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☞ MR. EDITOR:—You would confer a favor on me, and I think on the public, by publishing this lecture. The author is one of the best Massachusetts Teachers, which is as much praise as I can bestow upon any one. For some time I have been teaching Arithmetic, essentially upon the same system, and if any one wishes to see it in practice, I shall be glad to have him call at the school. I would ask your readers to give it a careful perusal, as they will find it interesting as well as instructive.

—By the by, I should like to read the speech of my old teacher, MR. HEDGES. Can any one inform me whether it is printed and where it can be obtained.

LEWIS D. VAIL.

MR. COLBURN'S REMARKS.

Before the American Institute of Instruction, on Arithmetic.

At the close of Mr. Hedge's remarks before the American Institute of Instruction, on the subject of Arithmetic, Mr. Dana P. Colburn, Principal of the State Normal School, Providence, R. I., continued the discussion as follows:—

Mr. President, and Ladies and Gentlemen:—As it is probably the wish of all present that the discussions before this Institute shall be of as practical a character as possible, I shall avoid all mere theories, and endeavor to offer such suggestions as my experience and observation have convinced me may be of value.

The subject of Arithmetic, as I understand it, is included within these limits:—To be a perfect arithmetician, a person must, in the first place, have a knowledge of the nature and uses of numbers and of the various methods of representing them. In the second place, he must have a knowledge of the nature and uses of numerical operations and the methods of indicating and performing them. These operations are four in number, viz: addition, substraction, multiplication, and division. Thirdly and lastly, he needs, in addition to these, such mental discipline as shall enable him to determine, from the conditions of any given problem, the operations necessary for its solution.

A person with these qualifications I hold to be a perfect arithmetician; such as a teacher should strive to make of his pupils. And in trying to accomplish this, he should endeavor so to shape his course as to secure the greatest possible amount of mental discipline, the best possible habits of thought, and the best preparation possible for the active duties of life.

The first thing to be done in teaching this department is, to make the scholars acquainted with the nature and use of numbers. The idea of number is of itself an abstraction. We have then to make our pupils acquainted with an abstract idea, and, as we were told in the lecture yesterday, we can only impart abstract ideas by first presenting a representation of them in the concrete. The first idea of number then must be given by reference to visible objects, as marbles, pebbles, pens, books, &c.;—no matter what they are, if they are such as can be easily exhibited to the pupil or readily handled by him. He should apply the term '*one*' to each of these, and to a variety of other objects, absent as well as present, and to words and actions as well as things.

This might perhaps be the first lesson, I would give this great variety of illustrations, because it seems important to leave in the mind a clear idea of unity, the abstract number one, as applicable to any object, and yet independent of all. Moreover unity is the base of all numbers, and unless its nature is understood, no higher number can be comprehended.

The pupil is now prepared to pass to the next number, *two*. To teach this I would exhibit any object and let the pupil apply the term *one* to its name, as '*one book*'; then exhibit another '*one book*,' then both together. They may be called '*one book and one book*,' for the present, or we may at once give the name '*two*'; it matters not which, for it is the idea of the union of one and one which is to be taught, and words must be subordinate to ideas always. These illustrations should be extended and varied till *two* is as familiar as *one*.

Instruction should now be commenced in the various numerical operations, always presenting them first in the concrete, and illustrating each to the eye. Thus, [taking a book] 'How many books have I?' If I should get another how many should I have?—[Taking another] 'How many have I?' How many more than before I took the last? If I should put one away, how many should I then have? &c., &c.

Then without exhibiting the objects, 'How many peas are 1 pea and 1 pea? 1 pea from 2 peas leaves how many peas? 1 pea and how many peas are 2 peas?' &c., &c. And finally such abstract questions as 'How many are 1 and 1? 1 and how many are 2? 2 are how many more than 1? 1 is how many less than 2? 1 from 2 are how many? 1 from how many leaves 1? 2 less 1? 2 less how many are 1? how many from 2 leave 1?' &c., &c.

