ARITHMETIC UPON THE INDUCTIVE METHOD OF INSTRUCTION: BEING A SEQUEL TO INTELLECTUAL ARITHMETIC

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Arithmetic Upon the Inductive Method of Instruction: Being a Sequel to Intellectual Arithmetic by Warren Colburn

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WARREN COLBURN

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Trieste

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BEING

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TO

INTELLECTUAL ARITHMETIC.

BY WARREN COLBURN, A. M.

BOSTON.
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1845.

RECOMMENDATIONS.

From B. A. Gould, Principal of the Public Latin School, Boston

Boston, 22d *Oct.*, 1822

Dear Sir,

I have been highly gratified by the examination of the second part of your Arithmetic. The principles of the science are unfolded, and its practical uses explained with great perspicuity and simplicity I think your reasonings and illustrations are peculiarly happy and original. This, together with your "First Lessons," forms the most lucid and intelligible, as well as the most scientific system of Arithmetic I have ever seen.—Its own merits place it beyond the need of commendation.

With much esteem,

Sir, your obedient servant,

B. A. GOULD

Mr. Warren Colburn.

From G. B. Emerson, Principal of the English Classical School, Boston.

Boston, 22d *Oct.*, 1822.

Dear Sir,

I have carefully examined a large portion of your manuscript, and do not hesitate to recommend it very highly to every person who wishes to teach arithmetic intelligibly. The arrangement is very much better, the explanations more convincing, and the rules, from the mode in which they are introduced, are clearer and simpler, than can be found in any book on the subject with which I am acquainted

I am, with great respect,

Yours, &c.

G. B. EMERSON.

Mr Warren Colburn.

PREFACE

It will be extremely useful, though not absolutely necessary, for pupils of every age to study the "First Lessons," previous to commencing this treatise. There is an intimate connexion between the two, though this is not dependent on the other. It is hoped that this will be found less difficult than other treatises on the subject, for those who have not studied the "First Lessons."

Pupils may commence the "First Lessons" to advantage, as soon as they can read the examples; and even before they can read, it will be found very useful to ask them questions from it. This may be done by other pupils who have already studied it. Those who commence early, may generally obtain sufficient knowledge of it by the time they are eight or nine years old. They may then commence this.

This Sequel consists of two parts. The first contains a course of examples for the illustration and application of the principles. The second part contains a developement of the principles. The articles are numbered in the two, so as to correspond with each other. The two parts are to be studied together, when the pupil is old enough to comprehend the second part by reading it himself. When he has performed all the examples in an article in the first part, he should be required to recite the corresponding article in the second part, not verbatim, but to give a good account of the reasoning. When the principle is well understood, the rules which are printed in Italics should be committed to memory. At each recitation, the first thing should be to require the pupil to give a practical example, involving the principle to be explained, and then an explanation of the principle itself.

When the pupil is to learn the use of figures for the first time, it is best to explain to him the nature of them as in Art. I., to about three or four places; and then require him to write some numbers. Then give him some of the first examples in Art. II., without telling him what to do. He will discover what is to be done, and invent a way to do it. Let him perform several in his own way, and then suggest some method a little different from his, and nearer the common

method. If he readily comprehends it, he will be pleased with it, and adopt it. If he does not, his mind is not yet prepared for it, and should be allowed to continue his own way longer, and then it should be suggested again. After he is familiar with that, suggest another method, somewhat nearer the common method, and so on, until he learns the best method. Never urge him to adopt any method until he understands it, and is pleased with it. In some of the articles, it may perhaps be necessary for young pupils to perform more examples than are given in the book.

When the pupil is to commence multiplication, give him one of the first examples in Art. III., as if it were an example in Addition. He will write it down as such But if he is familiar with the "First Lessons," he will probably perform it as multiplication without knowing it. When he does this, suggest to him, that he need not write the number but once. Afterwards recommend to him to write a number, to show how many times he repeated it, lest he should forget it. Then tell him that it is Multiplication. Proceed in a similar manner with the other rules.

