

**INTRODUCTION TO THE NATIONAL
ARITHMETIC, ON THE INDUCTIVE
SYSTEM; COMBINING THE ANALYTIC
AND SYNTHETIC METHODS WITH THE
CANCELLING SYSTEM**

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Introduction to the National Arithmetic, on the Inductive System; Combining the Analytic and Synthetic Methods with the Cancelling System by Benjamin Greenleaf

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BENJAMIN GREENLEAF

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INTRODUCTION

TO THE

NATIONAL ARITHMETIC,

ON THE

INDUCTIVE SYSTEM;

COMBINING THE

ANALYTIC AND SYNTHETIC METHODS

WITH THE

CANCELLING SYSTEM;

IN WHICH

THE PRINCIPLES OF ARITHMETIC ARE EXPLAINED

AND ILLUSTRATED IN A FAMILIAR MANNER.

DESIGNED FOR COMMON SCHOOLS.

By BENJAMIN GREENLEAF, A. M.,
PRINCIPAL OF BRADFORD TEACHERS' SEMINARY.

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GREENLEAF'S NATIONAL ARITHMETIC,

TWELFTH IMPROVED STEREOTYPE EDITION,

For the more advanced Scholars,

forming a volume of upwards of 300 pages, handsomely printed on fine paper, and bound in leather. Also, a COMPLETE KEY to this work, *designed exclusively for Teachers.* Fourth Edition.

PUBLISHED BY ROBERT S. DAVIS, BOSTON,

and sold by all the principal booksellers throughout the United States.

[] This work, having been extensively adopted in various sections of the country, is highly commended by all intelligent Teachers who have tested it, for its practical adaptation to make *thorough scholars* in this department of science.

The publishers have recently received the following letter from Rev. G. B. Perry, one of the Superintending Committee of Bradford.

Bradford, Mass., January 1, 1842.

"Gentlemen: The National Arithmetic, by Benjamin Greenleaf, Esq., after having been pretty thoroughly examined by those intrusted with the superintendence of the Public Schools, was introduced into them very soon after its first publication, and has been constantly used from that time; and, after so long and extended experiment, I have no hesitancy in saying, the best expectations of the Committee have been fully met. A new and increased interest was thereby given to that part of Education, which has been constantly increasing in most or all of our schools, — a spirit of perseverance excited, which has carried a considerable number of our youth through the whole book, and there are now a still greater number, who are going on with a determination to perform every question. Having formerly recommended the work, as, in my opinion, possessing great merit, from the lucid and scientific manner in which its parts are arranged, and the rules of operation expressed, I have thought the above statement would afford the best testimony, that I could now give of its practical worth, and of the benefits likely to result from its introduction into other places.

(Signed.)

"Very respectfully,

"GARDNER B. PERRY."

From H. Morison, Esq., of Baltimore, President, and Professor of Mathematics, in the University of Maryland.

"This is one of the most complete books of its kind, both in the extent and arrangement of its matter, that has yet appeared. Combining, as it does, the Analytic and Synthetic methods, and abounding in familiar examples, it is admirably calculated to interest the pupil, and lead him, by easy and progressive steps, through the difficulties of the science, to its complete mastery, and full comprehension. To make the work more perfect, than a treatise on Arithmetic merely could be, the author has added many geometrical, mechanical, philosophical, and astronomical problems, and a concise system of Book-keeping, so that, without the aid of any other book, it is calculated to make the perfect business man, in all his various departments.

(Signed.)

"H. MORISON."

Other testimonials to the merits of this work, will be found in the advertising sheet, at the end of the volume.

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DATE

GEORGE A. P. ...

P R E F A C E .

THE following treatise is intended for that class of pupils, who may not have sufficient time to read the larger work on this science, published by the author a few years since, and which has had extensive circulation.

It is believed, that this book contains all, that is necessary to prepare the young for the common avocations of life.

If the student wishes to obtain an extensive and full knowledge of this science, he can consult the *National Arithmetic*.

It has been a great object with the author to render the work *practical*; how far he has succeeded, the public must judge.

The questions are original, although there may be a similarity between some of these and others, which are before the public, and which could not be well avoided.

Although the author has carefully examined every question, yet, it is possible, some few mistakes may be found in this work. These, however, will be corrected in a future edition.

With these few prefatory remarks, the author commends this small volume to the candor of an enlightened Public.

THE AUTHOR.

BRADFORD SEMINARY,
Nov. 1st, 1842.

CHARACTERS USED IN THIS WORK.

- $\$$ Contraction, for U. S., United States' currency, and is prefixed to dollars and cents.
 $=$ Sign of equality ; as $12 \text{ inches} = 1 \text{ foot}$, signifies, that 12 inches are equal to one foot.
 $+$ Sign of addition ; as $8+6=14$, signifies, that 8 added to 6 is equal to 14.
 $-$ Sign of subtraction ; $8-6=2$, that is, 8 less 6 is equal to 2.
 \times Sign of multiplication ; as $7 \times 6=42$, that is, 7 multiplied by 6 is equal to 42.
 \div Sign of division ; as $42 \div 6=7$, that is, 42 divided by 6 is equal to 7.
 $\overline{\hspace{1em}}$ Numbers placed in this manner imply, that the upper line is to be divided by the lower line.
 $:::$ Signs of proportion ; thus, $2 : 4 :: 6 : 12$, that is, 2 has the same ratio to 4, that 6 has to 12 ; and such numbers are called proportionals.
 $\overline{15-5}+3=13$. Numbers placed in this manner show, that 5 is to be taken from 15, and 3 added to the remainder. The line at the top is called a vinculum, and connects all the numbers, over which it is drawn.
 9^2 Implies, that 9 is to be raised to the second power ; that is, multiplied by itself.
 8^2 Implies, that 8 is to be multiplied into its square.