I would present this great variety of questions and exercises to insure that the pupils shall have, at the outset, a true idea of the nature and use of numbers and numerical operations; that they shall *master* each number before passing to a larger one, and be able to compare each with every preceding one. Such thoroughness is essential to all true progress, and a want of it is the cause of a greater part of the difficulties which so often beset the path of the student in this department of science. If the teacher will see to it that each step is taken at the right time, and understood when taken; that each process follows naturally from a preceding one, and is mastered when it is introduced; that the mind of the pupil is ever kept active and his attention fixed;—the pupil will never, from the beginning of his course to the end, encounter any insurmountable or formidable difficulty. The questions in abstract numbers should be given very rapidly, to secure promptness, rapidity, and accuracy of thought, and fixed attention.

Simple practical problems, (stories, they may be called, to add to their interest,) should now be given; as John had 1 cent, his father gave 1 more; after which he lost 1. He soon after found 1 by the road side, and spent one for candy, and 1 for raisins. His mother then gave him 1 for being a good boy, and again he found one. He now gave 2 to a poor old woman; and did an errand for which he received 2 cents. He spent a cent for nuts, and received one for doing an errand. He then had the misfortune to lose 1 cent, how many did he have left?

This question involves only the numbers *one* and *two*, and is so simple that the smallest pupil can comprehended and perform it, yet it requires for its solution a continuous train of thought and investigation, and reasoning processes as complete as any required in arithmetic. Every scholar who solves it as it is given, must give his individual attention to it; must follow through a continuous train of thought; must note each condition; determine what operation it requires, perform the operation, and determine what use to make of the result; in short, must concentrate his entire mental energies, for the time being, on the work he is performing. How can such work be other than valuable to him? How can it do otherwise than discipline his mind and give him intellectual strength and vigor? And what more profitable work can he be called on to perform? What work will as surely lay a foundation for real or rapid after-progress?

The other numbers should be introduced in the same manner, and similar exercises should be given in each, till the first ten numbers are learned and mastered in all their various combinations.—This done, the foundation is laid; the most difficult work accomplished. All else connected with the mechanical operations of addition and substraction, the basis of every other is but an application and extension of operations on the numbers from one to ten. The child who knows that 4 and 3 are 7, has but to know the decimal formation of the higher numbers, to know that 40 and 30 are 70; that 400 and 300 are 700; that 4 trillions and 3 trillions are 7 trillions, &c., &c: So with 5 and 4, 15 and 4, 25 and 4, 85 and 4, 35,000 and 4000, &c., &c. Again 4 from 7, 40 from 70, 4000 from 7000, 24,000,000 from 27,000,000, &c., &c., exhibit the same dependence. Again, 4 times 3, 4 times 30; 4 times 30,000, 4000 times 3, &c., &c., are further illustrations of it.

Such being the case, it is of the utmost importance that here, in the primitive operations, we should be especially thorough, and that whatever amount of time is necessary to give the pupil a mastery of this fundamental work should be given to it. These operations, which we call addition, substraction, multiplication, and division, are all of like nature, all dependent on the memory. For instance, the child knows that 4 and 3 are 7. How does he know it? He once saw 4 things, then 3 things, then the two collections combined, and by counting he found that the united collection contained 7 things. This is true whatever are the objects, and it only remains to commit it to memory. At first it may be difficult to call up the idea of 7 whenever 4 and 3 are to be added; but by continued repetitions the thing becomes so familiar that the mention of 4 and 3 suggests 7 to the mind, without conscious effort. So with all other of these primitive combinations. If I speak to you of 8 and 9, the idea of 17 flashes into your minds as instantaneously and as certainly as though I had presented it by its more abbreviated representative, its name, *seventeen*. So the child should be taught at each step of his progress. He should be drilled now on one form, now on another, till these combinations are as familiar with him as with you, and as firmly impressed on his mind as they are in yours.

These mechanical operations on the ten primitive numbers, however dry subjects of discourse they may be, and however trifling and unworthy of attention they may appear, are of the utmost importance in the science and art of Arithmetic.—They are just what the letters of the alphabet are to reading. We *expect* to have *all* our pupils acquire such a power over the letters of the alphabet as to be able to call each printed word the moment their eyes fall upon it. No one is a tolerable reader who cannot do this readily and easily, and no amount of labor necessary to give this power is regarded as too much to devote to the *primary* lessons in reading. So the child should be drilled in this department of numbers, till he has such a power over them that the instant his eye falls on the numbers to be combined, he can seize the result and use it. Anything less than this is insufficient.

