

ECLECTIC EDUCATION SERIES

White's New Complete Math

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W. NEW COMP. AR.

E-P 75

PREFACE.

It is now thirteen years since the first issue of the author's Complete Arithmetic, which has been used from that time to the present with increasing satisfaction in thousands of American schools. In all this time there has been little demand for its revision, and the changes suggested from time to time have been comparatively unimportant. It is believed that few textbooks have more satisfactorily met the test of wide and continued use—the best possible test of a school book.

But the demand for a **two-book series**, which called for a new first book, has afforded an opportunity for a revision of the Complete Arithmetic, and this has been improved, not only with a view of better adapting it to its place as the second book in the new series, but also of bringing it fully up to the present condition of school instruction and of business. In this revision neither author nor publishers have spared expense or labor required to make the **New Complete Arithmetic** worthy of general use in the most progressive schools of the country.

The most important change made in the revision is a large increase in the number of **practical problems**, and this has been done without any reduction in the aggregate number of purely drill problems. This increase in practical problems is most marked in Mensuration and the applications of Percentage, including stock investments. There is an increase in the number of review problems in all parts of the book, and there is no reduction in the number and variety of the oral problems. A few of the more difficult problems, oral and written, have been omitted. It has been the aim to eliminate all obsolete terms

and measures, and to present the current values, forms, and usages of business. To this end, the author has gone to science and to the most recent statistics for data for problems, and to business men for present business usages.

Special attention is called to the new treatment of the Metric System. The omission of formal tables and the presentation of the metric denominations on the decimal scale will meet the hearty approval of teachers.

The characteristics that have given the author's arithmetics wide and successful use, are preserved in the new two-book series. These include:

1. *A special adaptation, in matter and method, to the grades of pupils for which each book is designed.*

2. *A practical union of oral and written exercises in a natural and philosophic system of instruction.*

3. *A true and practical embodiment of the inductive method, in which definitions, principles, and rules follow processes and problems.*

4. *The great number and variety and the practical character of the problems.* The number of problems has been greatly increased by often grouping two or more problems under the same number. This has been done by changing one of the conditions or elements of a problem—an excellent method of increasing the pupil's practice.

The introductory lessons in Algebra given in the new appendix (pp. 327—357) are designed for the last year of the course in Arithmetic. Their aim is to make pupils familiar with the use of the algebraic equation in the solution of problems; and only so much of the notation and processes of Algebra has been introduced as is necessary to this end. No attempt has been made to present the elements of Algebra in a technical manner.

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WHITE'S
NEW COMPLETE ARITHMETIC.

PRELIMINARY DEFINITIONS.

ARTICLE 1. A **Unit** is one.

ART. 2. A **Number** is a unit or a collection of units.

ART. 3. **Arithmetic** is the science and the art of numbers.

As a *science*, arithmetic treats of the properties, relations, and principles of numbers; as an *art*, it treats of numerical computation.

ART. 4. An **Integer** is a number composed of whole or entire units; as, 5, 12, 20. It is also called a *Whole Number*.

An integer is composed of integral units, and a fraction is composed of fractional units (Art. 72).

ART. 5. Numbers are either *Concrete* or *Abstract*.

A **Concrete Number** is applied to a particular thing or quantity; as, 4 stars, 6 hours.

An **Abstract Number** is not applied to a particular thing or quantity; as, 4, 6, 20.

A concrete number is composed of concrete units; and an abstract number, of abstract units.

ART. 6. A **Problem** is a question proposed for solution.

ART. 7. An **Example** is a problem used to illustrate a process or a principle.

ART. 8. A **Rule** is a general description of a process.

ART. 9. In the **Written Solution** of a problem, the results of the successive steps are written.

In the **Mental Solution** of a problem, the results of the successive steps are not written.

NUMERATION AND NOTATION.

ORAL EXERCISES.

1. How many tens and how many units in 37? 65?
84? 90? 75? 18? 60? 80?

2. Read 29; 47; 85; 70; 77; 90.

3. How many hundreds, tens, and units in 368?
427? 549? 608? 680? 600? 806? 860? 800?

4. Read 452; 506; 560; 600; 784; 690; 900; 909.

5. How many ten-thousands and how many thousands in 48500? 83250? 50400? 60070? 82405?

6. Read 37500; 84250; 70840; 92080; 90900.

7. How many hundred-thousands, ten-thousands, and thousands in 456048? 707803? 680435? 700450?
650048? 805347? 170480?

8. Read the thousands' period in 3045; 40607; 150482; 405360; 920400; 600060; 508320.

9. Read first the thousands' period and then the units' period in 65671; 120408; 400750; 650400; 80008.

10. Read 45037406; 520600480; 138405050.

11. Read 50008140; 600650508; 805000030.

12. Read 5308008450; 35006060600; 120500408080.

13. Read 7008360004; 302000860060; 500080800008.

WRITTEN EXERCISES.

