

**ELEMENTARY SCHOOL
MATHEMATICS BY GRADES
GLOBE SERIES. FIFTH BOOK,
STANDARD MEASUREMENTS**

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Elementary School Mathematics by Grades Globe Series. Fifth Book, Standard Measurements
by William E. Chancellor

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WILLIAM E. CHANCELLOR

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GLOBE SERIES

9

FIFTH BOOK

STANDARD MEASUREMENTS

BY

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"It is a curious fact that we Americans habitually underestimate the capacity of pupils at almost every stage of education from the primary school through the university."

"The right time for advancing a child to the study of a subject is the first moment he is capable of comprehending it."

President **CHARLES W. ELIOT, LL.D.**,
Harvard University.

From "Educational Reform."

A skillful teacher is always reviewing in connection with the advance work. . . . There is one season when a review is essential, a brisk running over of the preceding work that the pupil may take his bearings, and this is at the opening of the school year. Such a refreshing of the mind, such a lubricating of the mental machinery, gets one ready for the year's work. Complaints which teachers generally make of poor work in the preceding grade are not unfrequently due to the one complaining; the effects of the long vacation have been forgotten; the engine is rusty, and it needs oiling before the serious start is made.

DAVID EUGENE SMITH, PH.D.,
Professor of Mathematics, Teachers College,
Columbia University.

From "The Teaching of Elementary Mathematics."

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PREFACE

WE have come to see in the light of our new knowledge of mental and moral growth that what a child enjoys learning he profits by, and that what he profits by develops in him the normal life of the child which is the guarantee of an efficient life as an adult. There is a growing tendency to decrease the range of arithmetical instruction in grammar grades and to introduce early some geometrical instruction. There is also a distinct tendency to rely more and more upon the various forms of "manual training" in the education of boys and girls; and this development along the lines of the industrial arts which afford the materials of manual-mental discipline lends itself notably to the encouragement of the study of geometry early in life.

In the primary and first grammar grades children may easily learn common and decimal fractions, factoring, cancelling, finding least common multiples and greatest common divisors, and how to add, subtract, multiply, and divide accurately and rapidly. They ought to learn to image correctly the facts involved in ratios, percentages, and measurements, and to understand the simplest elements in simple proportion and in the equation involving one unknown quantity.

It appears from the investigations of child-students and of psychologists that unless a boy learns before the age of ten or twelve how to perform the fundamental operations both correctly and quickly he seldom becomes proficient later. Early proficiency, however, can be maintained only by constant exercise. For boys and girls who are prepared in the essential elements of arithmetic this, the Fifth Book of the Series, proposes additional instruction in concrete measurements, percentage, interest, and commercial matters.

Early arithmetical exercises are, in most cases, inevitably oral rather than written. As we go higher in the science of arithmetic the temptation to rely upon writing more than upon speech in the development of the processes of problems greatly increases in strength. Observation and reflection make it entirely clear that the most frequent uses of arithmetic are: simple multiplications, as in retail purchases, additions, and measurements by the eye. Various problems in this book illustrate the common instances in which we need to have arithmetical processes at perfect command. The complicated problems are for the special workers in business and industry, and do not belong in children's text-books.

It is possible that all the arithmetic which for its own sake as a useful body of knowledge every boy or girl ought to know is contained in the earlier books of this Series. Certainly very few girls will ever need to know much arithmetic beyond the topics of the Fourth Book. The chief value of advanced arithmetic is not utilitarian, but disciplinary and cultural. I have aimed to make the oral recitations reviews of practical matters, involving the fundamental operations and essential principles of arithmetic, but to make the written exercises such as involve careful, continued, and progressive reasoning.

This Series is not a scientific topical manual for teachers of arithmetic, published in parts. It purports to be only a systematic arrangement of lessons for children studying the subject. It is a series of handbooks for pupils. It consists of graded lessons arranged in the spiral order, partly of topical, partly of intentionally miscellaneous problems. Adults' minds sometimes grow; children's brains inevitably do grow. Adults often forget; children necessarily must forget. The developed cells of children's brains are constantly increasing in number and changing in their connections. Any moment with a child may mean a physical re-arrangement of the registering bases of the processes of memory and reasoning. To expect a child not to forget is to be ignorant of the anatomy and physiology of brain-growth. The review-drill, by keeping all knowledge

active, preserves for future use essential truths and principles, and maintains and increases proficiency in methods and processes.

In mathematics we have our traditions as to what ought and what ought not to be taught in the different grades. These traditions had their origins long before either courses of study were scientifically ordered or men questioned themselves as to the stages in the growth of the mind. In consequence there are many easy processes in mathematics which are postponed until after much more difficult processes have been mastered, at needlessly great costs in time and energy. It too often happens that the attack upon these more difficult processes results in such discouragement that the student never completes even the elementary school courses. It is not the purpose of this Series to overturn the accepted order of mathematical topics; but certain changes have been made in the direction suggested. The utilitarian value of the simplest geometrical exercises is not less than that of many arithmetical exercises; and their cultural value is greater because they fit more closely the powers and needs of the minds of boys and girls. It is unquestionably good pedagogy and sound common sense to develop for boys and girls fundamental geometric principles, of angles and areas, of forms and of volumes, even at the expense of an encyclopedic knowledge of the rules and methods of interest, discount, partial payments, and cube root at an age when the student is still living the natural life of the boy or girl and has years yet ahead before needing or caring to know all the conventions of the world of finance. We are not all destined for bank clerkships. There are more mechanics than merchants in the world. Boys and girls without knowledge of geometry cannot use tools or examine the construction of things made with tools.

A great amount of material has been presented in these pages so as to give the teacher an unusually large and free range of selection. No class in one year is expected even to try to solve every problem in any book. Classes in the same

grade vary radically in power. The first principle of each book, that it is a text-book for the students in their personal study rather than a handbook for teachers, necessitates the introduction of a considerable amount of explanatory instruction. Too much dependence upon oral teaching makes the pupil weak. To develop the self-activity of the boys and girls is the most important aim of education; and to secure such original effort is to establish the foundation of self-reliance, which is the substance of true character.

The familiar scientific topical epitome of arithmetic and the text-book of arithmetical methodology are both out of place in the children's hands. Mere separation of the topics and problems into books graded, or supposed to be graded, to fit the different years of the present conventional school curriculum is not enough. This Series is an effort to advance positively in the direction of the elementary mathematical handbook for boys and girls which modern psychology demands.

Author and publishers desire to acknowledge with thanks the helpful and valuable suggestions of Dr. F. E. Spaulding, Superintendent of Schools, Passaic, New Jersey, and of Mr. G. I. Aldrich, Superintendent of Schools, Brookline, Massachusetts, in revising the proofs of this book. We are indebted also for criticisms of methods and problems to several teachers, among whom Mr. Edgar S. Pitkin, Center Grammar School, Bloomfield, has given important assistance. No effort has been spared to make the text at once modern and practical.

W. E. C.

BLOOMFIELD, N.J.,
April 15, 1902.