This power over numbers is easily acquired as the power over the letters of the alphabet, to which I have referred. And how is that obtained? The child first learns some of the letters. Then the teacher combines them in a word, as CAT. The teacher calls the word; lets the child call it after him; points out the letters separately and lets the child distinguish each; points out the word in another place to see if the child can recognize it; requires the child to point it out and call it, now by itself, now to select it from other words;—and so he goes over it again and again, day after day if need be, till the word is *learned*. We have all been taught in some such way as this, and what a power do we possess in the art of reading! We take a book which we have never before seen, and which treats on an unfamiliar subject, yet we can call the printed words as rapidly as we can speak. Nay, more; the eye and the mind can recognize them more rapidly than the tongue can utter them. So skilled may we become in the mere mechanical art of reading that we may read pages aloud, calling every word correctly, and yet not note a single thought which has been expressed. In reading, the eye is usually in advance of the tongue. Who that reads much aloud, has not at some time or other found his eye glancing at words printed in one place, his tongue pronouncing words printed in another, and his mind dwelling on thoughts expressed by words printed in still another?

A similar course would give our pupils as great a power over numbers. Accountants often acquire it. An accountant once told me that in adding up long leger columns, he had often been surprised to find his eye at the top of the column, the result of the addition at his tongue's end, while, as far as he knew, his mind was engaged on numbers expressed between the bottom and top.

In passing to operations involving higher numbers, they should be so presented as to exhibit their dependence on the primitive ones, and to secure at once accuracy, confidence and rapidity. A thorough drill should be given upon the mechanical processes, and to insure the best possible results, the exercises should be given in a great variety of forms. I will suggest a few of them.

How many are five, nine, eight, seven, four, nine, six, eight, seven, six, eight, five, nine, three and six?

How many are twenty-four, plus eight, plus six, minus nine, minus four, plus seven, minus eight, minus five, plus seven, plus nine, plus eight, minus four, minus six, plus two?

How many are five times seven, plus one, divided by six, multiplied by nine, minus six, divided by six, multiplied by eight, plus nine, plus six, plus five, divided by seven?

Multiply three-fourths of twelve, by two-sevenths of twenty eight, add one-eighth of forty, divide by one-seventh of forty-nine, multiply by three-eighths of sixteen, and add four-ninths of eighteen.

These are but a few of the forms in which such exercises may be given. The questions should be given as rapidly as the condition of the class will allow, and scholars may be profitably exercised upon them, in connection with other work, at all stages of their progress. No very great amount of practice is necessary to give pupils a power of performing such operations as rapidly as the tongue can indicate them. I have to-day given these examples no more rapidly than I am in the habit of giving them to my own pupils, or than they are given daily in some of the Public Schools of this city.

By such exercises, pupils not only gain an almost perfect command over numerical operations, but they acquire great mental activity and quickness of thought, and a power of concentrating their undivided energies on the process they are required to follow. They must shut out from their mind, during the operation, everything which does not belong to it, or they cannot obtain the result; for if a single number or step of the operation is lost, it cannot be recalled, nor is there any time to rectify errors. Such work, then, aside from its arithmetical utility, cannot fail to give much valuable mental discipline.

The reasoning processes of Arithmetic should receive the careful attention of the teacher. They are sometimes apparently difficult and complicated, but may always be reduced to very simple elements.—Those involved in Multiplication and Division can be the most easily exhibited in such a discussion as this; and I will ask your attention to them for a few moments. Suppose that the question, 'How much will four apples cost at three cents a piece?' should be proposed to a class.—The answer promptly given will be 12 cents. 'But how do you know?' says the teacher. 'Because 4 times 3 are 12,' replies the scholar Mary.