14. Express in figures the number composed of 5 thousands, 7 tens, and 3 units.

15. Express in figures the number composed of 4 ten-thousands, 6 hundreds, and 5 units.

16. Express in figures 50 thousands and 40 units; 406 thousands and 30 units; 700 thousands and 7 units; 650 thousands and 13 units.

Express the following numbers in figures:

17. Five million five thousand five hundred.

18. Sixty million sixty thousand and sixty.

19. Seven hundred million seven hundred thousand seven hundred.

20. Five hundred sixty million sixty-eight thousand.

21. Four billion fourteen million forty-five thousand.

22. Sixty-five billion six thousand and fifty.

23. Three hundred fifty billion forty-nine million.

24. Seventeen trillion seventy billion seven hundred thousand four hundred.

25. Fifty-six trillion sixteen million and ninety.

26. Seven quadrillion eighty-five billion two hundred and four.

27. Eighty-five billion fifteen thousand.

28. Ninety million nine hundred fifty.

DEFINITIONS, PRINCIPLES, AND RULES.

ART. 10. There are three methods of expressing numbers, viz:

1. By *words*; as, ~~five, fifty, etc.~~
2. ~~By letters, called the Roman method.~~
3. ~~By figures, called the Arabic method.~~

ART. 11. In the Roman Notation, numbers are expressed by means of the seven *capital letters*, I, V, X, L, C, D, M.

I denotes one; V, five; X, ten; L, fifty; C, one hundred; D, five hundred; M, one thousand. All other numbers are expressed by repeating or combining these letters.

A bar placed over a letter, as \bar{D} , \bar{M} , multiplies its value by one thousand.

ART. 12. In the Arabic Notation, numbers are expressed by means of characters called *figures*. There are ten figures; viz, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

The first (0) is called *naught*, *cipher*, or *zero*, and is used to fill vacant orders. The other nine figures are called *significant figures*, since each denotes one or more units. The ten Arabic figures are called *digits*; also *numerals*.

ART. 13. **Notation** is the art of expressing numbers by figures or letters.

ART. 14. **Numeration** is the art of reading numbers expressed by figures or letters.

The term **Notation** is commonly used to denote the writing of numbers by figures; and **Numeration**, the reading of numbers expressed by figures.

ART. 15. The successive figures which express a number denote successive *Orders of Units*. These orders are numbered from the right, as *first*, *second*, *third*, *fourth*, and so on.

ART. 16. A figure standing in the first order denotes ones or *units*; in the second order, *tens*; in the third order, *hundreds*; in the fourth order, *thousands*; in the fifth order, *ten-thousands*; in the sixth order, *hundred-thousands*, etc.

ART. 17. The successive orders of units are divided into groups of three orders each, called *Periods*, as shown in the following table:

Hundred-trillions.	Ten-trillions.	Trillions.	Hundred-billions.	Ten-billions.	Billions.	Hundred-millions.	Ten-millions.	Millions.	Hundred-thousands.	Ten-thousands.	Thousands.	Hundreds.	Tens.	Units.
5	5	5	4	4	4	3	3	3	2	2	2	1	1	1
}			}			}			}			}		
5th Period.			4th Period.			3d Period.			2d Period.			1st Period.		
Trillions.			Billions.			Millions.			Thousands.			Units.		

NOTE.—The name of the sixth period is *Quadrillions*; the seventh, *Quintillions*; the eighth, *Sextillions*; the ninth, *Septillions*; the tenth, *Octillions*, etc.

ART. 18. The three orders of any period, counting from the right, denote, respectively, *units*, *tens*, and *hundreds* of that period. The first three orders express units, tens, and hundreds of *units*; the second three orders, units, tens, and hundreds of *thousands*; the third three orders, units, tens, and hundreds of *millions*, etc.

ART. 19. The **Value** of a figure is the number which it expresses; and this depends on the order in which the figure stands.

The value of each of the successive figures which express a number is a *Term*. The terms of 325 are 3 *hundreds*, 2 *tens*, and 5 *ones*.

ART. 20. **Principles.**—1. Ten units of the first order equal one unit of the second order; ten units of the second order equal one unit of the third; and, generally, *ten units of any order equal one unit of the next higher order.* Hence,

2. *The removal of a figure one order to the left multiplies its value by ten, and the removal of a figure one order to the right divides its value by ten.*

The successive figures which express a number are written on a scale of ten.

