INTRODUCTORY MENTAL ARITHMETIC FOR PUPIL TEACHERS AND ADVANCED PUPILS OF MIDDLE-CLASS AND ELEMENTARY SCHOOLS

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INTRODUCTORY MENTAL ARITHMETIC

FOR

PUPIL TEACHERS

AND

THE ADVANCED PUPILS OF MIDDLE-CLASS AND
ELEMENTARY SCHOOLS;

BEING

A SHORT EXPOSITION OF THE USES OF MENTAL ARITHMETIC,

WITH ILLUSTRATIVE EXAMPLES,

AND A GREAT NUMBER OF NEW AND ORIGINAL EXERCISES.

BY

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MENTAL ARITHMETIC.

INTRODUCTION.

I.

THIS little book seeks as much to indicate the manner in which Mental Arithmetic may be used as to provide young teachers with Exercises to be worked by their pupils.

It is necessary to explain that we consider the chief uses of Mental Arithmetic to be—

1st. *To give Facility in Computation* by teaching children to dispense with the slips of paper they are apt to use in making even easy calculations.

2nd. *To impress on the memory of the pupils any numbers which it may be desirable they should remember*, such as the length of a river, the date of a battle, &c., &c.

3rd. *To lead up to and to introduce all new Rules in Arithmetic*, thus proceeding from the known to the unknown. As an Exercise in inductive reasoning this use of Mental Arithmetic is perhaps the chief.

4th. *To illustrate and confirm the Rules of Arithmetic thus found.* Here it is particularly useful, because by it a teacher can ascertain almost in a moment how many of his class have understood his exposition of a Rule.

5th. *To provide short methods of finding required results.* This branch of the subject is more dealt with in the author's "Mental Arithmetic for Training Colleges;" it will, however, be slightly dealt with here.

6th. *To develope and strengthen the Reasoning Faculties of pupils.*
This it does by teaching them to reason out Rules from the
teaching of particular Examples, to apply these Rules to
new Exercises, and to disentangle problems. It also cul-
tivates the Memory by causing the pupils to remember the
Rules and the numbers involved in Exercises, as well as—in
the case of oral questioning—the Exercises themselves.

II.

These different *uses* will form the subjects of the Chapters into
which this book is divided. In

CHAPTER I. will be found Examples and Exercises intended to give
pupils a *power* and *facility* of finding, by Mental
Arithmetic, results which—if left to themselves—
they would seek to find by paper work. In

CHAPTER II. will be given Examples and Exercises of the Second
Use mentioned above. It may be called "*Incidental
Mental Arithmetic.*"

CHAPTER III. will contain an Example showing the inductive
process by which it is here proposed to teach all
the ordinary *Rules* of Arithmetic, and Exercises
on the Elementary Rules of Arithmetic as far as
Simple Proportion. This Chapter will therefore
attempt to attain the 3rd and 4th uses mentioned
above, and may be termed "*Inductive Mental
Arithmetic.*"

CHAPTER IV. will contain a few short and easy Rules of Mental
Arithmetic, and Exercises upon them.

CHAPTER V. will consist of Miscellaneous Examples and Exercises
intended, as far as possible, to examine upon all the
preceding Chapters, and at the same time to furnish
some additional problems to be solved by methods
which the pupils can find for themselves.

III.

We can recommend some such plan as the following for making
use of this book:—Provide each pupil with a slip of paper numbered
according to the number of questions it is proposed to ask; then,

with young pupils, write the Exercise on a Black Board, and suddenly present it to the class, requiring them to write their answers opposite the number of the question to which it refers. With more advanced pupils, read out the question once or twice, as it is thought necessary, instead of writing the questions on a Black Board.

To cultivate brilliancy and rapidity, divide the class into sections pretty well matched for ability, put question after question orally, take an answer only from the first boy who puts his hand up, and if his answer be correct let that be counted ONE to his section, and let that section be accounted the winner which first scores a given number, say SIX. Let it always be remembered, however, that such plans as this last cultivate sharpness rather than solidity, and that, unless modified according to circumstances, the struggle will almost always lie between some five or six children, the rest being simply spectators.

When each child is provided with a text-book, the above plans may be modified by requiring the pupils to find a certain page, and then calling upon some particular pupil to give the answer to a certain sum upon that page. Many other plans and modifications of these will suggest themselves to teachers; we merely give these as suggestions.

IV.

The Exercises provided in this little book will sufficiently indicate their own purpose, viz., *not* so much to supply a number of *easy* problems such as any moderately well-informed boy or girl could frame at a moment's notice, as to provide Exercises of a more difficult character for the use of advanced pupils and all Pupil Teachers. As far as possible, the aim of the Exercises—especially the Miscellaneous Exercises—is to cultivate not only a power of finding results in Arithmetic with ease, rapidity, and certainty, but also a *power of applying the mind to the solution of difficult problems.* For this reason most of the questions deal with Concrete numbers, and we may here observe that the teacher will do well—especially with young children—to frame all his Mental Arithmetic questions on Concrete numbers, and, when possible, to make them interesting and lively, and even laughable.

CHAPTER I.