But this is not enough. The scholar should trace clearly and state the connection between the problem and the result, 4 times 3; but he should first be led to see the deficiency of his former answer. To show him this, the teacher may reply, 'Yes, I know that 4 times 3 cents are 12 cents, and so 4 times 4 cents are 16 cents. Why do you not say 16 cents then?' 'Because the apples cost 3 cents a piece; not 4.' 'Then why not say 15 cents, because 5 times 3 cents are 15 cents?' 'Because there were only 4 apples, and they cost 3 cents apiece.' The pupil will now see that to make his reasoning perfect, he must take into account the number of apples and the price of each, and will after a little effort be able to give a perfectly rigid demonstration, similar to the following. 'If one apple cost 3 cents, 4 apples will cost 4 times 3 cents, which are 12 cents. Therefore 4 apples at 3 cents a piece cost 12 cents.'

It is much better that the scholar should thus discover this process for himself, than that the teacher should give him an arbitrary form for it, for he will better understand and appreciate his nature.—Moreover he will be thrown more fully upon his own resources, and will do more of the work for himself. It should be always borne in mind that it is work which the scholar does for himself which educates him. The work done by the teacher cannot do it. He is the best teacher who throws the most work on his pupils, and does the least direct work for them. Indeed, were it possible for a teacher to stand before his school and do nothing himself, yet keep every scholar profitably and constantly employed in performing the appropriate work of the school-room, he should do it; and he who could do it, would best deserve the title of Model Teacher.

The reasoning process now given, simple as it is, is the key to all processes in Multiplication which are required in Arithmetic, even those which depend directly on Algebraical or Geometrical principles. There is not in Arithmetic, from beginning to end, a question requiring a multiplication not depending directly on Algebra or Geometry, which does not require essentially this process. By fully mastering it, then, in its simplest form, we are preparing to refer to the same simple principles, questions apparently entirely unlike.

Thus 4 yards equal how many feet?—This question is, in works on Written Arithmetic, classed with questions in 'Reduction Descending, and a special rule is given for their solution. But it requires (the Tables being learned) no new principle, reasoning process, or operation.—Thus since one yard equals 3 feet, 4 yards must equal 4 times 3 feet, which are 12

Reduce 4 to thirds. This is classed with questions in the 'Reduction of Whole Numbers to improper Fractions,' and is honored with a new rule. The simple solution, however, is 'Since one equals three-thirds, 4 must equal 4 times three-thirds, which are 12 thirds.'

'What will 4 yards of cloth cost at 3-twentieths of a dollar per yard?' This again is thrown into a new class, viz:—'To multiply a Fraction by a Whole Number,' and has its peculiar rules. The solution is however as before. 'If one yard costs 3-twentieths of a dollar, 4 yards will cost 4 times 3-twentieths of a dollar, which are 12-twentieths of a dollar.' The list might be extended indefinitely, but cases enough have been given to show the absurdity of the common classification, or rather the absurdity of requiring scholars to burden their memories with formal arbitrary rules. I have given four questions, all, as we have seen, alike in principle, and all involving the same reasoning process; yet by the system of rules, the pupil is required to learn them as though they had nothing to do with each other. He first learns his rule for Simple Multiplication, then, after turning over a few pages, he comes to Reduction Descending, when he must learn a new rule, and how to work by it; a little further on is Reduction of Whole Numbers to Fractions, with a new rule to be learned, and a process presented as new to be mastered; as so on again to Multiplication of a Fraction by a Whole Number, when the same process is to be repeated. Now is not this unphilosophical? Does it not render the subject altogether too complicated, and impose a great amount of needless labor on the pupil?

In Division, there are two forms of reasoning process corresponding to two distinct classes of questions. One of them will be required in the solution of the question. 'How many apples at 3 cents apiece can be bought for 12 cents?' The reasoning process required is in spirit as follows:—'If for 3 cents one apple can be bought, for 12 cents as many apples can be bought as there are times 3 cents in 12 cents, which are 4 times. Therefore 4 apples at 3 cents apiece can be bought for 12 cents.'

The following questions requirie this process:

12 yards equal how many feet?

12 thirds equal how many ones?

How many yards of cloth at 3-twentieths of a dollar per yard, can be bought for 12-twentieths of a dollar.

To illustrate the other form of reasoning process, let us consider the question, If 4 apples cost 12 cents, what will 1 apple cost? The reasoning process is, If 4 apples cost 12 cents; one apple will cost one fourth of 12 cents, which is 3 cents.

