had unusual opportunities to examine Boyle's work, and this bibliography is the result of his remarkable researches.

The preface of this bibliography states clearly how the work came to be compiled, together with the source or location of many of Boyle's works. This is followed by a table of contents, consisting of four divisions: (a) separate works of Boyle, which is divided into 42 sections, wherein is described each book, together with a historical account as to how the work became known; (b) contributions to other works, including papers in the Philosophical Transactions of the Royal Society; (c) collections with Opera Varia; (d) biography and criticism, together with Appendices and a General Index. There are twenty-two facsimiles of title-pages and other illustrations of importance, with a portrait bust of the Honorable Robert Boyle, by J. M. Rysbrack, as a frontispiece. At this point it may be suggested that Dr. Fulton should have included a list of all the famous portraits of Boyle, together with the artist's name, location of these paintings, etc.

It is very apparent that the compiler has taken into account every known copy of the various editions of Boyle's writings. He has revealed how rich the various college libraries of Oxford and Cambridge universities are, as well as the British Museum and several continental libraries, and a number of private collections. It is to be regretted that the initials "L. C." (Library of Congress) are not among these references. A most astonishing thing is the large number of titles contained in Fulton's own private library.

This is not the sort of bibliography to be criticized by merely a study of its pages and contents—one can not presume even to evaluate the various items, unless he himself has access to the collections. In other words, Dr. Fulton has left no room for attack upon any phase of the complete bibliography. The care which he has given each and every item is very evident. He has described in full each book, using the various bibliographical and typographical symbols. To the last, the reviewer had hoped to find a place for attack, but a check upon the index showed that it had been compiled with care and caution.

The bibliography is unusual also, from the point of view that it is readable, fascinating and entertaining. As well as being of great use to the scholar in literature and science, its references and information are a great help to the librarian, and its beauty in form, type and printing will be appreciated by the typographical student.

FREDERICK E. BRASCH

LIBRARY OF CONGRESS

Johann Kepler, 1571–1630. Special Publication No. 2 of the History of Science Society. xii + 133 pp.; two plates. The Williams and Wilkins Company, Baltimore, 1931.

THIS little book contains three addresses delivered in commemoration of the tercentenary of Kepler's death at a joint meeting of the History of Science Society and Sections A, D, and L of the American Association for the Advancement of Science at Cleveland in December, 1930; and a bibliography by the secretary of the editorial committee in charge of publication.

The first part, "Kepler as an Astronomer," by W. Carl Rufus, is a lively and interesting presentation of the most important biographical facts about Kepler and of his astronomical achievements. Professor Rufus' concluding remarks seem to imply that modern physicists are tending to return to the outlook on the universe which dominated him, and even that this is a good thing. It seems to the reviewer that only a very thorough-going and detailed analysis of the matter could justify either the implication or its evaluation. Such an analysis has not been given and is obviously beyond the scope of this part of the book.

Part 2, "Kepler as a Mathematician," is by D. J. Struik. This is an orderly, authoritative and liberally annotated account of Kepler's contributions to mathematics. These included important adumbrations of the methods of the differential and integral calculus, investigations in the theory of regular polygons, and tables of "Keplerian" logarithms. Like the Naperian logarithms, these last were quickly superseded by those of Briggs, but nevertheless remained long in view by virtue of being used in the Rudolphine Tables. In general Kepler's mathematics seems to have lacked rigor, but not usefulness.

Part 3, "Kepler and Mysticism," is by E. H. Johnson. It is one of the commonplaces of history that the esteem in which a pioneer holds his scientific discoveries may differ profoundly from that of his successors. No better exemplification of this can be found than Kepler. In his work the famous three laws appear to us at first sight like gems, surrounded by masses of irrelevancies and mistakes. To Kepler, they were integral parts of a unified scheme, no more necessary to it, and not more to be celebrated than the other parts. It is evident from this that Kepler's mind was dominated by a set of ideas (both expressed and tacitly assumed) which was in many ways far different from that which conditions the modern outlook on the universe. Kepler was thus driven to seek and find emotional satisfaction in constructing vast systems that now seem chimerical in comparison to our own, but which fortunately contain some elements

still useful and even essential to ours. There seems to be need of a biography that would shed light on the specific ways by which these ideas entered Kepler's mind, on the way in which they were modified by the circumstances of his life and how they bore fruit in his works. While the third part of the book makes it clear that there is an interesting and important study to be made here, it does not seem to contribute much of a specific or exact nature to it.

