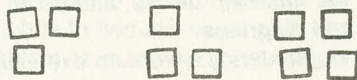


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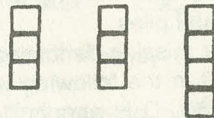
## SPECIAL EDUCATION IN MATHEMATICS HOW SPECIAL IS IT?

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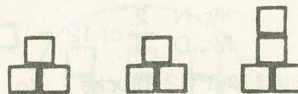
At this writing Jenny is in the fourth grade. She is a bright looking, most cooperative child who has difficulty learning and remembering facts such as  $3 \times 4 = 12$ . On a Wednesday morning in October, 1984, Jenny was trying to put 10 cubes into piles with the same number of cubes in each pile. The method was that of testing conjectures. Her first conjecture was that the 10 blocks could be placed in 3 equal piles. Jenny placed the cubes on the desk something like this:



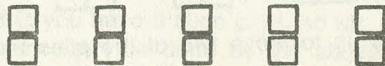
She studied them for a moment, decided that the piles were not the same, and rearranged them in rows, like this:



She reflected for a moment on that arrangement, and decided that the piles were still not the same. She then placed them in 3 vertical columns: two columns of three and a column of four. Again, she reflected for only a moment, realizing that one column was higher than the other two, and rearranged them in pyramid-shaped piles. From the side view they looked like this:



Having made these four arrangements, Jenny decided that ten blocks cannot be placed in three equal piles. She then tried 5 piles:



Finding that 10 cubes can be placed in 5 equal piles, Jenny smiled and wrote 5 in the response blank.

Piaget, an often-quoted Swiss psychologist, wrote extensively of how children learn some fundamental concepts of mathematics and, some-

what by inference, told us of the kind of mathematics instruction they need. A student of Piaget might suspect that Jenny has not fully achieved conservation of number. Later, an exercise with a set of cubes spaced close together in a row, then spread farther apart while Jenny watched, also suggested she has not achieved conservation. She asserted that there were more cubes after the row was lengthened.

What might we do with Jenny that would draw a nod from Piaget, were he still with us? I don't think he would have us spending a lot of time drilling her to memorize  $8 + 7 = 15$ , or  $3 \times 4 = 12$ . Piaget would, I believe, urge us to give Jenny exercises in arithmetic which would give her a lot of experience in counting things that she can move, in forming subsets of things she can move, in working with geometric shapes, in doing whole number computation with concrete material such as the base-ten blocks, and doing other things with manipulable material and diagrams.

Piaget might endorse Jenny's work on exercises such as:

$$\frac{2 \times 10 = 4,}{\square}$$

which is the exercise she was working on when trying to decide how to place ten blocks in equal piles.

Before being given the missing-denominator exercise, Jenny learned to find a fraction of a set in the following way. There are two messengers, Mr. N and Mr. D. Mr. D is always downstairs, and Mr. N is upstairs.

Mr. N

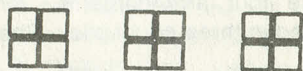
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Mr. D

Upon entering a house, you are downstairs first, so you receive Mr. D's message first. For the exercise

$$\begin{array}{l} \text{Mr. N } \frac{2}{3} \text{ of } 12 = \square \\ \text{Mr. D } \frac{2}{3} \text{ of } 12 = \square \end{array}$$

the first job is to count out 12 blocks. In this exercise, Mr. D's message is to place the blocks in 3 equal piles:



Then, Mr. N tells us to move two of the piles to an answer circle,

