EMERSON'S THIRD PART. THE NORTH AMERICAN ARITHMETIC. PART THIRD, FOR ADVANCED SCHOLARS

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Emerson's Third Part. The North American Arithmetic. Part Third, For Advanced Scholars by Frederick Emerson

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THE

NORTH AMERICAN ARITHMETIC.

PART THIRD,

FOR

ADVANCED SCHOLARS.

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PREFACE.

The work now presented, is the last of a series of books, under the general title of The North American Arithmetic, and severally denominated *Part First*, *Part Second*, and *Part Third*.

Part First is a small book, designed for the use of children between five and eight years of age, and suited to the convenience of class-teaching in primary schools.

Part Second consists of a course of oral and written exercises united, embracing sufficient theory and practice of arithmetic for all the purposes of common business.

Part Third comprises a brief view of the elementary principles of arithmetic, and a full development of its higher operations. Although it is especially prepared to succeed the use of Part Second, it may be conveniently taken up by scholars, whose acquirements in arithmetic are considerably less than the exercises in Part Second are calculated to afford. While preparing this book, I have kept in prominent view, two classes of scholars; viz.— those who are to prosecute a full course of mathematical studies, and those who are to embark in commerce. In attempting to place arithmetic, as a science, before the scholar in that light, which shall prepare him for the proper requirements of college, I have found it convenient to draw a large portion of the examples for illustration and practice, from mercantile transactions; and thus pure and mercantile arithmetic are united. No attention has been spared, to render the mercantile information here presented, correct and adequate. Being convinced, that many of the statements relative to commerce, which appear in books of arithmetic, have been transmitted down from ancient publications, and are now erroneous, I have drawn new data from the counting-room, the insurance office, the custom-house, and the laws of the present times. The article on Foreign Exchange is comparatively extensive, and I hope it will be found to justify the confidence of merchants. Its statements correspond to those of the British '*Universal Cambist*,' conformably with our value of foreign coins, as fixed by Act of Congress, in 1834.

Although a knowledge of arithmetic may, in general, be well appreciated as a valuable acquisition, yet the effect produced on intellectual character, by the exercises necessary for acquiring that knowledge, is not always duly considered. In these exercises, the mental effort required in discovering the true relations of the data, tends to strengthen the power of comprehension, and leads to a habit of investigating; the certainty of the processes, and the indisputable correctness of the results, give clearness and activity of thought; and, in the systematic arrangement necessary to be observed in performing solutions, the mind is disciplined to order, and accustomed to that connected view of things, so indispensable to the formation of a sound judgment. These advantages, however, depend on the manner in which the science is taught; and they are gained, or lost, in proportion as the teaching is rational, or superficial.

Arithmetic, more than any other branch of learning, has suffered from the influence of circumstances. Being the vade-mecum of the shop-keeper, it has too often been viewed as the peculiar accomplishment of the accountant, and neglected by the classical student. The popular supposition, that a compendious treatise can be more easily mastered than a copious one, has led to the use of text-books, which are deficient, both in elucidation and exercises. But these evils seem now to be dissipating.—The elements of arithmetic have become a subject of primary instruction; and teachers of higher schools, who have adopted an elevated course of study, are no longer satisfied with books of indifferent character.

It has been my belief, that a treatise on arithmetic might be so constructed, that the learner should find no means of proceeding in the exercises, without mastering the subject in his own mind, as he advances; and, that he should still be enabled to proceed through the entire course, without requiring any instruction from his tutor. Induced by this belief, I commenced preparing The North American Arithmetic about five years since; and the only apology I shall offer, for not earlier presenting its several Parts to the public, is the unwillingness that they should pass from my hands, while I could see opportunity for their improvement.

Boston, October, 1834. F. EMERSON.

A KEY to this work (for teachers only) is published separately.

ARITHMETIC.

Article I.

DEFINITIONS OF QUANTITY, NUMBERS, AND ARITHMETIC.

QUANTITY is that property of any thing which may be increased or diminished—it is *magnitude* or *multitude*. It is magnitude when presented in a mass or continuity; as, a quantity of water, a quantity of cloth. It is multitude when presented in the assemblage of several things; as, a quantity of pens, a quantity of hats. The idea of quantity is not, however, confined to visible objects; it has reference to every thing that is susceptible of being more or less.