Part 4, by Frederick E. Brasch, is an accessible and extensive bibliography of works by and on Kepler. It has the great advantage of brief descriptive notes on many of the important entries.

R. I. WOLFF

THE COLLEGE OF THE
CITY OF NEW YORK

Antony van Leeuwenhoek and his "Little Animals." Being some account of the father of protozoology and bacteriology and his multifarious discoveries in these disciplines. Collected, translated and edited from his printed works, unpublished manuscripts and contemporary records. By CLIFFORD DOBELL, F.R.S., protistologist to the Medical Research Council, London. Harcourt, Brace and Company, New York, 1932. Price, $7.50.

THIS book was published on October 24, 1932, on the 300th anniversary of Leeuwenhoek's birth. It covers 435 quarto pages and contains 32 full-page plates, consisting of portraits of Leeuwenhoek, facsimilies of his hand-written letters to the Royal Society in London, figures of bacteria, spirochaetes and protozoa reproduced from original drawings in his manuscripts, illustrations of Leeuwenhoek's "Microscope" and his pepper tube, and scenes of Delft which were intimately associated with Leeuwenhoek's everyday life. The book contains over 600 references to works referred to in the text and gives a short list of Leeuwenhoek's writings. The author gives Leeuwenhoek the title "Father of Protozoology and Bacteriology."

Dobell, with the background of a busy lifetime of research as one of the world's foremost protozoologists, interprets for the reader in copious footnotes Leeuwenhoek's simple descriptions of his "little animals" and identifies them in terms of present-day zoological and bacteriological nomenclature.

The value of the book to the reader is unspeakably enhanced by the circumstance that its author laboriously mastered the Dutch language of Leeuwenhoek's time that he might truly breathe the spirit of Leeuwenhoek's words into his English translation of the original manuscripts still preserved by the Royal Society in London.

The standards of Leeuwenhoek's micrometry of the "animalcules" are discussed—a sand-grain, a human red blood corpuscle, a vinegar-eel, the diameter of a louse's eye, the bigness of a hair on a louse, the thickness of a spider's web and the bigness of a cheesemite.

The modern research worker, housed by towering walls, equipped with elaborate apparatus all ordered from catalogues, and assisted by a multitude of specialists: Contrast him with the Dutch janitor and his simple tools—a home-made lens, some rainwater, some pepper water, some vinegar, some thin pipes of glass and some spittle.

Leeuwenhoek's secret, which he never revealed in any of his writings or to anybody and which was buried with him, concerned the method by which he observed objects with his microscopes. Microscopes he gave and left aplenty, but Leeuwenhoek alone could see with them the minutiae of bacteria and protozoa which he described. One is stunned at the discoveries which he made with his limited equipment. Dobell supplies a notion in elucidation of the missing method by which Leeuwenhoek observed flagella, cilia and spirochaetes.

The dedicatory page affectionately names Paul de Kruif, who in "Microbe Hunters" rates this shopkeeper of Delft "First of the microbe hunters."

The printing and binding of this magnificent book are perfect specimens of the printer's art.

EDWARD FRANCIS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVEMENTS IN BIOLOGICAL LABORATORY APPARATUS

THE electrical thermostat without water-jacket has come permanently into use in biological laboratories. Its extreme convenience has made that inevitable. It has one serious disadvantage, however, namely, that the heater is apt to cause explosions if by any means a mixture of air and vapor or air and gas is set free inside the system. Some quite serious accidents have occurred in biological laboratories throughout the country on this account. The rapidly increasing use of hot nitro-cellulose, where the most perfect results in embedding are to be obtained, has made the danger of explosion much more in evidence.

The heater in baths of this type is either directly exposed inside the bath or, if shut off from the main cavity, is surrounded by walls which naturally have apertures to allow the heat to make its way. In either case the conditions for an explosion are present, since the heated wires which produce the necessary tempera-