"HE THAT IS IGNORANT OF NUMBERS IS SCARCE HALF A MAN."

CHARLES XII. OF SWEDEN.

In the present attempt to convey to the minds of some of your readers, a slight knowledge of mathematical science, both as regards measurements by numbers (arithmetic) and measurements by dimensions (geometry), the sketch I offer of each is necessarily brief and imperfect; but my end will be gained if I afford that amount of information on the subject which is generally possessed by persons of moderately well cultivated intellect.

A recognition of the value of numbers is coeval with the dawn of mental cultivation in every community. But considerable *progress* must be made before methods of *reckoning* are reduced to a regular system, *and* a notation adopted to express *large* and complex quantities.

An inability to *reckon* beyond a few numbers is always a *proof* of mental obscurity; and in this state *various* savage nations have been discovered *by* travelers. Some are found to be able *to* count as far as five, the digits of the *hand* most likely familiarizing them with that number; but any further quantity is rather said to consist of so many fives, or is expressed by the more convenient phrase, "a great many."

Among our various Indian tribes any great number which the mind is incapable of distinctly recognizing and naming, is figuratively described by comparing it to the leaves of the forest, and in the same manner the untutored negro of Africa would define any quantity of a vast amount by pointing to a handful of sand of the desert.

In the first advance of any early people toward civilization, it would be found impossible to give a separate name to each separate number which they had occasion to describe. It would, therefore, be necessary to consider large numbers as only multiplication of certain smaller ones, and to name them accordingly.

This is, no doubt, what gave rise to classes of numbers, which are different in different countries. For instance, the Chinese count by twos, the ancient Mexicans reckon by fours; some count by fives. The Hebrews, from an early period, reckoned by tens; the Greeks adopted this plan; from the Greeks it came to the Romans, and by them was spread over a large part of the world. The Hebrew improved, and Grecian and Roman numbers were perhaps sufficient to express any single number.

The Greeks certainly contrived to overcome many obstacles in the business of calculation, and even could express fractions. In fact, the Romans were obliged, where mental cal*culation would not serve, to resort to a me*chanical process for performing problems in arithmetic. A box of pebbles called *loculus*, and a board called *abacus*, constituted their means of calculation, and of these every schoolboy and many other persons possessed a set. The word calculate claims no higher descent than from *calculus*, a stone or pebble. The labor of counting and arranging the pebbles was afterward greatly abridged, by drawing across the board a horizontal line, above which each single pebble had the power of five. And afterward the whole system was made more convenient by substituting beads strung on parallel threads, or pegs stuck in grooves. Methods of calculating still used in Russia and China, and found convenient in certain departments of the Roman Catholic devotion, and in several familiar games of more civilized countries.

The numbers now in use, and the mode of causing them, by a peculiar situation, to express any number, and thereby the processes of arithmetic have been rendered so highly convenient, have heretofore supposed to be of Indian origin, transmitted through the Persians to the Arabs, and by them introduced into Europe in the tenth century, when the Moors invaded and became master of Spain.

In the eleventh century, *Gerbert*, *a benedictine* monk *of Fleury*, and who afterward ascended the papal throne under the designa*tion* of Sylvester the Second, traveled into Spain and studied for several years the science there cultivated by the Moors. Among other acquisitions he gained from that singular people a knowledge of what are now called the "Arabic Numerals," and of the mode of arithmetic founded on them, which he forthwith disclosed to the Christian world, by whom at first his learning caused him to be accused of an alliance with evil spirits.

It would be impossible to calculate even by their own transcendant power, the service which they have rendered to mankind.

The Arabic numerals take the following well-known form, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. The last, called a nought, nothing or cipher, is in reality, taken by itself, expressive of an absence of number or nothing. But in connection with other numbers it becomes expressive in a very remarkable manner. The valuable peculiarity of the Arabic notation is the enlargement and variety of values which can be given to the figures by associating them.

