# GRAMMAR SCHOOL ALGEBRA

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Grammar School Algebra by David Eugene Smith



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# PREFACE

This book is intended for use in the seventh or eighth school year, either replacing the arithmetic for a time or carried along simultaneously with it. The large majority of pupils do not enter the high school, and for those who do not this book furnishes such algebra as is necessary for the intelligent reading of formulas and the solution of equations found in elementary industrial manuals. Those who continue their school work will find the subject treated in such way as to stimulate an interest in their later work, and will meet no obsolete forms that must be unlearned before proceeding.

In sequence of topics the author has continued the plan adopted in his arithmetics, that of recognizing the value of the various courses of study in use in different parts of the country. Modern curricula no longer sanction for the grammar school the plan of treating each topic but once. On the contrary, they suggest the repetition of the most important portions of algebra, although favoring a somewhat exhaustive treatment of each subject whenever it is under discussion. Of the three chapters of this book, the second covers some of the ground of the first, and the third reviews some of the topics treated in the second. The first two chapters furnish sufficient work for schools that devote part of a year to algebra and part to arithmetic. The third chapter may be used if a full year is given to the subject.

The work seeks to interest the pupil in the subject at once by showing him its utilities. The formula which the

artisan meets in his trade journals and the equation which throws so much light upon business arithmetic find place in the early pages. With these applications is combined the recreation element, as seen for example in the finding of numbers which satisfy given conditions, — an element which lends much interest to mathematics.

Oral algebra, like oral arithmetic, is necessary to lead to rapidity and to an understanding of general processes. Hence enough types have been suggested to form a basis for the best of all oral work, that which comes spontaneously from the teacher and the class.

While a large number of genuine applications have been made in the domain of the pupil's present and prospective experiences, scientific and financial problems in which he has no interest have been omitted. With the applications has gone a large number of those abstract, formal problems so necessary for drill in rapid algebraic work. These "problems without content" have an interest in themselves, and give to the elementary pupil some of that pleasure which comes to the more advanced student in the discovery of positive truth in the domain of pure science.

DAVID EUGENE SMITH.

# CONTENTS

## CHAPTER I

### THE USES OF ALGEBRA; THE OPERATIONS WITH INTEGERS AND FRACTIONS; THE EQUATION

## CHAPTER II

### OPERATIONS CONTINUED; FACTORING; PROPORTION; EQUATIONS



## CHAPTER III

### FRACTIONS CONTINUED; ROOTS; SIMULTANEOUS EQUATIONS; THE COMPLETE QUADRATIC

# GRAMMAR SCHOOL ALGEBRA

## CHAPTER I

### THE USES OF ALGEBRA; THE OPERATIONS WITH INTEGERS AND FRACTIONS; THE EQUATION

### SOME OF THE USES OF ALGEBRA

**1. Numbers represented by letters.** — In arithmetic we often represented numbers by letters. We learned that

If one thing costs $d$ dollars, 5 things will cost $5 \times d$ dollars, which we write $\$5d$; and $n$ things will cost $\$nd$.

**2. How we indicate multiplication.** — In algebra *the absence of a sign indicates multiplication.*

It is not so in arithmetic, for 51 means $50 + 1$; but in algebra $ab$ means $a \times b$.

#### ORAL EXERCISE

1. If a rectangle is 12 ft. long and 7 ft. wide, what is its area? If it is $l$ ft. long and $w$ ft. wide, what is its area?

2. If a train travels at the rate of 30 mi. an hour, how far will it travel in 10 hr.? If it travels $m$ miles an hour, how far will it travel in $h$ hours?

3. While the hour hand of a clock passes over 5 1-min. spaces, how many does the minute hand pass over? While the hour hand passes over $n$ spaces, how many does the minute hand pass over?

**3. Rules stated by letters.** — We have just seen that the area of a rectangle $l$ long and $w$ wide is $lw$. If $l$ and $w$ are numbers of feet, $lw$ is the number of square feet in the rectangle; if inches, $lw$ is the number of square inches. If $a$ represents the area, then the statement

$$a = lw$$

is a simple rule for finding the area of a rectangle.

**4. Formulas.** — A rule stated in letters is called a *formula*. For example, you may have found in arithmetic that the circumference of a circle equals the radius multiplied by twice the number 3.1416, 3.1416 being represented in mathematics by the Greek letter $\pi$ (pi). But it is much easier to express this rule by the formula

$$c = 2\pi r.$$

### ORAL EXERCISE

1. If a triangle has a base 4 and height 6, what is the area? Suppose it has a base $b$ and height $h$?

2. Given $a = \frac{1}{2}bh$, find the value of $a$ when $b = 7$ and $h = 6$; when $b = 6$ and $h = 7$; when $b = h = 10$.

3. If an automobile has a constant velocity of 8 miles an hour, how far will it go in 3 hours? If it has a constant velocity of $v$ miles an hour, how far will it go in $t$ hours?

4. From Ex. 3, what meaning do you get from the statement $d = vt$? (Think of $d$ as standing for distance.) What is the value of $d$ when $v = 15$, $t = \frac{1}{3}$?

5. If 5 men can do a piece of work in 8 days, how long will it take 4 men, working at the same rate? If $m$ men can do it in $d$ days, how long will it take $x$ men? Read from the formula a rule for solving all such examples.