

**COMPLETE GRADED
ARITHMETIC.
PP. 263-402**

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Complete Graded Arithmetic. pp. 263-402 by George E. Atwood

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GEORGE E. ATWOOD

**COMPLETE GRADED
ARITHMETIC.
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COMPLETE
GRADED ARITHMETIC

FIFTH GRADE

BY

GEORGE E. ATWOOD



BOSTON, U.S.A.
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1901

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ATWOOD'S
COMPLETE GRADED
ARITHMETIC.

A new edition, thoroughly revised, and printed from new electrotypes plates. The work for each grade may be had in a separate book as follows:

THIRD GRADE.	SIXTH GRADE.
FOURTH GRADE.	SEVENTH GRADE.
FIFTH GRADE.	EIGHTH GRADE.

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PREFACE

By WILLIAM E. CHANCELLOR, A.M.,

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ARITHMETIC is an essential element in every stage of human progress. Though there may be a difference of opinion as to how much of it is essential or desirable, the subject must hold its position as one of the two constants in our fundamental education, of which the other constant is Language. The necessity of Arithmetic in human progress, its value in practical life, and its efficiency as a means of intellectual development demand that it shall be taught in the full light of modern psychology.

Most of the teaching of Arithmetic is determined by the text used. Hence it is evident that the use of a book which is unpedagogical in plan, arrangement, and character gives meagre results, while the use of a book which is in harmony with the laws of mental development and mental growth gives results which are commensurate with the time and energy devoted to it. For various reasons it has lately come to pass that Arithmetic is challenged to defend its position as one of the most prominent subjects in our schools. The author of this series shows a strong conviction that the cause of this widespread dissatisfaction with results now obtained is traceable to the character of the texts in general use. These pages also express the author's confident belief that it is possible to prepare a text which is entirely adapted to the needs and gradually developing powers of the child.

Modern psychology has contributed to our educational practice no truth of greater importance than this, that education is

the process of building up, thought by thought, the structure which is to be the adult mind. From this it follows infallibly that children must be graded not merely by ages and capacities but by actual attainments, and that the texts provided for their use must also be graded. The educational text-writer must therefore fit his texts to the pupils. Commonplace as this truth nowadays is, the topical manual of Arithmetic, which considers the logic of the subject, not the psychology of the pupils, is still in use in most American schools.

Again, the inductive philosophy, which teaches us that principles are to be derived from the facts, and that facts are not to be selected or made to suit predetermined principles, and the experimental psychology, which demonstrates that nothing is completely learned until it has issued in action, have pointed unmistakably to the principle that Arithmetic should be learned in its examples. But few text-book writers have been willing to abandon the scholastic traditions descended from the centuries before either the inductive philosophy or experimental psychology were even in wise men's minds.

As opposed to the topical plan, what is now known as the spiral plan is rapidly growing in favor among teachers. This plan consists in daily reviewing the important processes so far known, and in frequently adding new processes. It combines the old and the new, the review and advance lesson, systematically. This series illustrates the spiral plan with no concessions to topical traditions. The topical division, if logically followed to all its conclusions, results in teaching addition one term and subtraction the next, fractions one year and denominate numbers the next. Though logical, such a division is neither psychological nor pedagogical. It neglects the mind's need of variety in the daily exercises, and tends to the repetition of mere process work. The topical Arithmetic may be an excellent teacher's manual, but the pupil, through ignorance, is not ready in any early grade for even abridged treatises upon the science and art of Arithmetic.

The alliance of oral, often called mental, Arithmetic with the written lessons illustrates the author's confidence in the principle of grading the topics and developing them through examples. No severer test of a theory can be applied than by putting it into exclusive practice. Written lessons may be given in which for weeks and months, even for terms and years, the pupils may conceal their failure to understand their work; but oral Arithmetic is the complete revelation of the progress and position of class and pupil in the science. It is impossible for a teacher to conduct an oral recitation which is beyond the pupils' comprehension. Interest at once ceases, and there are no answers to the questions. The successful union of oral and written lessons, as seen in all these pages, is an artistic achievement in pedagogy.

In itself oral work unquestionably deserves the prominence it receives in these pages. Mental Arithmetic promotes attention, concentration, accuracy, ingenuity, skill, familiarity, and confidence. It tests all written work as to the essential point, whether or not the process is understood. It secures the education of the class by the efforts of individuals, who are followed and criticised by their fellows. It is a language training of the highest value.

This series emphasizes to an unusual degree the necessity of employing the imagination in the study of Arithmetic. Most teaching of Arithmetic has appealed to the memory almost to the exclusion of the other faculties. Though the development of the reason is earnestly desired, little or no intelligent effort has been put forth with the certainty of accomplishing this object. The author has made it very clear that thinking or reasoning in mathematics involves the exercise of the imagination. Since faculties grow strong by exercise, work must be provided which will compel the exercise of the imagination.

Here is abundant material in the first three books of this series, of which the direct aim is the training of this faculty. This work not only aims at this power; but if done at all, the

desired result will be inevitable, for the nature of it is such that doing it by rule is precluded, even if the teacher would do so. As is clearly shown, the child can respond to these exercises only by imaging, comparing, and perceiving relations. This is reasoning. Let no one say that this work does not belong to Arithmetic. The purpose of it, and the certainty that this purpose can be accomplished, fully justify its introduction into a text in Arithmetic.

With theory and rules reduced to the smallest amount consistent with a proper presentation of the science, and with examples offered in great variety and number, this series secures the teaching and the learning of Arithmetic inductively. The problems unfold the processes and the forms of reasoning. This feature, together with the adoption of the spiral rather than of the topical plan, not only gives the pupil a graded manual of problems, but also compels thought as to what the problems mean and choice of methods for their solution. On the other hand, the topical plan, in which the process is given and is followed by a score or a hundred problems to be solved by that process, establishes the habit of working by rules without thought or choice. The spiral graded plan, based on problems, as embodied in this series, develops independence and self-reliance.

Drawn, as are the books of this series, upon these lines of modern psychology and of the best pedagogical practice, they deserve educational attention and recognition for the positive and noteworthy quality of being consistent in detail with the principles they profess to represent. These principles are no longer in question. There is nothing experimental here. The series stands to affirm where it may be used, the supreme importance of Arithmetic in education, and the necessity of conforming the methods of instruction to the principles of mental acquisition and mental growth.

SUGGESTIONS TO TEACHERS

PRACTICE in the fundamental processes, with the application of the same to problems, is continued in this book, as in the Third Grade; and the new topics of factoring, cancellation, greatest common divisor, least common multiple, and fractions are carefully treated. The book is made on the same general plan as the two that precede it. The first thirty-eight pages are essentially a review of the processes and types of problems contained in the Fourth Grade book. New work is then gradually introduced, topics previously presented are extended, and a constant review is kept up as the work advances.

In this book, for the first time, the more important definitions are given, principles are developed and formulated, model solutions accompany the presentation of new types of examples, and in some topics rules are given. This matter is reduced to the smallest amount consistent with an intelligent presentation of the subject. The definitions and principles pertaining to the fundamental rules will be found from page 277 to page 285. No rules for these processes are given. Pupils have been adding, subtracting, multiplying, and dividing, in the preceding grades. They know the name of each process and they know which one to apply in the solution of a problem, but they have not been required to define them. Reasons have been given for not presenting this matter in the Third Grade where each topic is begun. As this is not a topical manual, there is not a definite portion of the book devoted to each subject. It is therefore immaterial where the definitions of the fundamental rules are given, but since the first pages are devoted principally to a review, it has seemed proper to introduce them somewhere