There are four elementary departments in arithmetic—addition, multiplication, substraction and division. Addition is the operation by which several numbers are united in one. The number thus obtained is called the sum or amount. By multiplication we ascertain what a number amounts to when repeated a given number of times; hence multiplication is a short method of addition under certain circumstances. By substraction we ascertain how much greater one number is than another, or what remains when a less number is taken from a greater, or the difference between any two numbers. By division we find how many times one number is contained in another. It is the converse of multiplication. The product and one factor being given, and the other resulting from the operation.

In this short essay, it is not *my design to* enter into a complete and full detail *of all the* different rules and regulations *of Arithmetic*, but shall pass them over *as slightly* as possible.

The rule of *three, which* has been considered by many *as being of* great and vital importance *to the* arithmetician, is simply the Rule *of Ratio*, which we now call Proportion.

Ratio is the relation which one quantity bears to another of the same kind, with respect to magnitude; or the ratio of two numbers is the quotent resulting from the division of the first by the second: thus the ratio of 13 to 17 is 13-:-17, and that of 65 to 85 is—

$$\frac{65}{85} = \frac{13}{17}$$

Proportion is equality of Ratio: four numbers are said to be proportionals, when the ratio of the first to the second is the same as the ratio of the third to the fourth: hence, 17, 13, 85, 65 are proportionals. The first and fourth are called the extreme terms, and the second and third are called the means. If four numbers be in proportion, the product of the extremes *is equal to that of the means.*

When the answer to a question depends upon several conditions, the process by which we effect the solution, is called Compound Proportion. The best illustration is an example, viz:

A sold to *B* 20 hogsheads of molasses, at a loss of 7 1-2 per cent; *B* sold the same to *C* and gained 20 per cent; *C* then sold the whole to *D* for $666, and thereby gained 12 1-2 per cent, how much did *A* give per hogshead for it.

In making this statement, we reason thus: Since *C*, by selling the whole for $666, gained 12 1-2 per cent, (which was 1-8 of what it cost him) he sold it for 9 parts, whereas he bought it for 8; we, therefore, put the 8 on the right of the line, and we have the statement of the cost-price to *C*. Next we perceive that *B* sold to *C* so as to gain 20 per cent (which was 1-5) of what it cost; he sold it, therefore, for 6 parts, whereas it cost him but 5; hence we place the 5 on the right of the line, and the statement, thus far, will give the cost-price to *B*. Now, we perceive that *A sold to B* at at a loss of 7 1-2 per cent, which was 3-40 of what it cost him, he therefore sold it for 37 parts, whereas it cost him 40 parts; hence we place the 40 *on the right of the line.*

SOLUTION.

	$666
9	8
6	5
37	40
20	
	160
	$26.66⅔

The rule of Proportion generally given directs the learner to reduce the terms to the lowest denomination mentioned, which, in effect, is teaching to express those terms by the greatest possible number of figures. Now the opposite of this is certainly the only rational course to pursue; that is, to express the terms of the statement by the least number of figures that the proportion will admit of. To do this, consider each lower denomination as a fraction of the next higher: thus (5 cwt., 3 qrs., and 12lbs.)=41-7 cwt. We arrive at this result by a very simple mental process; thus 12 pounds=3-7 of a quarter; then 3 3-7 quarters are 24-7 quarters, and 1 cwt.=28-7; hence 24 parts are 6-7 of 28 parts (disregarding the denominators) and, finally, 5 6-7 cwt. =41-7 cwt.

The pupil, who now adopts the course of making his solutions of as great an extent as possible, by a purely mental operation will make much greater progress than by solving his questions by the mere mechanical process of making figures; whilst, at the same time, he will thus strengthen his memory and develop the reasoning powers of his mind more in one day, than would result *from the common method of pursuing the study of this science in a week.* It should be impressed on the mind of the learner that he should accustom himself to use as few figures in the solution as possible; but, after the statement is made, the answer should be obtained simply by a mental operation.