One general maxim to be observed with pupils of every age, is never to tell them directly how to perform any example. If a pupil is unable to perform an example, it is generally because he does not fully comprehend the object of it. The object should be explained, and some questions asked, which will have a tendency to recal the principles necessary. If this does not succeed, his mind is not prepared for it, and he must be required to examine it more by himself, and to review some of the principles which it involves. It is useless for him to perform it before his mind is prepared for it. After he has been told, he is satisfied, and will not be willing to examine the principle, and he will be no better prepared for another case of the same kind, than he was before. When the pupil knows that he is not to be told, he learns to depend on himself; and when he once contracts the habit of understanding what he does, he will not easily be prevailed on to do any thing which he does not understand.

Several considerations induce the author to think, that when a principle is to be taught, practical questions should first be proposed, care being taken to select such as will show the combination in the simplest manner, and that the numbers be so small that the operation shall not be difficult. When a proper idea is formed of the nature and use of the combination, the method of solving these questions with large numbers should be attended to. This method, on trial has succeeded beyond his expectations. Practical examples not only show at once the object to be accomplished, but they greatly assist

the imagination in unfolding the principle and discovering the operations requisite for the solution.

This principle is made the basis of this treatise; viz. whenever a new combination is introduced, it is done with practical examples, proposed in such a manner as to show what it is, and as much as possible, how it is to be performed. The examples are so small that the pupil may easily reason upon them, and that there will be no difficulty in the operation itself, until the combination is well understood. In this way it is believed that the leading idea which the pupil will obtain of each combination, will be the effect which will be produced by it, rather than how to perform it, though the latter will be sufficiently well understood.

The second part contains an analytical developement of the principles. Almost all the examples used for this purpose are practical. Care has been taken to make every principle depend as little as possible upon others. Young persons cannot well follow a course of reasoning where one principle is built upon another. Besides, a principle is always less understood by every one, in proportion as it is made to depend on others.

In tracing the principles, several distinctions have been made which have not generally been made. They are principally in division of whole numbers, and in division of whole numbers by fractions, and fractions by fractions. There are some instances also of combinations being classed together, which others have kept separate.

As the purpose is to give the learner a knowledge of the principles, it is necessary to have the variety of examples under each principle as great as possible. The usual method of arrangement, according to subjects, has been on this account entirely rejected, and the arrangement has been made according to principles. Many different subjects come under the same principle; and different parts of the same subject frequently come under different principles. When the principles are well understood, very few subjects will require a particular rule, and if the pupil is properly introduced to them, he will understand them better without a rule than with one. Besides, he will be better prepared for the cases which occur in business, as he will be obliged to meet them there without a name. The different subjects, as they are generally arranged, often embarrass the learner. When he meets with a name with which he is not acquainted, and a rule attached to it, he is frequently at a loss, when if he saw the example without the name, he would not hesitate at all.

The manner of performing examples will appear new to many, but it will be found much more agreeable to the practice of men of busi

ness, and men of science generally, than those commonly found in books. This is the method of those that understand the subject. The others were invented as a substitute for understanding.

The *rule of three* is entirely omitted. This has been considered useless in France, for some years, though it has been retained in their books. Those who understand the principles sufficiently to comprehend the nature of the rule of three, can do much better without it than with it, for when it is used, it obscures, rather than illustrates, the subject to which it is applied. The principle of the rule of three is similar to the combinations in Art. XVI.

The rule of Position has been omitted This is an artificial rule, the principle of which cannot be well understood without the aid of Algebra: and when Algebra is understood, Position is useless. Besides, all the examples which can be performed by Position, may be performed much more easily, and in a manner perfectly intelligible, without it. The manner in which they are performed is similar to that of Algebra, but without Algebraic notation. The principle of *false position*, properly so called, is applied only to questions where there are not sufficient data to solve them directly.

Powers and roots, though arithmetical operations, come more properly within the province of Algebra.

There are no answers to the examples given in the book. A key is published separately for teachers, containing the answers and solutions of the most difficult examples.