ART. 21. **Rule for Notation.**—*Begin at the left, and write the figures of each period in their proper orders, filling all vacant orders and periods with ciphers.*

ART. 22. **Rule for Numeration.**—1. *Begin at the right, and separate the number into periods of three figures each.*

2. *Begin at the left, and read each period containing one or more figures as if it stood alone, adding its name.*

NOTES.—1. The name of the units' period is usually omitted.

2. In reading numbers, it is not necessary to connect the terms of a period or the successive periods with "and." 405,020 may be read *four hundred five thousand twenty.* The use of "and" is not, however, incorrect. 405,020 may be read *four hundred and five thousand and twenty;* and this reading is in accordance with general usage. (Art. 116, note 3.)

A D D I T I O N .

O R A L E X E R C I S E S .

1. Add by 3's from 1 to 100; thus: 1, 4, 7, 10, etc.
2. Add by 4's from 3 to 51; from 51 to 99.
3. Add by 5's from 2 to 52; from 52 to 102.
4. Add by 6's from 1 to 49; from 49 to 97.
5. Add by 6's from 2 to 50; from 50 to 98.
6. Add by 7's from 3 to 52; from 52 to 94.

7. Add by 7's from 4 to 53; from 53 to 95.
8. Add by 8's from 5 to 53; from 53 to 93.
9. Add by 8's from 2 to 50; from 50 to 98.
10. Add by 9's from 1 to 55; from 55 to 100.

WRITTEN EXERCISES.

11. Add 347, 4086, 7080, 29408, and 67736.
12. $667 + 3804 + 45608 + 304867 + 87609 =$ what?
13. Add four thousand fifty-six; sixty-three thousand seven hundred; seven million nine thousand ninety-nine; and fifty-six million nine hundred seventy-eight.
14. Add eight million eighty thousand eight hundred; seven hundred thousand and seventy; five million eighty-six thousand seven hundred and eight; and sixty million six hundred thousand and seventy.
15. A grain dealer bought wheat as follows: Monday, 2480 bushels; Tuesday, 788 bushels; Wednesday, 1565 bushels; Thursday, 2684 bushels; Friday, 985 bushels; Saturday, 3867 bushels. How many bushels did he buy during the week?
16. The value of the property of a certain university is as follows: endowment fund, \$340,000; land, \$59,000; college building, \$155,817; steam, water, and gas fixtures, \$35,655; apparatus, cabinets, and other appliances, \$22,562; other improvements, \$39,624. What is the total value of the property?
17. Ohio contains 41060 square miles; Indiana, 36350; Illinois, 56650; Michigan, 58915; Wisconsin, 56040; Minnesota, 83365; Iowa, 56025; and Missouri, 69415. What is the total area of these eight states?
18. The population of these states, in 1880, was as follows: Ohio, 3198062; Indiana, 1978301; Illinois, 3077871; Michigan, 1636937; Wisconsin, 1315497; Minnesota, 780773; Iowa, 1624615; Missouri, 2168380. What was their total population?

19. The territory of the United States has been acquired as follows:

	SQ. MILES.
Territory ceded by England, 1783,	866391
Louisiana, acquired from France, 1803,	862922
Florida, acquired from Spain, 1821,	58680
Texas, admitted to the Union, 1845,	365573
Oregon, settled by treaty, 1846,	298804
California, etc., conquered from Mexico, 1847,	515764
Arizona, acquired from Mexico by treaty, 1854,	57466
Alaska, acquired from Russia by purchase, 1867,	577390

What is the total area of the United States?

ADDITION OF TWO COLUMNS

ART. 23. There is a practical advantage in adding two columns at one operation. Some accountants add three or more columns in this manner.

20. Add 67, 58, 43, 36, and 54.

PROCESS.

67	Add thus: $54 + 30 = 84, + 6 = 90; 90 + 40 = 130,$
58	$+ 3 = 133; 133 + 50 = 183, + 8 = 191; 191 + 60 =$
43	$251, + 7 = 258.$
36	Or thus, naming only results: 54, 84, 90; 130,
54	133; 183, 191; 251, 258.
258	

NOTE.—The process consists in first adding the tens of each couplet, and then the units. If preferred, the units may first be added, and then the tens. Sufficient practice will enable the accountant to add two columns without separating the numbers into tens and units.

