HOW TO TEACH ELEMENTARY ARITHMETIC: GRUBE'S METHOD OF TEACHING ARITHMETIC EXPLAINED WITH A LARGE NUMBER OF PRACTICAL HINTS AND ILLUSTRATIONS

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How to Teach Elementary Arithmetic

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PRACTICAL HINTS AND ILLUSTRATIONS

BY

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PREFACE.

THE first of the following two essays is the same in substance as the one read before the St. Louis Teachers' Association in 1870, which has been republished since extensively in state and city school reports and educational magazines. It is presented here in a somewhat changed form, because the practical experience in the schoolroom has shown since what points of the method are in such harmony with established views as to require no further explanation, and what details need full comment and amplification in order to guard against such mistakes as are likely to creep in. In some respects I was guided by many inquiries on the part of the friends of the method. I regret to say that I have not always been able to answer these questions as fully as I wished. I hope that my correspondents will find the desired explanation in this new version of the old essay. I deem it my duty, however, to say, in justice to Mr. Grube, that the following pages are not in every respect a translation from his work, as has been supposed by some. One gentleman has done me the credit to publish my essay over his own signature as a translation from Mr. Grube's work. It should be distinctly understood that the full credit for one and every idea contained herein belongs to

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Mr. Grube, but that he is not responsible at all for the many imperfections in the manner in which his thoughts are stated here. In a few instances only, the writer has allowed himself to depart from Mr. Grube's ideas. The two essays are, may I be allowed to repeat, not altogether a translation, but rather an attempt to give a condensed account of the 160 pages of Mr. Grube's work.

The second essay was read before the St. Louis Normal School Association in 1876, when it appeared proper to supply the continuation of the course recommended by a method which had attracted the attention of many thinking educators of the land, from California (See San Francisco Report of 1872) to New Hampshire (See State Report of 1876). The second essay contains a recapitulation and continuation of the first essay. It presumes as little as its predecessor to *recommend*, but simply submits a new and important method to the thoughtful consideration of those who are interested in the matter. If circumstances permit, this little book will be followed by a text-book of Primary Arithmetic, based on Grube's Method.

<div align="right">L. S.</div>

St. Louis, November, 1878.

GRUBE'S METHOD

OF

TEACHING PRIMARY NUMBERS.

THE old, long-established method in arithmetic is calculated to teach the first four processes of addition, subtraction, multiplication, division, in the order in which they are named, finishing addition with small and large numbers, before subtraction is begun, and so forth. A more recent improvement on this method consisted in excluding the larger numbers altogether at the beginning, and dividing the numbers on which the first four processes were taught, into classes, or so-called circles. The child learns each of the four processes with the small numbers of the first circle (i.e., from 1 to 10) before larger numbers are considered; then the same processes are taught with the numbers of the second circle, from 10 to 100, then of the third, from 100 to 1,000, and so forth.

Grube, however, went beyond this principle of classi-fication. He discarded the use of large numbers, hun-dreds and thousands, at the beginning of the course, as others had done before him; but instead of dividing the primary work in arithmetic into three or four circles or parts only, i.e., from 1 to 10, 10 to 100, etc., he con-sidered each number as a circle or part by itself, and taught it by a method that is to be set forth in the

following pages. He recommended that the child should learn each of the smaller numbers in succession, and all the operations within the range of each number, before proceeding to the next higher one, addition, subtraction, multiplication, and division, before proceeding to the consideration of the next higher number.

In order to guard against a mistake which has been made rather frequently, it should be stated that such examples only are considered to be within the limit of a number, and are to be taught in connection with it, in which a larger number than the one that is being considered does not appear in any way whatsoever. Thus, for instance, when the number four is taught, the teacher should exclude at the beginning addition and subtraction by fours, multiplication with 4 as one of the factors, division with 4 as the divisor, because these belong to a later and more advanced part of the course, since they involve in the sum, minuend, product, or dividend numbers beyond the limit of the one that is being considered. But all the examples that do not involve a higher number than four, are illustrated and taught, before passing over to the next higher number, five. Treating, for instance, the number 2, Grube leads the child to perform all the operations that are possible within the limits of this number, i.e., all those that do not presuppose the knowledge of any higher number, no matter whether in the usual classification these operations are called addition, subtraction, multiplication, or division. The child has to see and to keep in mind that

$$1 + 1 = 2, \quad 2 \times 1 = 2, \quad 2 - 1 = 1, \quad 2 + 1 = 2, \text{ etc.}$$

The whole circle of operations up to 2 is exhausted

before the child proceeds to the consideration of the number 3, which is to be treated in the same way.

Why adhere to the abstract division of the work in arithmetic into addition, subtraction, etc., in the primary grade, where these distinctions do not help to make the subject any clearer to the pupil? The first four processes are naturally connected, and will appear so in the untaught mind. If you take away 1 from 2, and 1 remains, the child, in knowing this, also understands implicitly the opposite process of adding 1 to 1 and its result.

Multiplication and division are, in the same way, nothing but another way for adding and subtracting, so that we might say one operation contains all the others. "Every text-book of primary arithmetic professes to teach the numbers in some way or other," says Grube; "but to know a number really means to know also its most simple relations to those numbers, at least, which are smaller than it." Any child, however, who knows a number and its relations, must be also able to perform the operations of adding, subtracting, etc., for they are nothing but the expression of the relation in which one number stands to others. Each example shows what must be added to or subtracted from a number to raise it or lower it to equality with another, or, as in multiplication and division, it sets forth the multiple relation of two numbers.

The four processes are the direct result of comparing, or "measuring," as Grube calls it, two numbers with each other. Only when the child can perform all these operations, for instance, within the limits of 2, can it be supposed really to have a perfect knowledge of this number. So Grube takes up one number after the

other, and compares it with the preceding ones, in all imaginable ways, by means of addition, subtraction, multiplication, and division. This comparing or "measuring" takes place always on external, visible objects, so that the pupil can see the objects, the numbers of which he has to compare with each other. The adherents of this method claim for it that it is based on a sound philosophical theory, and that it has proved superior in practice to the methods in use before its invention.

Some of the most important principles of this method of instruction are given by Grube in the following:

"1 (Language). We cannot impress too much upon the teacher's mind, that each lesson in arithmetic must be a lesson in language at the same time. This requirement is indispensable with our method. As the pupil in the primary grade should be generally held to answer in complete sentences, loud, distinctly, and with clear articulation, so especially in arithmetic, the teacher has to insist on fluency, smoothness, and neatness of expression, and should lay special stress upon the *process* of solution of each example. As long as the language for the number is not perfect, the idea of the number is defective as well. An example is not finished when the result has been found, but when it has been solved in a proper way. Language is the only test by which the teacher can ascertain whether the pupils have perfectly mastered any step or not.

"2 (Questions). Teachers should avoid asking too many questions. Such questions, moreover, as, by containing half the answer, prompt the scholar, should be omitted. The scholar must speak himself as much as possible.

"3 (Class and Individual Recitation). In order to animate the lesson, answers should be given alternately by the scholars individually, and by the class in concert. The typical numeri-