprints I have noted are few and innocuous, an indication of the great care and accuracy everywhere visible in this work. They do not even bear listing here, for if the reader finds them he will correct them more easily himself. The book is well printed, and the plates are excellently reproduced, as is usual with books from the Oxford press. There are some 700 figures in the text, all clear and well detailed. Three indexes, of personal names, place names, and subjects, make the volume as a whole easy to consult. In addition, each article is followed by a list of exact references and usually by a separate general bibliography which covers that particular topic. Finally, it might be mentioned that volume II has been considerably lightened, in comparison with volume I, by the sensible use of thinner, yet amply strong, paper within the same format. This is still far from a pocket book, and for this we are also glad, but it is at least easier to handle than is its somewhat bulky predecessor.

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History of Analytic Geometry. Carl B. Boyer. Scripta Mathematica, Yeshiva University, New York, 1956. 291 pp. Illus. $6.

The greater part of the *History of Analytic Geometry* was first published as a series of articles in *Scripta Mathematica,* volumes 16 through 21 (1950–55). It is gratifying that the complete book, in final form, has now appeared.

The first four chapters cover the period prior to the beginning of the 17th century and give the history of the ideas which precede the invention of analytic geometry proper. Although coordinates in the plane or on the sphere were already used in ancient times, in particular by Greek mathematicians in connection with their very elaborate theory of conic sections (founded by Menaechmus and systematically completed by Apollonius) or with their astronomy, the Greek mathematicians did not develop an algebraic geometry in our sense. Probably one of the chief reasons is the fact that their algebra had a geometric form. The introduction of a literal symbolism into algebra during the 16th century—in particular the work of the French mathematician Viète—was an important preparation for analytic geometry.

The central chapter V of the present book is devoted to the two great French mathematicians Fermat and Descartes, who, in the first part of the 17th century, almost simultaneously, but independently, founded analytic geometry. Although Descartes' book *La Géométrie* was published in 1637, Fermat's short but systematic treatise *Ad Locos Planos et Solidos Isagoge* and his other contri-

butions to analytic geometry were not printed during his lifetime; hence, it is difficult to estimate their influence. There was an essential difference of emphasis between the works of Fermat and Descartes: Descartes usually started with a locus problem and then obtained an equation of the locus; Fermat, conversely, had the habit of beginning with an equation from which he derived the properties of the curve.

Chapters VI ("The age of commentaries"), VII ("From Newton to Euler"), and VIII ("The definitive formulation," which leads into the second part of the 18th century), show how slow, relatively, the further progress in analytic geometry was: it was some time before negative abscissas were admitted, before two axes in the plane were systematically used, or before solid analytic geometry was developed. The author calls Euler's *Introductio in Analysin Infinitorum* (1748) the most influential textbook in modern times and, in particular, considers this work a turning point in the development of analytic geometry.

Finally, chapter IX, "The Golden Age," is devoted to the great and original advance in the first three-quarters of the 19th century. The remarkable contributions of the German mathematicians Möbius and Plücker and of the English mathematician Cayley, among others, are stressed: barycentric and homogeneous coordinates, symbolic notations, line coordinates and line geometry, the theory of algebraic curves, and the more dimensional analytic geometry. The last quarter of the 19th century and our 20th century are not taken into consideration by the author.

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Pion Physics. vol. 2 of *CERN Symposium on High Energy Accelerators and Pion Physics, Proceedings.* European Organization for Nuclear Research, Geneva, 1956. 444 pp. Illus. F. 40.

This is the second volume of the papers submitted to the European Organization for Nuclear Research (CERN) Conference, held at Geneva 11–23 June 1956. After the meeting, the proofs were checked by the editors against corrected preprints. In general, the speakers who took part in the discussions also had an opportunity to correct the text of their remarks.

There is a group of eight papers on bubble chambers, including a review of the field by Brown, Dodd, Glaser, and Perl (University of Michigan) and Rahm (Brookhaven), followed by a series of discussions of experimental work at the University of California, the University of Chicago, Duke University, the U.S.S.R. Academy of Sciences, the University of Padova, the University of Pisa, and the Centre d'Etudes Nucleaires. The fact that bubble chambers are far from having taken over the fundamental particle experimental field from cloud chambers is shown by a series of five papers on more standard chambers, from sources almost equally well distributed geographically.