1. THE EXTENDED MULTIPLICATION TABLE—*i.e.*, from 13 to 24.

The children should be taught these tables in a manner somewhat similar to the following :—

Specimen of Teaching *—

(1.) *Twelve twos* = ? 24 + 2 = ?   ∴ Thirteen twos = ?   ∴ Two thirteens = ?

(2.) If there are two rows of boys, each containing 13, there are altogether —— ?

(3.) If one horse be worth 2 donkeys, thirteen horses are worth —— donkeys?

Therefore, THIRTEEN TWOS ARE 26.

2. THE EXTENDED PENCE TABLE.

Specimen of Teaching—

(1.) *Twenty pence* = ? ∴ 30d. = ? 20 + 30 = ? 1s. 8d. + 2s. 6d. = ? ∴ 50d. = ? ∴ 100d. = ?

With advanced pupils, continue as follows :—

∴ 1000d. = ?   ∴ SIX THOUSAND PENCE = £25.

(2.) Again, *Twelve pence* = ? and, 12 × 10 = ? ∴ 120d. = ? 120 × 10 = ? ∴ 1200d. = ? and 1200 × 5 = ? ∴ SIX THOUSAND PENCE = ?

And *vice versa*—

(1.) *One shilling* = 12 *pence*, ∴ 10s. = ? ∴ £1 = ? ∴ £1, 10s. = ? ∴ £3 = ?

Therefore, THREE POUNDS = **720**d.

(2.) *One shilling* = 12 *pence*, ∴ 3s. = ? ∴ 30s. = ? ∴ 60s., *i.e.*, £3 = ?

Therefore, THREE POUNDS = HOW MANY PENCE?

Observe, that by two different processes we found the value of *six thousand pence* and *the number of pence in £3*. In practice it would be well to find such values in SIX or EIGHT different ways, until, in fact, the teacher observes that most of the pupils remember just what he wishes them to know—*e.g.*, *that* 6000d. = £25.

After a great many such lessons as these, the pupils will be ready to learn by heart the Extended Multiplication and Pence Tables; but the young teacher must carefully remember that he is not to require his pupils to commit these to memory before they have been taught them thoroughly by such oral teaching as has been exemplified above.

3. THE TABLES OF ALIQUOT PARTS AND THEIR USES.

Specimen of Teaching—

(1.) *Six shillings* × 3 = ? and, *Eight pence* × 3 = ? ∴ (6s. × 3) + (8d. × 3) = ? ∴ 6s. 8d. × 3.

(2.) 80 × 3 = ? and 24d. = How many shillings? And 24d. × 10 = How many pence? ∴ 240d. = ?

But 80d. = 6s. 8d. ∴ 6s. 8d. × 3 = ?

(3.) The price of 3 hats at 6s. 8d = ? ∴ The price of 6 hats = ?

Therefore, ONE-THIRD OF £1 = 6s. 8d., or

THREE TIMES 6s. 8d. = ONE POUND.

4. MULTIPLICATION BY 12 AND BY 20.

Ex. 1. £3, 2s. 4½d. × 12.

Specimen of Teaching—

Working such a sum as this on the B. B., the children begin thus :— 2f. × 12 = 24f. = 6d. Carry 6. 4d. × 12 = 48d., and 48d. + 6d. carried = 54d. = 4s. 6d. Set down 6 and carry 4. Having got as far as this, let the teacher begin thus :—

One penny × 12 = one shilling ∴. **2** pennies × 12 = ? and, **3** pennies × 12 = ? and, **4** pennies × 12 = ? and, half-a-penny × 12 = ?
∴. 4½d. × 12 = ?

Ex. 2. £3, 5s. 6d. × 20.

5s. 6d. = 5½s.   Now, **one shilling** × 20 = **one pound.**
Therefore, as above, 5½ shillings × 20 = 5½ pounds = £5, 10s.

N.B.—The process will be reversed for Division. Arithmetic is full of such examples; let the teacher look for them carefully, for children like such little "dodges" immensely, and they are very useful in business.

The one golden rule in all these lessons is "*tell* the children as *little* as possible, but teach them to find out as much as possible."

Exercise 1.*

1. What is the value of 19 cows at £20 each ?
2. If a cow is worth 7 sheep, 23 cows are worth —— sheep?
3. Six bags of potatoes contain in all 648, how many in each bag?
4. What is the price of 7 yd. of calico at 10d. per yard ?
5. Thirteen pounds of salt at ¾d. per lb, ?
6. If 3 lb. of potatoes cost 2d., how many lb. for 1s. ?
7. If 2 lb. of tallow cost 1s. 3d., what is the price per lb. ?
8. If 2 cabbages cost 1¾d., what is the price of 6?
9. What is tea per oz, when 3 oz. cost 10½d. ?
10. What is the price of an egg when 1 doz. cost 1s. 9d. ?
11. If 1 pear be worth 3 plums, how many plums are worth 2 pears and 3 plums?
12. How many oranges are worth 9 pears and a penny, if 1 orange is worth 3 pears, and you can buy 2 oranges for a penny ?
13. A house and a piece of land are sold for £100. If the land is valued at £30, what was the price of the house ?
14. Fifteen new bonnets at 10s. each ?
15. Six ton of coal at £1, 10s. a ton ?

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* All the Exercises are intended as much to afford models for the teacher in asking questions as to form actual Exercises for the pupil.