21. Add 37, 40, 63, 84, 67, 22, and 70.

22. Add 95, 36, 77, 66, 88, 63, 33, and 44.

23. Add 67, 76, 45, 54, 38, 83, 27, and 72.

24. Add 68, 86, 97, 79, 86, 68, 78, and 87.

25. Add 45, 60, 57, 86, 83, 76, 49, 58, and 84.
 26. Add 56, 75, 83, 96, 69, 37, 73, 38, and 205.
 27. Add 27, 72, 33, 38, 69, 96, 75, 57, and 336.
 28. Add 235, 88, 77, 66, 55, 44, 33, 22, and 11.
 29. Add 405, 56, 43, 47, 74, 38, 63, 75, and 66.
 30. Add 46, 67, 72, 38, 99, 87, 65, 74, and 88.
 31. Add 73, 86, 47, 56, 69, 65, 58, 33, 52, and 94.

32. A drover bought 37 sheep of one farmer, 44 sheep of another, 48 sheep of another, and 27 sheep of another: how many sheep did he buy?

33. The Senior class of a college contains 27 students, the Junior class 34, the Sophomore class 38, and the Freshman class 46: how many students in the college?

34. A lady paid \$36 for a carpet, \$34 for a bureau, \$16 for a washstand, \$28 for a bedstead, and \$42 for chairs: how much did she pay for all?

35. A man paid \$85 for a horse, and \$17 for his keeping; and then sold him so as to gain \$15: for how much did he sell the horse?

DEFINITIONS, PRINCIPLES, AND RULE.

ART. 24. The **Sum** of two or more numbers contains as many units as all the numbers taken together. It is also called the *Amount*.

ART. 25. **Addition** is the process of finding the sum of two or more numbers.

ART. 26. An **Arithmetical Sign** is a character which denotes an operation with numbers, or a relation between them.

The **Sign of Addition** is a vertical cross [+]. It is read *plus*, which means *more*.

The **Sign of Equality** is two short horizontal parallel lines [=], and is read *equals* or *is equal to*. Thus, $7 + 8 = 15$ is read *7 plus 8 equals 15*.

ART. 27. **Like Numbers** are composed of units of the same kind or order. Thus, 4 steps and 8 steps are like numbers; also 4 dimes and 8 dimes; 4 tens and 8 tens; 4 and 8.

ART. 28. **Principles.**—1. *Only like numbers can be added.*
2. *The sum is of the same kind or order as the numbers added.*

ART. 29. **Rule.**—1. *Write the numbers to be added so that figures denoting units of the same order shall be in the same column, and draw a line underneath.*

2. *Beginning with units, add each column, and write the sum, when less than ten, underneath.*

3. *When the sum of any column exceeds nine, write the right-hand figure under the column added, and add the number denoted by the left-hand figure or figures with the next column.*

4. *Write the entire sum of the left-hand column.*

NOTE.—See appendix for method of proof by “casting out the 9’s.”

SUBTRACTION.

ORAL PROBLEMS.

1. Count by 4's from 61 back to 1; thus: 57, 53, etc.
2. Count by 6's from 53 back to 5; from 74 back to 2.
3. Count by 7's from 66 back to 3; from 85 back to 1.
4. Count by 8's from 75 back to 3; from 94 back to 6.
5. Count by 9's from 73 back to 1; from 96 back to 6.
6. Count by 9's from 94 back to 58; from 58 back to 4.
7. A man sold a horse for \$95, which was \$28 more than the horse cost him: what was the cost of the horse?

8. Two men start at once from the same point, and travel in the same direction, one traveling 52 miles a day, and the other 39 miles: how far will they be apart at the close of the first day?

9. A man earns \$85 a month, and pays \$18 for house rent, and \$35 for other expenses: how much does he save each month?

10. A gentleman being asked his age said, that if he should live 27 years longer, he should then be three score and ten: what was his age?

11. From a piece of carpeting containing 68 yards, a merchant sold 27 yards to one man and 18 yards to another: how many yards of the piece were left?

12. A man bought a carriage for \$135, paid \$21 for repairing it, and then sold it for \$170; how much did he gain?

13. A boy earned 65 cents, and his father gave him 33 cents; he paid 45 cents for an arithmetic, 15 cents for a slate, and 12 cents for pencils: how much money had he left?

WRITTEN PROBLEMS.

14. A builder contracted to build a school-house for \$25460, and the job cost him \$21385: what were his profits?

15. The earth's mean distance from the sun (old value) is 95274000 miles, and that of Mars is 145168136: how much farther is Mars from the sun than the earth?

16. The population of Illinois, in 1880, was 3077871, and in 1865 its population was 2141510: what was the increase in fifteen years?

