ARITHMETIC.

(*Continued.*)

At every stage of the pupil's advancement in arithmetic the following three things should *never be lost sight of*: 1st. A correct knowledge of the principles of numbers. 2nd. How to work numbers with celerity and correctness. 3rd. Their multifarious applications.

These three things should be perseveringly attended to, from the very beginning of arithmetical training.—In doing this the language and manner of the teacher should be such as to suit the scholar at each degree of advance, and the progressive increase of his knowledge. At first, to be successful, there must be great plainness, so as to make the language level with his capacity; and the utterance should be distinct, bland and telling. This is *a part of the art of teaching* far too little studied by *our educators*. Yet it is one of the most special, and of the very first that should be particularly studied. Unless a teacher's language be studiously accommodated to the capacity and knowledge of his pupil, how can he expect success? Of what value is instruction if imparted in language not understood, or but very imperfectly comprehended? Of what value is an explanation, or an illustration, if the master's ideas are so expressed as not to bring the thing explained within the reach of the child's *capacity, or if his knowledge of the subject*, a part of the subject under illustration, is *not sufficient* to make the illustration clear to him—so well understood as intelligently *to* enable him to do the thing himself?—How often happens it that the use of a single word not well understood or part of an explanation out of place, or not commenced *at the* proper starting point, perplexes the student, and mystifies what was intended to be made plain—comprehensible?—Verily teaching and expounding are of no avail, except so far as they benefit the scholar, throw light on his path, and enable him, by his own steady efforts, to profitably advance.—Teachers, look well to your language, *to* your words,—to their choosing and using. Study well the proper starting points of every part of your instructions. All the parts of instruction should have their legitimate sequence —each brought up and carried on in its right place.

Remember that the teacher's language requires a teaching character—as well as his mind a teaching mould. However distinct may be our views, however vivid our conceptions, however correct and extensive our knowledge of the subject we teach, how often do we fail in calling up words, and *momently* divising forms of expression faithfully to pourtray our thoughts and sentiments, enabling us successfully to effect our object? This is a thing of daily occurrence with the best educators: much more must it be so with those beginning the profession.

Let us now proceed and give a few farther hints on teaching the fundamentals of Arithmetic.

Pupils should have now reached a stage to admit of giving a still farther variety of examples. The clearer and more correct their knowledge of the properties of numbers is, the better will they be prepared for the business applicative parts of arithmetic. It is very important that, as they advance, as much *light* as possible be thrown on the relations of numbers in multiplying and dividing them. Rightly to understand and masterly to know *them in calculating, is* of vast advantage to them. The more their knowledge on these various relations is enlarged, the more are their minds brought under the guidance of reason, the more does arithmetic become to themselves a training instrument; and the more does their own independent working capacity strengthen, —thus hastening on development and a rational well-grounded advancement.

Multiplication and Division.

The relations between multiplier, multiplicand, and product; and between divisor, dividend and quotient should by little and little, be expounded and examplified to them—making each of the illustrations suit each stage of mental development and acquired knowledge. Let me direct attention to a few of the most suitable at this stage.

1. To increase or lessen the products of numbers, we increase or lessen the multipliers. For example. Multiplying 32 by 4 gi'es 128. Now it is evident that multiplying by 3 times 4, or 12, would give three times this answer, i, e, 384; $32 \times 12 = 384$. *Again*, if we lessen the multiplier 4 by 2, we have $32 \times 2 = 64 = \frac{128}{2} = 64$ equal to half the first product. Illustrate these relative properties till well understood, and the scholars are able readily to work processes. Begin with numbers which their minds can comprehend: as 6 by 2, 8 by 5, 10 by 6, &c. and reason on each example, *till*, in turn, they can correctly reason to you. Then give them examples to be worked, and to exercise their own minds upon them, that they may be able to explain to you when called up. Then, when this exercise is well understood, how the product is affected by increasing or diminishing the multipliers, show by illustrations how it is increased or decreased by increasing or decreasing the multiplicand, as follows:

$$3)\ \underline{24 \times 5 = 120}$$
$$8 \times 5 = 40 = \frac{120}{3} = 40 = \tfrac{1}{3} \text{ of the product of 24 by 5.}$$

Again: $24 \times 5 = 120$, and 24 increased by $3 = 72$, and multiplied by 5 is $360 = 120 \times 3 = 360$. Multiplied $425 \times 12 = 5100$; double the multiplicand $425 = 850 \times 12 = 10200 \div 2 = 5100, =$ to the first product.

Where they well understand how products are thus increased and decreased in proportion to the increase or decrease of the factors; show that if one factor is increased as many times as the *other is diminished* the product remains unaltered. *Ex.* 9 multiplied by $6 = 54$; the double of 9 is 18; and the half of 6 is 3: 18 multiplied by 3 is 54, the same product; for as 9, the multiplicand, is increased so the 6, or multiplier, is decreased. · Ex. Multiply 25 by 14; the product is 350; increase the multiplier 5 times, and decrease the multiplicand 5 times; the product will be the same, viz., 350: for 5 times 14 is 70, and the fifth of 25 is 5. 70 multiplied by 5 is 350, the same product as 25 multiplied by 14.

Farther Exercises.

N. B. *Place a factor in each of the vacant spaces*, so that the products shall be equal.

$5 \times 9 = \frac{9}{3} \times (\quad)$; $16 \times 12 = (\quad) \times \frac{12}{4}$; $49 \times 3 = \frac{49}{7} \times (\quad)$.
$18 \times 6 = 2 \times 6 \times (\quad)$; $36 \times 8 = \frac{36}{4} \times (\quad)$; $350 = 17 = \frac{350}{10} \times (\quad)$.

2. *Observe that* to obtain the same quotient in dividing by different divisors, both the divisor and dividend, must be increased or diminished by the same figures, i. e, they must be equally increased or decreased; as may be required: for example $72 \div 12 = 6$ quotient. If I double the 72 I must also double the 12 to get the same quotient, viz. 6. If I lessen the 72, dividing it by $4 = 18$, the divisor 12 must, to get the same quotient, be also divided by $4 = 3$; and $18 \div 3 = 6$, the same quotient, as $72 \div 12$ gives.—Again, if I wish to give a multiplicative increase to the quotient 6, I have to give a proportionate decrease to the divisor, as follows: dividing 96 by 8 gives 12 quotient; I wish to increase the quotient 12 three times $= 36$: to get this quotient by the same dividend, (96,) the divisor must be 3 times less, namely $\frac{8}{3} = 2\frac{2}{3}$; and 96 divided by $2\frac{2}{3}$ gives 36, the quotient required; or the dividend may be increased, instead of the divisor decreased, by three, thus $96 \times 3 = 288 \div 8 = 36 =$ the quotient required.

3. In every Division sum the dividend is the product, of which the divisor and the quotient are the two factors.—

In multiplication, multiplier × multiplicand = product;

In division, quotient × divisor = dividend: therefore every truth which can be asserted of the parts of a multiplication sum, can be asserted in another form which will be applicable to division.