By pursuing the course here suggested, much time will be gained, a great amount of useless labor dispensed with, and the intellectual capacities of the learner invigorated at every stage of his progress.

There is no necessity for the special rules for the solution of questions in Tare and Tret, Loss and Gain, Barter, Interest, Discount, etc., which we find in the Arithmetics generally used in our schools.

If the pupil has learned the proper exercises of his reasoning faculties, he will ascertain generally, without much assistance from the teacher, what is required, as the answer to a question, and will make his statement and solution accordingly.

It is evident that all methods of computation lies in their brevity. Hence, Algebra must be considered as one of the most important departments of mathematical science on account of the extreme rapidity and certainty with which it enables us to determine the most involved and intricate questions.

The term Algebra is of Arabic origin, and has a reference to the resolution and composition of quantities. In the manner in which it is applied, it embodies a method of performing calculations by means of various signs and abbreviations, which are used instead of words and phrases; so that it may be called a system of symbols. Although it is a science of calculation, yet its operations must not be confounded with those of arithmetic.

All calculations in arithmetic refer to some particular individual question, whereas those of algebra refer to a whole class of questions. One great advantage in algebra is that all the steps of any particular course of reasoning are by means of symbols placed at once before the eye; so that the mind, being unimpeded in *its operations, proceeds* uninterrupted from one step of reasoning to another, until the solution of the question is attained.

Symbols are used to represent *not only* the known, but also the unknown *quantities.* The present custom is to represent the *known* quantities by the first letters of the alphabet, as *a, b, c*, etc., and the unknown quantities by the last, *x, y, z.* The signs used in algebra are +, —, X, ÷, =, 2√ & 3√.

In addition, the same process is always used in algebra as in arithmetic, whenever like quantities with like signs are to be added. But it often happens that like quantities which are to be added together have unlike signs. Addition has in algebra a far more extended signification than in arithmetic; for example, to add $7a+4a$ to $8—3a$, it is evident that after $7a+4a+8a$ have been added according to the usual method, $3a$ must be substracted. Hence, the general rule as laid down by algebraists, adding of like quantities with like signs, is to add the co-efficients of *the positive terms and the negative terms;* the less sum to be substracted from the greater, and to the difference the sign of the greater must be annexed, with the common letter or letters. The multiplication is performed by multiplying, as in arithmetic, the co-efficients of the quantities, and then prefixing the proper signs, and annexing letters. In division all letters common to both quantities must be omitted in the quotient; and when the same letters occur to both with different indices, the index of the letters must be substracted from that of the dividend.

The doctrine of equation constitutes by far the most important part of algebra, it being one of the principal objects of mathematics to reduce all questions to the form of equation, and then to ascertain the value of the unknown quantities by means of their relations to other quantities, of which the value is known. Many problems which are now quickly and readily determined by being reduced to equation, used formerly to be solved by tedious and intricate arithmetical rules, and may still be found in old treatises on arithmetic, arranged under the title of Double and Single Position, False Position, Allegation, etc.

Equations receive different names according to the highest power of the unknown quantities contained *in them. The quantities of* which an *equation* is formed or composed are called its terms; and the parts that stand on *the right and left of the sign* = are called the members or *sides of the equation.* When it is desired to determine any question that may arise respecting the value of some unknown quantity by means of an equation, two distinct steps or operations are requisite. The first step consists in translating the question from the colloquial language of common life into the peculiar analytical language of the science.

The second step consists in finding, by given rules, the answer to the question, or in other words the solution to the question. Expertness and facility in performing the former operation cannot be produced by any set of rules. in this, as in many other processes, practice is the best teacher. Every new question requires a new process of reasoning. A quadratic equation means a square equation, the term being derived from the Latin *quadratus*, squared. A quadratic equation, therefore, is merely an equation in which the unknown quantity is squared or raised to the second degree. There are two kinds of quadratic equations, namely, pure and adfected. Pure quadratic equatione *are those in which* the first *power of unknown* quantity does not *appear.* Adfected quadratic equations are such as contain not only the square; but also the first power of the unknown quantities. *For the method of solving* quadratic equations, we are indebted to the Hindoos, of which a full account is in a very curious Hindoo work, entitled Baja Ganita, the principles of which I have neither time nor space to illustrate.