A group of nine papers on fast counting techniques, most of which are related to Cerenkov counters, includes one paper on neutron time of flight techniques in the 100 Mev region, by Stafford (Harwell). Two papers are included on antiproton physics, including reviews, by Segrè, of the Berkeley work and, by Amaldi, of cosmic-ray work. Papers on nucleon-nucleon scattering are presented, primarily from the U.S.S.R.

A group of papers on the theory of pion physics includes a review by Wick, an article on the generation of mesons in nucleon collisions by Blokhintsev, a discussion of radiation during the collision of pions and nuclei by Landau and Pomeranchuk, and a simple treatment of meson-nucleon scattering, using the Yukawa potential and the Born approximation, by Edwards and Matthews. Wick's review nicely points out that "features of meson theory included in the cut-off model have something to do with reality."

A paper by Kallén discusses the mathematical consistency of quantum electrodynamics. Kallén carefully points out that his ideas do not constitute mathematical proof but are intended to serve as a basis for further discussion.

Papers on pion nucleon scattering include a review by Yuan (Brookhaven); data at six energies from 200 to 300 Mev from the U.S.S.R.; data at 150, 170, and 220 Mev by Ashkin, Blaser, Feiner, and Stern (Carnegie Institute of Technology); data at 70 and 130 Mev by a group from Bologna; a discussion of phase shifts by Orear, at Columbia University; and two papers on the very low energies of 20 Mev and 18.7 Mev, respectively, from Liverpool and Chicago.

On the subject of photoproduction of pions there is a review by Bernardini (Illinois) and there are about ten papers, including photoproduction from bound nucleons and complex nuclei as well as from protons and deuterons. This section of the conference includes an announcement, by Pauli, of the telegram received, 15 June, from Reines and Cowan at Los Alamos, stating the detection of neutrinos in the inverse beta decay of protons.

A section on pion production by nucleons includes an introductory talk by Merrison (Liverpool) and a group of papers, including bombarding energies from 383 Mev at Liverpool, 600, 650, and 929 Mev at Birmingham, 660 Mev in the U.S.S.R., and various energies up to 2.75 Bev at Brookhaven.

A few papers on mesonic atoms were introduced, with a review by Roberts (Rochester). These include the beautiful proportional counter work of West and Bradley at Harwell, the absolute yields by the two Stearns at Carnegie Institute of Technology, and the work on the lifetime of muons by Lederman and Weinrich at Columbia.

This volume provides a useful review of the state of the art, both theoretical and experimental, in pion physics as of the time of the meeting. The authors and editors have done an excellent job in presenting up-to-date, accurate material in a form very useful for reference. The drawings of experimental equipment and the curves presented are remarkably clear and accurate for a publication of this nature.

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Handbuch der Physik. vol. XXI, *Gas Discharges I*; vol. XXII, *Gas Discharges II.* S. Flügge, Ed. Springer, Berlin, 1956. 683 pp.; 652 pp. Illus. DM. 105.50; DM. 128.

At certain epochs of advance in the field of physics, there have appeared in Germany notable *Handbucher*—or, better, encyclopedias—of physics. I gratefully recall Winckleman's *Handbuch,* which was so useful to me in my student days. Nearly coincident with the development of the modern outlook on physics —ushered in by the age of atomic structure and quantum mechanics in 1926— there appeared a truly monumental and invaluable work in 26 volumes, the famous Geiger and Scheel *Handbuch der Physik,* from the presses of Springer. Now, 30 years later, following the post-World War II advances, there appears, under the editorship of S. Flügge, the timely new *Encyclopedia of Physics* of international scope, from the same publishing house. Volumes XXI and XXII comprise summaries of most of the material in the fields of electronics and gaseous electronics. The increasing demands of an adequate modern knowledge of these fields, so vital to technologic and experimental advance, make the publication of these two volumes, by many authors, an invaluable addition to the modern literature, since the scope of recent advances makes it impossible for any one person to summarize expertly this material.

Flügge is to be congratulated on having secured contributions from a group of authors so competent in their respective