NUMBERS are the expressions of quantity. Their names are, One, Two, Three, Four, Five, Six, Seven, Eight, Nine, Ten, &c. In quantities of multitude, *One* expresses a Unit; that is, an entire, single thing; as one pen, one hat. Then each succeeding number expresses one unit more than the next preceding. In quantities of magnitude, a certain known quantity is first assumed as a measure, and considered the unit; as one gallon, one yard. Then each succeeding number expresses a quantity equal to as many times the unit, as the number indicates. Hence, the value of any number depends upon the value of its unity.

When the unit is applied to any particular thing, it is called a *concrete* unit; and numbers consisting of concrete units are called concrete numbers: for example, one dollar, two dollars. But when no particular thing is indicated by the unit, it is an *abstract* unit; and hence arise abstract numbers: for example, one and one make two.

Without the use of numbers, we cannot know precisely how much any quantity is, nor make any exact comparison of quantities. And it is by comparison only, that we value all quantities; since an object, viewed by itself, cannot be considered either great or small, much or little; it can be so only in its relation to some other object, that is smaller or greater.

ARITHMETIC treats of numbers: it demonstrates their various properties and relations; and hence it is called the Science of numbers. It also teaches the methods of computing by numbers; and hence it is called the Art of numbering.

II.

NOTATION AND NUMERATION.

NOTATION is the writing of numbers in numerical characters, and NUMERATION is the reading of them.

The method of denoting numbers first practised, was undoubtedly that of representing each unit by a separate mark. Various abbreviations of this method succeeded; such as the use of a single character to represent *five*, another to represent *ten*, &c.; but no method was found perfectly convenient, until the Arabic FIGURES or DIGITS, and DECIMAL system now in use, were adopted. These figures are, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9; denoting respectively, nothing, one unit, two units, three units, &c.

To denote numbers higher than 9, recourse is had to a law that assigns superior values to figures, according to the order in which they are placed. viz. *Any figure placed to the left of another figure, expresses ten times the quantity that it would express if it occupied the place of the latter.* Hence arise a succession of higher orders of units.

As an illustration of the above law, observe the different quantities which are expressed by the figure 1.

When standing alone, or to the right of other figures, 1 represents 1 unit of the first degree or order; when standing in the second place towards the left, thus, 10, it represents 1 ten, which is 1 unit of the second degree; when standing in the third place, thus, 100, it represents 1 hundred, which is 1 unit of the third degree; and so on. The zero or cipher (0) expresses nothing of itself, being employed only to occupy a place.

The units of the second degree, that is, the tens, are denoted and named in succession, 10 ten, 20 twenty, 30 thirty, 40 forty, 50 fifty, 60 sixty, 70 seventy, 80 eighty, 90 ninety. The units of the third degree, that is, the hundreds, are denoted and named, 100 one hundred, 200 two hundred, 300 three hundred, and so on to 900 nine hundred. The numbers between 10 and 20 are denoted and named, 11 eleven, 12 twelve, 13 thirteen, 14 fourteen, 15 fifteen, 16 sixteen, 17 seventeen, 18 eighteen, 19 nineteen. Numbers between all other tens are denoted in like manner, but their names are compounded of the names of their respective units; thus, 21 twenty-one, 22 twenty-two, 23 twenty-three, &c.; 31 thirty-one, 32 thirty-two, &c. &c. This nomenclature, although not very imperfect, might be rendered more consistent, by substituting regular compound names for those now applied to the numbers between 10 and 20. This alteration would give the names, 11 ten-one, 12 ten-two, 13 ten-three, &c.

As the first three places of figures are appropriated to simple units, tens, and hundreds, so every succeeding three places are appropriated to the units, tens, and hundreds of succeeding higher denominations. For illustration, see the following table.

Duodecillions.	Undecillions.	Decillions	Nonillions	Octillions	Septillions	Sextillions	Quintillions	Quadrillions	Trillions.	Billions	Millions	Thousands	Units
460	725	206	194	007	185	039	000	164	396	205	013	008	741

By continuing to adopt a new name for every three degrees of units, the above table may be extended indef-