17. The population of Massachusetts, in 1880, was 1783085, and in 1865 it was 1267031: what was the increase in fifteen years?

18. The area of the Chinese Empire is 4553102 square miles, and the area of the United States is 3602990 square miles: how much greater is the Chinese Empire than the United States?

19. The area of Europe is 3928252 square miles: how much greater is Europe than the United States? The Chinese Empire than Europe?

20. In 1880, Ohio produced 112681046 bushels of corn, and Illinois 327796895 bushels: how many bushels did Illinois produce more than Ohio?

21. A man bought a farm for \$5867, and built upon it a house at a cost of \$1850, and then sold the farm for \$7250: how much did he lose?

22. An estate of \$13450 was divided between a widow and two children; the widow's share was \$6340; the son's, \$1560 less than the widow's; and the rest fell to the daughter: what was the daughter's share?

23. A man deposited in a bank at one time \$850, at another, \$367, and at another, \$670; he then drew out \$480, and \$375: how much money had he still in bank?

24. A man bought a farm for \$6450, giving in exchange a house worth \$4500, a note for \$1150, and paying the difference in money: how much money did he pay?

25. A grain dealer bought 15640 bushels of wheat, and sold at one time 3465 bushels, at another, 4205, and at another, 1080: how many bushels remained?

26. From the sum of 45003 and 13478, take their difference.

DEFINITIONS, PRINCIPLES, AND RULE.

ART. 30. **Subtraction** is the process of taking a less number from a greater.

The **Minuend** is the number from which the less number is taken.

The **Subtrahend** is the number taken from the minuend.

The **Difference** is the number obtained by subtracting.

The difference is the number of units in the minuend more than in the subtrahend. When the subtrahend is a part of the minuend, as in division, the difference is called the *Remainder*.

ART. 31. The **Sign of Subtraction** is a short horizontal line $[-]$, and is read *minus* or *less*. Thus, $12-5$ is read 12 *minus* 5 or 12 *less* 5.

ART. 32. **Principles.**—1. *A number can be subtracted only from a like number.*

2. *The minuend is the sum of the subtrahend and difference.*

3. *If the minuend and subtrahend be equally increased, the difference will not be changed.*

ART. 33. **Rule.**—1. *Write the subtrahend under the minuend, placing units under units, tens under tens, hundreds under hundreds, etc.*

2. *Begin at the right, and subtract each term of the subtrahend from the term above it, and write the difference underneath.*

3. *When any term of the subtrahend is greater than the term above it, add 10 to the upper term, and then subtract, and write the difference underneath.*

4. *When 10 has been added to the upper term, add 1 to the next higher term of the subtrahend before subtracting.*

Proof.—*Add the remainder and subtrahend; if their sum is equal to the minuend, the work is correct.*

NOTES.—1. The adding of 10 to a term of the minuend and 1 to the next higher term of the subtrahend, increases the minuend and subtrahend equally, and hence does not affect the difference (Prin. 3).

2. Instead of adding 1 to the next term of the subtrahend, 1 may be subtracted from the next term of the minuend.

MULTIPLICATION.

ORAL PROBLEMS.

1. There are 24 hours in a day: how many hours in 7 days? In 9 days? 11 days? 20 days?

2. There are 60 minutes in an hour: how many minutes in 8 hours? In 12 hours? 10 hours? 7 hours? 15 hours? 20 hours?

3. If a man earn \$63 a month, and spend \$48, how much will he save in 1 month? In 5 months? 6 months? 8 months? 12 months?

4. If 12 men can do a piece of work in 15 days, how long will it take one man to do it?

5. If 35 bushels of oats will feed 8 horses 25 days, how long will they feed one horse?

6. Two men start from the same place and travel in opposite directions, one at the rate of 28 miles a day, and the other at the rate of 32 miles a day: how far will they be apart at the end of 1 day? At the end of 5 days? At the end of 10 days?

7. A drover bought 15 sheep at \$4 a head, and sold them at \$6 a head: how much did he gain?

8. A merchant bought 12 suits of boys' clothes at \$15 a suit, and sold them at \$18 a suit: how much did he gain?

9. A cask has two pipes, one discharging into it 90 gallons of water an hour, and the other drawing from it 75 gallons an hour: how many gallons of water will there be in the cask at the end of 12 hours?

10. A farmer sold to a grocer 15 pounds of butter at 30 cents a pound, and bought 8 pounds of sugar at 15 cents a pound, and 9 pounds of coffee at 20 cents a pound: how much was still due him?