The following questions require the same process, which, as will be perceived, recognizes the principle of Fractions.

What will 1-fourth of a barrel of flour cost at 8 dollars per barrel.

If 4-sevenths of a yard of cloth cost 12 cents, what will 1-seventh of a yard cost?

The processes thus hastily sketched are all which can occur in Multiplication and Division, except when we come into the province of Algebra and Geometry. They will not always assume precisely the forms which have been given, but in spirit and essence they will be the same. And they are the key to all operations in Multiplication and Division. Equally simple and general are the processes required in Addition and Subtraction. We would not be understood to say that no problem requiries the application of more than one of these processes; far from it. A problem may require several of them, or that the same process shall be many times repeated; but each process shall of itself be simple, and in all such cases the original problem can be resolved into a series of simple ones, each as simple and easy of solution as those we have given. We say, then, that these processes, are the key to all arithmetical operations, and submit the question,—Is it not better, is it not more philosophical to require our pupils perfectly to master these, and to base their work upon them, and learn every where to apply them, than to burden their memory with so many arbitrary rules and useless distinctions? In the one case we are teaching principles, developing the reasoning powers, and cultivating the whole mind; while in the other we are teaching forms and cultivating the memory only.

In Mental Arithmetic we take such a course as has been recommended. We do teach principles, we do require our pupils to follow out rigid reasoning processes. What teacher in using Warren Colburn's First Lessons ever thought of giving his pupils a rule? Yet every one praises that book as the best ever wrtten; every one who ever studied it speaks of it as the one from which he derived his most valued arithmetical knowledge and discipline. Why is this? Simply, I fancy, because it has no rulers, because it throws the pupils so much upon their own resources, compelling them to learn principles, to follow out rigid reasoning processes, and connected trains of thought, to examine and know for themselves the necessity and reason of the steps they take and the operations they perform.

When the scholar has been through Mental Arithmetic and take up Written, he seems to have entered on an entirely different field, where all that he has formerly learned is to be thrown away. At the very outset he is required to learn an arbitrary rule, then another, then another, &c., &c., learning each as a new and distinct thing, having nothing to do with any other principle or process, or with anything previously learned; when perhaps precisely the same operations may be required, and the same principles involved in all of them. Is this philosophical? What difference is there between Mental and Written Arithmetic, to require so wide a difference in our methods of teaching them? The only real difference in their nature is that in Mental Arithmetic we must retain in the mind the numbers we use and the results we obtain, while in Written Arithmetic we write them, and thus relieve the menory.

Another point which I would suggest is, that scholars ought always to prove their work for themselves, instead of verifying it by comparison with the work or answer of another I believe that the practice of placing the answers to arithmetical problems within reach of the pupil, either in the text-booh or key, is always injurious.

In the first place such tests are unpractical, for they can never be resorted to in the problems of real life. What merchant ever thinks of looking in a text-book or key, or of relying on his neighbor to learn whether he has added a column correctly, drawn a correct balance between the debit and credit sides of an account, or made a mistake in finding the amount of a bill?

When a pupil, having left the school-room, performs a problem of real life, how anxious he is to know whether his result be correct! Neither text-book nor key can aid him now, and he is forced to rely on himself and his own investigations to determine the truth or fals ty of his work. If he must always do this in real life, and if his school course is to be a preparation for the duties of real life, ought he not to do it as a learner in school? Is it right to lead him to rely on such false tests?

But the labor of proving an operation is usually as valuable arithmetical work as was the labor of performing it; and it will oftentimes make a process or solution appear perfectly simple and clear, when it would otherwise have seemed obscure and complicated.

Again, the science of Mathematics, of which Arithmetic is a branch, is an exact science; it dwells in no uncertainties, its reasonings are always accurate, and, if based on true premises, must always lead to true results. In Arithmetic, the pupil may always *know* that a certain step is a true one, and one which he has a right to take. He may know whether he has taken it correctly, and thus be certain of the truth of his first result He may be as sure of the truth of his second step and second result, and of his third and his fourth. And when he reaches the end, and obtains his final result, he may be as sure of the truth of that as of any preceding; so sure that he will be willing to abide by it and stake his reputation upon it. And the subject should always be so presented that the pupil will be forced to apply such tests, and to determine for himsalf the truth and accuracy of his processes, and thus be led to form a habit of patient investigation and just self-reliance.

