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University of Alberta
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CHAPTER ONE

CHILD EXPERIENCES RICH IN NUMBER SITUATIONS

How does number touch the life experiences of young children in a natural way? The answer to this question will depend greatly upon the community in which the child lives and the richness of his home environment. The farm child will meet number in situations not so familiar to the child who lives in the city and vice versa. There are, however, many situations related to number which are common to the work and play of children wherever they may live.

It is highly important that the primary teacher know the child experiences in which number plays a part, so that she may draw upon the child’s past experiences to make her number work interesting and meaningful. The experiences listed in this chapter are not to be regarded as a course of study to be taught but rather as a survey of the many ways in which a young child encounters number in his home, his community, and his school. This chapter will serve as the background for the actual course of study which is outlined in Chapter Two. It provides ways and means of approaching number teaching in the classroom. The teacher should take the experiences listed here and find which of them have been experienced by her group so that she may use them as her basis for approaching beginning number in terms of the child’s experience and understanding and interests.

The outline of child contacts with number given in this chapter includes some experiences in which the child is an interested observer, others in which he is an active participator, and still others in which he has been both observer and participator. All, however, touch his interests, his needs, or his convenience in such a way that he has a definite feeling that these number situations are useful to him.
I. COUNTING

Little children have encountered many life situations in which the need for counting has been an important factor. At times it has been prompted by curiosity, interest, or just for the pleasure of counting. At other times the counting has been necessary to their convenience or the attainment of their ends. The following list will suggest to the teacher some of the ways in which the children meet counting in a natural way in their daily experiences.

Counting Activities in School

a. Number of library books read or the number of books on the library table
b. Counting pencils and crayons the child owns
c. Counting flash cards
d. Number of sheets of paper, pencils, crayons, or scissors to be passed out
e. Counting lines and spaces on a sheet of paper
f. Number of desks
g. Number of pages read in a book
h. Number of blocks the child must walk to school
i. Counting days of school and play days in a week
j. Number of children in a class or game
k. Number of chairs or desks needed for the class
l. Distribution of books
m. Determining number of children absent or present
n. Number of children in each row
o. Counting materials by 2’s to save time
p. Putting children in pairs for games

Counting Activities at Play

a. Counting children for games
b. Counting your dolls or other toys
c. Counting marbles
d. Counting in hide-and-go-seek, tag, or ball
COUNTING

e. Keeping score in games
f. Strikes made in a baseball game
g. Dots on dominoes
h. Counting when bouncing a ball
i. Counting when skipping rope
j. Counting for rhythms
k. Counting in playing jacks with ball and jacks

Counting Activities in Setting a Table

a. Counting people for meals
b. Number of places at the table
c. Counting dishes, forks, knives, spoons
d. Counting cookies or doughnuts needed on a plate
e. Number of chairs needed for company
f. Putting chairs around the table
g. Counting napkins needed

Counting Activities in Making a Garden

a. Counting rows in a garden
b. Counting seeds when planting
c. Counting plants in a row

Counting Activities on a Farm

a. Counting chickens, sheep, pigs, cows, horses
b. Counting eggs gathered, or sold, or bought
c. Counting bushels of apples or potatoes
d. Number of eggs to set under a hen
e. Counting the number of rings on a rural telephone
f. Counting trees in an orchard
g. Feeding animals and poultry

Miscellaneous Counting Activities

a. Counting fruit and vegetables such as apples, oranges, lemons, beets, carrots, etc.
b. Number of weeks or days or months
CHILD EXPERIENCES IN NUMBERS

c. Number of children in a family or number of members in a family
d. Counting one’s money
e. Counting drops of medicine you must take when you are sick
f. Time in music lessons or dancing lessons: 1, 2; 1, 2; or 1, 2, 3; 1, 2, 3; or 1, 2, 3, 4; 1, 2, 3, 4.
g. Number of blocks in a quilt
h. Number of windows or doors in a room or house
i. Number of apples or peaches in a box
j. Number of stars or stripes in our flag
k. Number of stories in tall buildings
l. Number of candles on a birthday cake
m. Number of cars passing on the highway
n. Counting cars on freight or passenger trains
o. Counting cars you meet when riding in an automobile
p. Counting fish in fish bowl or aquarium or fish pool