I now come to Geometry. which derive its name from two Greek words, signifying the earth and to measure. It is that branch of mathematical science which is devoted to the consideration of form and size, and may, therefore, be said to be the best and surest guide to the study of all science, in which idea of dimention or space is involved almost all the knowledge required by navigators, architects, surveyors, engineers, and opticians, in their respective occupation, is deduced from geometry and other branches of mathematics. All works of art are constructed according to the rules which geometry involves. The study of mathematics generally is also of great importance in cultivating habits of exact reasoning, and in this respect it forms a useful auxiliary to Logic. It has been frequently asserted, though apparently with little truth, that geometry was cultivated first in Egypt. Thales, of Miletus, who lived about 600 years before Christ, is among the first concerning whose attainments in mathematical knowledge we have any authentic information. About two centuries later the Platonic school was founded, which event is one of the most memorable epochs in the history of geometry. Its founder, Plato, made several important discoveries in mathematics, which he considered the chief of sciences. A celebrated school, in which great improvements were made in geometry, was established about 300 years before Christ. To this school the celebrated Euclid belonged. In modern times, Kepler, Galileo, Tacquet, Pascal, Huggens of Holland, Newton, and many others, have enlarged the bounds of geometry. As improved by the labors of mathematicians, geometrical science now include the following leading departments:—Plain geometry, the basis of which is the six books of Euclid's Elements, solid and spherical geometry, spherical trigenometry, the projection of the sphere, perpendicular projection, conic sections, etc. But to these main branches of the science, there are added practical mathema*tics.* Among the branches we find practical geometry, trigonometry, measurements of heights and *distance*, leveling, measuring of surface, measuring *of* solids, land surveying, calculating the strength *of material*, guaging, projectiles, fortifications, astronomical problems, navigation, etc. In such a *limited* space as the *present*, it would be altogether impossible to present even a mere outline of these numerous branches *of* general and practical mathematics.

Sept. 15, 1862. G. W. M.

PROPOSED UNIVERSAL EXHIBITION IN 1863 IN PARIS.—It is announced that a permanent Universal Exhibition will be opened in Paris in the summer of 1863, under the patronage of the Emperor. The building is to be on a grander scale than the London International Exhibition. The dimensions will be 1800 feet long, with a central dome 345 feet in height. One of the grand features is, that foreign goods will be admitted for exhibition free of duty, with liberty to re-export them, or they may be sold on the spot, paying the duties levied under the new tariff. The great inducement held out to English manufacturers is, that they will be enabled to exhibit their goods, and thereby prevent the large sale of spurious articles now going on in Paris. The capital of £600,000 has already been subscribed in France and Belgium. The building is in course of construction.

YEARLY FOOD OF ONE MAN.—From the army and navy scales of France and England, which of course, are based upon the recognized necessities of large numbers of men in active life, it is inferred that about two and one-fourth pound avoirdupois of dry food per day are required for each individual; of this about three-fourths are vegetable and the rest animal. At the close of an entire year the amount is upwards of 800lbs. Enumerating under the title of water *all the various drinks* (coffee, tea, *alcohol, wine*, etc.,) the estimated *quantity is* about 1,500 pounds in a year.

ALTERING THE CLOCK. — The Duke of Bridgewater observed that though the men dropped work promptly as the bell rang when he was not by, they were not nearly so punctual in resuming work, some straggling in many minutes after time. He asked the reason, and the men's answer was that though they could hear the clock when it struck twelve, they could not so readily hear it when struck one. On this, the Duke had the mechanism of the clock altered so as to make it strike thirteen at one o'clock, which it continues to do until the present day.