

olds are too young for formal number study. Of course, when an older pupil enters grade I he may be quite ready for number. It is very absurd to put a boy of twelve at studying systematically the number facts up to ten, when he can equally well do work in numbers up to one hundred. For the purposes of this discussion we shall suppose pupils are seven years old, that they are of average intelligence—having reached the second grade—and that they can speak English freely.

### The Old Way and the New

Now, the old-time plan was to teach first of all the reading and writing of numbers up to billions and quintillions, and, as the boys said, up to "dillions." With this went Roman notation. Then came the four simple rules with exercises that filled a slate from frame to frame. Now, all this is changed. The first study is that of numbers below ten, then that of numbers to twenty, then the group from twenty to one hundred. After this the formal rules are taught in order, but the totals usually do not go beyond the thousands. Moreover, as each of these groups is studied there are introduced quite informally the terms used in measurement, such as inch, foot, yard, square inch, square foot, mile, pint, quart, gallon, bushel, hour, day, week, month, and so on. In other words, as the truths of number are learned they are applied to problems containing the terms of measurement usually required in life. A teacher soon realizes that country children have a knowledge which many city children lack. The reverse is also true in some respects. The practical problems cannot be obtained from a book. They must grow out of life experience.

### Numbers 1-10

A simple plan is to study these in their natural order, though teachers should not ignore the fact that some of the higher combinations may be known from experience before some of the lower ones are met with. A good order of treating a number with a class is to relate it to the numbers below it in order. For example, 6 will be related to 5, then to 4, then to 3, and so on. The

relation of 6 to 5 takes such forms as 6 is one more than what number? What number put with five makes six? How many fives in six? and so on. The relation of 6 to 3 takes such forms as 6 is three more than what number? 6 is how many threes? 2 threes are how many? Three is what part of 6? etc. There is an advantage in giving problems in all the forms mentioned and in other forms that will suggest themselves, because one difficulty of a pupil is to get command of the language employed in number. And though all the problems touching the relation of 5 to 6 are, in a sense, the same problem, the language employed differs from question to question, and the mind of the pupil, if it does not act automatically, moves differently in response to each question. Now there is always a danger that the mind of the pupil will act mechanically if all the problems relating to 6 and 5 are asked in succession. The teacher will guard against this by inserting, from time to time, problems on the numbers already mastered.

The very essence of this method is that pupils must think their way to results. They do not learn and remember that 4 and 2 make 6 by repeating the sounds over and over, nor by visualizing the figures 4 and 2, nor by visualizing groups of dots, nor by counting objects. They proceed by an effort of thought—relating the new problem to some knowledge they already have as the result of previous study. For instance, they may think "4 and 1 make 5, and another 1 makes 6; therefore 4 and 2 make 6." Or they may think "4 and 2 is the same as 2 threes, which is 6," or "2 and 3 make 5, therefore 2 and 4 make 6." This is what is meant by saying "the truths of number should be discovered by thought." And one should not be too dogmatic in demanding that thought should always flow in fixed channels. A good illustration of this is taken from the next group of numbers, 10-20. Suppose a pupil were asked "How much are 7 and 8?" His mind might say "Two sevens are 14, and therefore 7 and 8 are 15," or "7 and 3 of the 8 make 10, and 10 and the other 5 of the 8 make 15." In either case the pupil is using known truth to