With these views, then, I would do away with everything like an answer in the text-book, and with everything like a key. I would from the first throw the scholars on their own resources, and hold them strictly responsible for the accuracy of their work. Such a course, faithfully followed, would almost entirely prevent the formation of those careless habits of work which scholars so usually form.—How often may we see a scholar studying with book and slate before him in a manner something like the following. The book is open perhaps at simple addition. Every problem on the page is one in addition, and usually all the numbers in each problem are to be added together. The pupil knows this, and so, without reading the problem he is to solve, or noting its conditions, he writes all the numbers mentioned in it, adds the first column, compares the unit's figure of the result with that of the answer in the book, —if alike, right; and the second column is added; if unlike, wrong, and the whole is removed, only to be re-written as carelessly as before, or to prepare the way for the call,' Please to show me how to do this sum.'

Is not this a true representation of what has taken place again, and again, and again in our schools, and is called the study of arithmetic? But it is no study, it is caricature on study. And can we wonder that pupils who pass through our schools, subject in a greater or less degree to such influences, fail to become fitted for business pursuits and duties! Go to the Counting-room and ask the merchant if the boys who come to him from the school with the reputation of being good arithmeticians are prepared for an accountant's duties, and he will tell you that he would scarcely trust one of them to add up a leger column, or make out a simple bill. Ask him again if he follows the processes he learned at school, and he will reply that he never uses them, and has entirely forgotten them; yet he will put our school-boys to shame by rapidity and accuracy with which he performs his work; and he has acquired this power by being thrown on his own resources, by being forced to throw away all arbitrary rules, by learning to consider each example by itself, by learning to seize it in its most vulnerable point, and perform it in the readiest manner possible. So it should be in our schools.

Is it asked, 'Would you have no rules?'—I think them useless, unless for the operations depending directly on Algebra and Geometry; for so long as the scholar finds it difficult to reason out and explain fully his processes, the labor of doing it will be the most profitable which he can perform; and when it becomes perfectly easy, the whole thing will be understood, and no rule will be needed, other than that which the scholar himself will give in describing his processes.

I have thrown out these sentiments, Fellow Teachers, for your consideration. I have spoken very freely and frankly, and have endeavored to give my honest opinions and views, assured that they will receive such treatment at your hands as they may deserve.

Escape of a Nun.—Miss Josephine Blankley, a novice of the Roman Catholic Convent at Emmetsburg, Md., has effected her escape from the establishment, and the stories connected therewith have caused much excitement. It is reported that, some months since, she wished to dissolve her connection with the Sisterhood, and expressed a desire to return home. She then wrote her father a letter, which was destroyed before her eyes, and she was compelled to write another, in a different strain, declaring the satisfaction she felt in being where she was. This letter deceived her father as to the true facts in the case, and all his letters in return to his daughter were consequently handed to her unopened. Aware at length that she was a prisoner, Miss B. determined to escape, and finally succeeded in doing so by climbing through a sash over the door of her place of confinement. She then walked ten miles, to Creagerstown, where she communicated with her father, who came to her aid. These facts have been fully related by herself, and therefore perfectly reliable.—*North American.*

☞ An old lady entirely out of the hearing of the preacher's voice, at a camp meeting, being found sobbing, was asked why she wept since she could not hear the wores of the minister. "O," said she "I can see *the holy wag of his head*."

A YOUNG MAN at a social party was urged to sing a song. He replied that he would first tell a story, and then if they persisted in their demands, he would execute a song.

When a boy, he said, he took lessons in singing, and on Sunday morning he went into his father's attic to practice by himself. When in full play, he was suddenly sent for by the old gentleman.

"This is pretty' conduct," said the father, pretty employment for the son of pious parents, to be sawing boards on Sunday morning, loud enough to be heard by the neighbors. Sit down and ake tyour book.'

The young man was excused from singing the proposed song.