

clearly set forth. Thereafter, the sine, cosine, tangent, and cotangent serve all purposes in computation. The more serious work with right triangles follows, extending to page 77.

The functions of *any* angle are introduced as ratios involving the coordinates of a point on the rotating line or terminal side of the angle; yet, as before, these functions are at once visualized as lines.

The advanced theoretical portions are well presented and ample for any student in his college course through the calculus. A clear open-faced index ends the text, pages 187-188.

The ten tables in the latter half of the book are so varied and so superior in arrangement and appearance as to be worth the full price of the book, as the list of tables that the student might regularly use in the future, even if he goes into any one of many lines of technical work.

This new revision has all the good features of the former texts and a spring-like, refreshing breath from the Napier Tercentenary in 1914 brought to it by Professor Smith. It is also a text that will be likely to "dominate the teaching of the subject" in the next and more exacting generation.

C. C. GROVE.

Modern Instruments and Methods of Calculation. A handbook of the Napier Tercentenary Exhibition. Edited by E. H. HORSBURGH with the cooperation of a committee. London, G. Bell & Sons, 1914. New York, The Macmillan Company. viii + 343 pp. 8vo. \$1.90.

It is very refreshing to read a book that provides so much more than its title leads one to expect, as does the volume under review. Even in its distinctively handbook features it gives copious notes concerning the special characteristics and history of the exhibits, the inventor, his period, etc. The editor states that "an endeavor has been made to make the Exhibition and Handbook useful to the laboratory computer, the engineer, the astronomer, the statistician, and to all who are interested in calculation," and success has crowned the effort in respect to the handbook at least.

There are a dozen sections lettered A to M, omitting J. In section A is an historical essay, reprinted from the *Proceedings* by permission of the Royal Philosophical Society of Glasgow, by Professor George A. Gibson on Napier's Life and Works.

Section C alone, on Mathematical Tables, would give the book a place in every mathematical reference library. It contains an account by Professor Cargill G. Knott, D.Sc., of Dr. Edward Lang's Logarithmic, Trigonometrical, and Astronomical Tables: A Working List of Mathematical Tables most conveniently arranged and amplified by notes by Herbert Bell, M.A. and J. R. Milne, D.Sc., both members of the editorial committee, as was also Professor C. G. Knott, its honorary secretary. There is also an historical essay by W. G. Smith on "Special development of calculating ability" that considers the psychology of calculating ability, with numerous references to the literature of the subject. Section D on Calculating Machines was written, or edited in part, by F. J. W. Whipple who presents the subject along the lines of the Catalogue raisonnée which he prepared for the Exhibition in connection with the Fifth International Congress of Mathematicians held at Cambridge, in 1912. His point of view is that "of the user of a machine who wishes to have a general idea of how it works rather than that of the expert who has to master every detail." He lets many of the manufacturers describe, through a scholarly expert, their own machines, hence I said, "edited in part." He outlines the prominent and essential mechanical means of performing the various arithmetical operations, and as an expert that he is, adds a paragraph on "The scope for improvement of calculating machines" that to the reviewer was of interest and inspiration.

It must be remembered that this is a catalog of the calculating machines on exhibition, not of all that have existed or are now on the market. With this in mind, attention was attracted by the sentences (pages 74, 75):

"In the first place, it is remarkable that no machine which does long multiplication automatically is on the market at present. . . . I fancy that it would not be difficult to modify the Thomas machine to enable it to act in this way."

On page 89 there follows, in another paper, the sentence:

"Two separate multiplications can be carried out at the same time by turning the handle."

These statements refer to quite different operations but they brought to the mind of the reviewer a vague recollection of having heard that the former process had been accomplished, possibly in some such way as described on pages 124-

125. They reminded him of experience with a Thomas machine in student days and of his wish then for a key-board instead of levers and for a carrying device for the quotient register. It may interest some readers to know that an American machine, the Monroe, supplies much of this that was left to be desired.

An article by P. E. Ludgate on "Automatic calculating machines," which will interest anyone who has seen a loom weaving the pictures of presidential candidates, say, into silk ribbon; an article by T. C. Hudson on "H. M. Nautical Almanac Office anti-difference machine"; and one on "Mathematical and calculating typewriters," complete section D.

Section E gives an abridgment of a classic article on "The abacus" by Dr. Cargill G. Knott, professor of physics, Imperial University of Tokyo, published in 1886 in the *Transactions of the Asiatic Society of Japan* and so almost unobtainable by us.

Space does not permit me further to enumerate the essays and notes, each written by a specialist and authoritative, concerning slide rules (25 pages), integragraphs, integrometers, planimeters, their use in naval architecture, differentiating machine, harmonic analysers, tide-predicting machine, etc., but I cannot pass unnoticed Section H on Ruled Papers and Nomograms by the editor and Professor M. d'Ocagne respectively, which are parts of the literature to be read by anyone who would know the subject; also Section I (26 pages) on Mathematical Models, and Section K, a catalogue of portraits, engravings and medals of the collection of Prof. W. W. Rouse Ball, author of the well-known Short Account of the History of Mathematics.

The volume closes with a list of contributors and exhibitors, Section M. The names of the former are sufficient guarantee of the value of the articles. Their authority will secure for the book wide use amongst those for whom it was published.

C. C. GROVE.

Tables and Formulas (revised edition). By WILLIAM RAYMOND LONGLEY. Ginn and Company, 1915. 37 pp. Price, 50 cents.

THE author states in his preface: "This collection of tables and formulas is intended for use as a handbook for solving numerical problems in connection with the courses in mathematics in technical schools and colleges." It is a good collec-