Arithmetic.

Arithmetic has been, and still continues to be, one of the most important subjects in the course of instruction for common school, both from a practical point of view and as a means of mental culture. Nothing need be said here as to the practical value of arithmetic, and there is no subject so ready to hand and so efficient as a means of mental discipline, especially as a basis for effecting connected thinking, as it is.

Now, since we have determined the value of arithmetic as a subject of instruction, the question arises: How shall we best utilize this subject as a means of mental furniture and as a means of mental development? The application of rules of the text to the question to be solved is not an educative method, it simply aims at the practical result and not in the best way. The method of developing rules is a good one. Another line of procedure, which I have proved satisfactory to myself is to establish the simple arithmetical principles and to work from these. The two aims being kept in view, the one strengthens and tests the other, accuracy, readiness and neatness are obtained and the mind is broadened. In this way the subject is utilized to the best advantage. I will now indicate in a general way how the subject matter of the prescribed texts may be taught.

NUMERATION AND NOTATION:—Children should express numbers below ten as one-unit, two-units, three-units, etc., not as one, two, three, etc., for these same terms apply to various groups of numbers afterwards to be formed, such as tens and hundreds. The number ten may now be presented objectively in the form of ten tooth-picks or slivers tied in a bundle, thus giving the idea of ten as being a group of ten units; then by placing first one-unit, then two-units alongside of the bundle, the idea of eleven being a ten and one-unit, of twelve being a ten and two-units, etc., will be given. When ten units have been laid along side of the bundle the children will want to group these into another bundle, and this opperation being continued they will get ten groups with ten-units in each group which they will want to put into one large bundle of ten-tens or one hundred.

In connection with notation the children should be led to consider the period as an essential part of the number, and that no figure has any value until its place from the decimal point is determined: that 0 in itself has no value but is of great use in determining the name and value of the figure or figures coming before it. Thus they will see that ten is expressed as 10, but that eleven is not expressed as 101, but as 11. The numeration and notation of hundreds may be introduced and illustrated in the same way as of tens. Exercises in writing numbers in words and figures from dictation and in reading them in all possible ways should be given.

We may now introduce different scales of notation by leading the children to see that we need not necessarily group by tens, but that we may group by any number we choose, and then familiarize them with some of the different scales. *Method of Illustration*:—Perhaps the pupils have decided that they can just as well group by eights as by tens. If so give them a number of picks, say one hundred and seventy-five, let them group these according to the decimal scale, express the number in figures on the board, and hang each group of picks over the figure representing it. Now give them the same number of picks and have these grouped by eights. They will first get twenty-one groups of eight and seven units; the groups of eight they will regroup into two groups of eight eights, and five eights. The expression of the grouping, as 257, in the octenary scale, will naturally follow. The number should then be expressed in figures on the board with the grouping of the picks above them, and comparisons made with the first grouping and its expression. The pupils will now be able to apply this knowledge of the principle of reduction to the different scales of notation, and, later on, to solving problems in business arithmetic.

Roman notation may now be introduced and practice given in all possible ways of combining these characters to represent numbers.

Some may question the advisability of attaching so much importance to the teaching of the principles of numeration and notation; but when we stop to consider the extent to which the operations upon number are based upon these principles, we see the necessity of laying the foundation for these operations broad and deep in a full intelligence of the principles.

The process of addition may be objectively illustrated by means of tooth-picks, putting together different grouping of picks and then regrouping them into one series of groups. Multiplication should be taught as the addition of equal numbers, and by examples and comparison shown to be a contracted method of addition. Clear notions about multiplying by units, tens, hundreds, etc., about carrying, and about the partial products should be given. Subtraction should be taught simply by allowing the pupils to take some objects away from a group. They will thus see that subtraction is the way of making a number smaller, not of taking one number away from another as there is only one number involved. Then by subtracting equal parts a number of times from a number, and by proper questioning, the idea of division being the subtraction of equal parts will be developed Along with these operations the multiplication and division tables should be constructed and memorized.

On the success of the teacher's effort to teach division depends the facility with which the pupils will take up fractions. Long division naturally comes before short. After the pupils have become sufficiently acquainted with the operation, each of the seven principles involved in and concerning division should be dealt with in turn, the ideas being gotten from the pupil and firmly fixed in their minds.

This part of arithmetic well taught will be more than half the battle in teaching fractions. The idea of fractional quantities should be brought out when dealing with division. A fraction expresses division and is the quotent, thus $6 \div 3$, 6-3, and 2, are the same, The idea of proper fractions will be all the more readily grasped from a knowledge of fractional modes of expressing division. Pupils should be led to see that, for example, $6+2$, 4×2, $12-4$, $16 \div 2$, and 8 are simply different forms of expression for the same number. Operations should be combined and worked in many different ways.

Example: — $24 \times 18 \div 16 \times 3 = 432 \div 48 = 9$, then express the division in fractional form, write out the factors and cancel; again express the question as a fraction and cancel without expressing the factors in full.

The pupils will see that in the process of cancellation they are simply applying one of the principles of division they