# PRIMARY ARITHMETIC: FIRST YEAR, FOR THE USE OF TEACHERS, PP. 1-153

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# PRIMARY ARITHMETIC

## FIRST YEAR

FOR THE USE OF TEACHERS

BY

WILLIAM W. SPEER

ASSISTANT SUPERINTENDENT OF SCHOOLS, CHICAGO

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# PREFACE.

THIS book is one of a series soon to be issued. The point of view from which it is written is indicated in the introduction.

The essence of the theory of teaching arithmetic can be expressed in a few sentences. The fundamental thing is to induce judgments of relative magnitude. The presentation regards the fact that it is the *relation* of things that makes them what they are. The *one* of mathematics is not an individual, separated from all else, but the union of two like impressions: the *relation* of two equal magnitudes. A child does not perceive this *one* until he sees the *equality* of two magnitudes. He will not become sensitive to relations of equality by handling equal units with the attention directed to something else, as the color, the texture, or the how many; nor by one or two experiences in comparing magnitudes.

To aid the learner in seeing a 1 as the *relation* of two equal units, a 2 as the *relation* of a unit to another one half as large, a $\frac{1}{2}$ as the *relation* of a unit to another twice as large, we must induce the repeated acts of comparing which bring these relations vividly before the mind. With this purpose the child is not required to build out of parts a whole which he has never seen, nor expected to discover a relation in the absence of one of the related terms. He does not begin with elements. He is not prevented from

seeing things as they are by pushing elements into the foreground. The mind grasps something vaguely as a whole, moves from this to the parts, and gradually advances to a clearer and fuller idea of the whole. Whether the object of study be a flower, a picture, a cubic foot, or a six, the process of learning is the same. If we promote progress in the discovery of relations of magnitude, we will make it possible for the compared wholes to be pictured in their full extent, thus affording opportunity for comparing, for activity in judging. There is no such opportunity when a child who has no idea of a thing constructs it mechanically from given parts. Creation, in any subject, requires a basis in elementary ideas.

It is not to be forgotten that there is a wide difference between seeing that the relation of two particular things is 8, and realizing 8 as a relation, realizing it in such a way that it can be freely used without misapplying it.

There is no real progress unless the mind is gradually gaining power to think of things not present to sense, and to think of a relation apart from a particular thing. But there is no way to promote this progress except by securing continued activity of sense and mind. The child grows into the idea 8, slowly and unconsciously but surely, under right conditions. A cube does not become known by counting surfaces, edges, etc., again and again, but by observing other forms and many different cubes. Through repeated acts of dissociating and relating, what is particular sinks out of sight and the common trait stands out. This principle is of general application.

There should be constant calls for reperception, for judging and verifying. Only by multiplying experiences in the concrete, by noting the same relation in many different things and in many different conditions, does the child come to know a relation as it is.

The slow development of the power to form perfectly quantitative judgments is considered. Hence the earlier work makes no demand for close analysis. It provides for a gradual advance toward exactness. The exercises are only suggestive. The condition of the child determines what he should do. But in any case, the work in the beginning should be so simple that it can be done easily; it should look to the free action of both body and mind.

The child interested in finding colors and forms wishes to move about, to touch and handle things. Out of school he combines thinking and acting. Why should he not do so in the school? Interest will lead the child to control himself, but repression from without induces dullness, indifference, and antagonism. Force a child to preserve a regulation attitude, to keep his nerves tense, and you destroy the foundation of healthful mental activity. In the transition from home to school life, careful provision should be made for the *whole* child to express himself.

Attention is asked to the remarks upon over-direction, premature questioning, demands for analysis beyond the inclination and power of the pupil and for outward forms which are not the genuine expression of the child.

Great importance is attached to that order of work which puts things before the pupil and leaves him free to see and to tell all he can before interfering with his action by questioning or direction. Questions have their uses. They serve to arouse attention, to aid in testing the pupil's view, and may lead to the correct use of new forms of expression. But there are effects of questioning which are too often overlooked. Questions do for the child what he should do for himself; they conceal his attitude toward the work and prevent your seeing what he would do unaided. They call attention to details for which the mind may not be prepared, and present a partial, fragmentary view. The

questioning may be logical, but the learner connects only that which he himself relates. Questions cause the teacher to suppose that the child grasps what is not appreciable by him, and so prevent the adaptation of the work. To attempt to force through questions what *you* see in a poem, picture, or problem, instead of leaving the pupil to discover what *he* is prepared to see, is to ignore the true basis of advance, to disregard the law that the mind passes from vague ideas to those fuller and more exact, only through its own acts of analysis and synthesis. Free work reveals the pupil and makes it possible to meet his needs.

This view furnishes no excuse for random, desultory work. The teacher must carefully select the means, whether the ideas into which he wishes to lead the child are mathematical, biological, or historical.

In conclusion it is urged that any success is dangerous which lessens the susceptibility of the mind to new impressions. We may be so successful in training the child to reproduce as to destroy his power to produce. Progress is impossible without growing power to do unconsciously what was at first done consciously; but accuracy is not to be desired at the expense of growth. The purpose of automatic action in education is not to restrict, but to set force free. When the work of the school is mechanical it weakens the relating power, the power to act in new circumstances, and thus lowers the child in the scale of being.

As insight into the subject and contact with the child enable us to open right channels for free action, there will be little occasion for drills. The fresh, vigorous effort of involuntary attention carries the child forward with surprising rapidity. Out of *self*-activity comes the self-control which gives strength to persist.

# THEORY OF ARITHMETIC.

## INTRODUCTION.

THE following quotations may be found suggestive of working ideals. The teacher who enters into their spirit will feel the need of knowing both the child and the subject. She will see that attention is a condition of thinking, and interest a condition of attention; that the mind is one and indivisible, and must be so treated if we would strengthen it. The mental as well as the physical nature is under law. When our teaching is in accord with this law, we shall find the forces of nature working for us; the child will become strong with the strength of nature.

Apprehension by the senses supplies, directly or indirectly, the material of all human knowledge; or, at least, the stimulus necessary to develop every inborn faculty of the mind. — *Helmholtz.*

The products of the senses, especially those of sight, hearing, and touch, form the basis of all the higher thought processes. Hence the importance of developing accurate sense concepts. . . . The purpose of objective