

which will probably play a role of fundamental importance in the further development of certain central branches of mathematics.

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SHORTER NOTICES.

Opere di Evangelista Torricelli. Edited by GINO LORIA and GIUSEPPE VASSURA. Faenza, 1919, 2 volumes. Volume I, part 1, xxxviii + 408 pp.; part 2, iv + 482 pp. + plates; Volume II, iv + 322 pp. + plates.

OF those who sat at the feet of Galileo (1564–1642) and from him received instruction and inspiration, two were permitted to enjoy this privilege only in the last weeks of his life. One of these, Viviani (1622–1703), was fifty-eight years his junior and was only twenty years of age when the great teacher passed away. Viviani survived Galileo by sixty-one years, the lives of the two bridging a span of nearly a century and a half. With propriety as well as with pride he could say, in his later life, that he was “postremus Galilei discipulus.” In a way, however, Torricelli (1608–1647) could have said the same, for he too was one of the last of those who learned from the great master, although he died so early that he was not, like Viviani, the last disciple to pass away. Viviani signed his famous problem on the hemispherical dome by an anagram of the words “A postremo Galilei Discipulo,” while Torricelli was proud to observe that the letters of his own name could be transposed to form the sentence “En virescit Galileus alter.”

Of these two great disciples the more brilliant was Torricelli. With a span of life that was less than half as long as that of Viviani, he may be said to have accomplished twice as much, and the results of his labors have been set forth in the volumes under review.

Volume I, consisting of two parts, covers the work of Torricelli in the field of geometry and appears under the editorship of Professor Loria, while Volume II includes his academic lectures, his work in mechanics, and his writings in various minor lines, and is published “per cura” of Professor Vassura.

The introduction to Volume I gives a general survey of the life and works of Torricelli, contains much valuable bibliographical material, and includes considerable interesting information relative to the manuscripts which he left.

The inception of this edition dates from the action of the Congresso Internazionale di Scienze Storiche, held in Rome in 1903. At that time Professor Loria read a paper on "Un' impresa nazionale di universale interesse (pubblicazione delle Opere di Evangelista Torricelli)," with the result that the congress recommended that the Italian government assign to the R. Accademia dei Lincei the task of examining the manuscript works of Torricelli for the purpose of determining what ones should be printed, and also of deciding upon the works already published which should properly find place in a new edition. The recommendation was indorsed by other organizations, and on the occasion of the tercentenary of Torricelli's birth, in 1906, the Consiglio Comunale of Faenza determined to render financial assistance in the publication. The result of this decision was the publication of the present edition, some thirteen years later.

The editors have properly exercised their privilege of rearranging the material so as to present a unified appearance, transferring certain parts of the geometry, which appeared in 1644, to the second volume, and making other changes of a like nature as seemed necessary. This has resulted in a better sequence, and the only criticism that seems proper to make in this respect is that the text does not give, at the beginning of each of the separate divisions, a brief statement of the date and place of the first editions. Such information would be helpful to the bibliophile and historian and would not interfere in any way with the sequence chosen. Information of a somewhat similar nature is given with respect to the material published from hitherto unedited manuscripts.

In his more scientific works Torricelli wrote in Latin, but some of his popular essays and addresses are in Italian. In the present edition no attempt has been made at translation, and the several works appear as in the original. As to sequence, however, many changes have been made. Most of the *Opera Geometrica* (Florence, 1644) has been included in Volume I, which treats of geometry, but the portion "*De motu gravium naturaliter descendentium, et projectorum libri duo*" has been transferred to Volume II, which relates in part

to mechanics. On the other hand, there has been added to the geometry considerable material from the "Discepoli di Galileo" in the manuscripts of the Collezione Galileiana at Florence (volumes 26, 27, 28, 29, 32, 33, and 37). This includes an appendix to lemma XX of the memoir "De dimensione parabolæ," and also a number of other chapters relating to geometry and now for the first time made generally accessible. Among these is Torricelli's Truffle Field ("Campo di tartuffi"), with a number of interesting propositions relating chiefly to the circle; his notes "Contro gl'infinito" (mostly in Italian), evidently begun with the idea of placing a series of interesting paradoxes before his students; the essay on the center of gravity of sectors of a circle; the one "De maximis et minimis"; the "Nova per armillas stereometria," containing the particularly interesting chapter "De solidis vasiformis"; the essay "De infinitis spiralibus"; a brief treatment of conic sections; and his essay "De indivisibilibus," a chapter of particular interest to students of the period in which Cavalieri was beginning to pave the way for the calculus which developed towards the end of the seventeenth century. In this connection the reader will also wish to examine the second part of the essay "De centro gravitatis sectoris circuli," where the subject is treated "per geometriam indivisibilium."

The second volume contains the *Lezioni Accademiche* (in Italian) which were published in Florence in 1715, the essays on mechanics, the heretofore unpublished essay on *Prospettiva Pratica* (in Italian), and various miscellaneous letters and articles.

The reader who wishes to see Torricelli's classical discussion of the cycloid will find it on page 163 of Volume I, but should also consult the appendix, page 444.

Considering the work as a whole, the general reader will probably be surprised to find that Torricelli, who is generally looked upon as a physicist, wrote chiefly upon geometry. He will find, particularly in the hitherto unpublished chapters, considerable material that can be used with profit in connection with problem courses.

The matter here reprinted from the edition of 1644, judging from several random selections, shows a commendable degree of care on the part of both the editors and the publishers. As would naturally be expected in a work of this size, there are various typographical errors, as in the cases of Huyeggs

for Huygens (I, 232), and Withe for White (*ibid.*). Exception may also be taken to the positive assertion that the birthplace of Thomas White was Hutton, which seems to be only a probability. There are also numerous misprints such as *scguento* for *seguento* (I, 294). Matters of this kind, occurring only casually, are too trivial to mention in detail in a review. The most serious defect in the work is the absence of an index, the tables of contents not being sufficiently complete to enable a reader to find easily the particular subject which he wishes to investigate, particularly in connection with the notes.

Aside from the introduction, the work of the editors consists chiefly in the arrangement of the material, with a few important notes such as the one by Professor Loria at the end of the chapter "De tactionibus" (Volume I, page 291). On the whole, the edition is a very satisfactory one, and it is another testimonial to the remarkable scientific and productive powers of Professor Loria.

DAVID EUGENE SMITH.

An Introduction to String Figures. By W. W. ROUSE BALL.
Cambridge, W. Heffer and Sons, 1920. 38 pp.

IN the spring of 1920 Mr. Ball gave a lecture at the Royal Institution, London, on simple string figures and their history, and this lecture has now appeared in pamphlet form, designed to set forth, as the title page asserts, "an amusement for everybody." Much of the information given in the essay is already familiar to those who are acquainted (and what student of mathematics is not?) with Mr. Ball's *Mathematical Recreations* (fifth edition, chapter XVI, page 348), but there is a certain amount of added material in the present publication. On the other hand some of the figures mentioned in the *Recreations* are not given here. For those who do not have the larger work at hand, this pamphlet will be found of interest.

DAVID EUGENE SMITH.

Solutions of the Examples in a Treatise on Differential Equations.
By A. R. FORSYTH. London, Macmillan and Company,
1918. 249 pages.

THIS volume should serve as a time-saver to those who are giving the usual course in differential equations. Since the solution of a differential equation so often depends upon selecting the proper ingenious device, even the experienced