ARITHMETIC.

Section 1.

ARITHMETIC is the art of computing by numbers. Its five principal rules are Numeration, Addition, Subtraction, Multiplication, and Division.

NUMERATION.

Numeration teaches to express the value of numbers either by words or characters.

The numbers in Arithmetic are expressed by the following ten characters, or Arabic numeral figures, which the Moors introduced into Europe about nine hundred years ago ; viz. 1 one, 2 two, 3 three, 4 four, 5 five, 6 six, 7 seven, 8 eight, 9 nine, 0 cypher, or nothing.

The first nine are called significant figures, as distinguished from the cypher, which is, of itself, insignificant.

Besides this value of those figures, they have also another, which depends on the place in which they stand, when connected together ; as in the following table.

| | | | | | | | | |
|-----------------------|-------------------|-----------|------------------------|--------------------|------------|-----------|-------|--------|
| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Hundreds of Millions. | Tens of Millions. | Millions. | Hundreds of Thousands. | Tens of Thousands. | Thousands. | Hundreds. | Tens. | Units. |
| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Here any figure in the first place, reckoning from right to left, denotes only its simple value ; but that in the second place, denotes ten times its simple value ; and that in the third place a hundred times its simple value ; and so on ; the value of any successive place being always ten times its former value.

Thus in the number 1834, the 4 in the first place denotes only four units, or simply 4 ; 3 in the second place signifies three tens, or thirty ; 8 in the third place signifies eighty tens or eight hundred ; and the 1, in the fourth place, one thousand ; so that the whole number is read thus, — one thousand eight hundred and thirty-four.

As to the cypher, 0, though it signify nothing of itself, yet being joined to the right hand of other figures, it increases their value in a tenfold proportion ; thus 5 signifies only five, but 50 denotes 5 tens or fifty ; 500 is five hundred ; and so on.

NOTE. — The idea of number is the latest and most difficult to form. Before the mind can arrive at such an abstract conception, it must be familiar with that process of classification, by which we successively remount from individuals to species, from species to genera, from genera to orders. The savage is lost in his attempts at enumeration, and significantly expresses his inability to proceed, by holding up his expanded fingers or pointing to the hair of his head. See Lacroix.

ENGLISH NUMERATION TABLE.

| | | |
|--|----------------|--|
| 129,456; 799,123; 456,123; 456,123; 456,123; 123,456; 799,799; 999,456; 799,712; 999,845; 799,123; 127,890; 711,716; 871,712; 456,711. | Thousands. | To enumerate any number of figures, they must be separated by semicolons into divisions of six figures each, and each division by a comma, as in the annexed table. Each division will be known by a different name. The first three figures in each division will be so many thousands of that name, and the next three will be so many of that name, that is over its unit's place. The value of the numbers in the annexed table is, One hundred twenty-three thousand, four hundred fifty-six tridecillions; seven hundred eighty-nine thousand, one hundred twenty-three duodecillions; four hundred fifty-six thousand, one hundred twenty-three undecillions; four hundred fifty-six thousand, one hundred twenty-three decillions; one hundred twenty-three thousand, four hundred fifty-six nonillions; seven hundred eighty-nine thousand, seven hundred eighty-nine octillions; three hundred twenty-three thousand, four hundred fifty-six septillions; seven hundred eighty-nine thousand, seven hundred twelve sextillions; three hundred thirty-three thousand, three hundred forty-five quintillions; seven hundred eighty-nine thousand, one hundred twenty-three quadrillions; one hundred thirty-seven thousand, eight hundred ninety trillions; seven hundred eleven thousand, seven hundred sixteen billions; three hundred seventy-one thousand, seven hundred twelve millions; four hundred fifty-six thousand, seven hundred eleven. |
| | Tridecillions. | |
| | Thousands. | |
| | Duodecillions. | |
| | Thousands. | |
| | Undecillions. | |
| | Thousands. | |
| | Decillions. | |
| | Thousands. | |
| | Nonillions. | |
| | Thousands. | |
| | Octillions. | |
| | Thousands. | |
| | Septillions. | |
| | Thousands. | |
| | Sextillions. | |
| | Thousands. | |
| | Quintillions. | |
| | Thousands. | |
| | Quadrillions. | |
| | Thousands. | |
| | Trillions. | |
| | Thousands. | |
| | Billions. | |
| | Thousands. | |
| | Millions. | |
| | Thousands. | |
| | Units. | |

NOTE. The student must be familiar with the names from Units to Tridecillions, and from Tridecillions to Units, so that he may repeat them with facility either way.