II. READING OF NUMBERS

Even very young children observe people reading numbers in ways which are comprehensible to them because these numbers concern their interests. While they may not know how to read these numbers themselves, they nevertheless have an understanding of their importance in their own lives. A suggestive list of situations in which children see adults reading numbers in which they themselves have an interest is given below:

a. Telephone numbers
b. Numbers on a calendar
c. Dials on a radio
d. Dials on dial telephones
e. Finding pages in a catalog or magazine
f. House numbers
g. Street numbers
h. Post-office box numbers
i. Route or station numbers
j. Numbers on hospital room doors
k. Numbers on doors of hotel rooms
l. Numbers on a thermometer
m. Numbers on playing cards
n. Price tags in stores or store windows
o. Speedometers on cars
p. Oil gauge in automobiles
q. Gasoline gauge in automobiles
r. Automobile license numbers
s. Mileage on a car
t. Number of gallons indicated on a gasoline pump
u. Number of highway indicated on road signs
v. Reading a register in a taxicab as the price changes during the course of a taxi ride
w. Page numbers in book used in locating pages or stories
x. Numbers on a scales when one is being weighed
y. Numbers on a scales in a grocery store or meat market
z. Numbers on a ruler, yard stick, or tape measure

III. MONEY

Little children have many experiences with money. They soon learn the value of a penny or a nickel or dime when one is given them to spend. They are constantly confronted with the need for money in securing things they desire. They see adults earning, spending, saving, or handling money in some way almost constantly. Here are some of the situations in which this experience with money touches their personal needs or interests:

Selling Things

a. All merchants, stands, peddlers, etc.
b. Selling newspapers
c. Father may sell eggs, fruits, vegetables, poultry, pigs, cows, sheep, etc.
Buying Things

a. Buying toys
b. Buying candy, gum, ice cream cones, peanuts, pop corn, etc.
c. Buying tablets, pencils, erasers, books, etc.
d. Buying groceries, meat, baked goods, etc.
e. Buying valentines
f. Buying stamps
g. Buying newspapers or magazines
h. Buying seeds for a garden
i. Buying meals in restaurants or hotels or on a train
j. Buying gasoline for the automobile
k. Price of bus or train tickets or for street car fare
l. Buying clothing in which the purchaser is interested in both size and cost: dress, suit, coat, hat, underwear, stockings, shoes, rubbers, gloves, cap.

Miscellaneous Experiences with Money

a. Earning money: pennies, nickels, or dimes for errands
b. Putting money in a bank or banking money at school
c. Gifts of money for birthdays or at Christmas
d. Clerks taking money and giving change
e. Father's wages or salary
f. Church or Sunday school collections
g. Paying rent
h. Admission price to shows or movies or circuses
i. Kinds of coins or bills: penny, nickel, dime, quarter, half dollar, dollar, paper money
j. Father writing a check instead of giving money itself
k. Hospital, dentist, doctor, or grocery bills

IV. TELLING TIME

Telling Time in Minutes or Hours

Many little children have been taught to tell the hours and even half hours on a clock. This is dependent, however, on
whether parents have taken time and patience to teach them to do so. A child’s interest in the clock is not governed by his own ability to read time. He meets countless occasions when time is a great factor in attaining his ends. Below are given some such situations:

a. All clock faces have numbers on them.
b. All watches have numbers on them.
c. Mother watches the clock sometimes when she bakes or cooks.
d. The clock tells how many minutes to practice the music or dancing lesson.
e. Time for meals
f. Bedtime
g. Getting-up time
h. School time, danger of being late
i. How long a child may play at another child’s house
j. Time busses, trains, or street cars are due
k. Class time, recess time, study time, time to go home
l. The striking of a tower or steeple clock

Telling Time in Days, Weeks, Months, or Years

a. Mother or the teacher looks up dates on a calendar.
b. People speak of the date on which an event happened, or will happen, as: last week, yesterday, tomorrow, next year, last year, two years ago, etc.
c. Telling your age
d. Looking for holidays on a calendar
e. Counting weeks or days
f. Counting days before your birthday
g. Counting days until Christmas
h. Counting school days and vacation or play days in a week
i. Counting vacation days at Christmas or spring vacation time
V. MEASURES

Very young children become familiar with many measures. They are not able to use these measures alone, but they see adults use them day after day in ways that affect them very materially. Below are given some of these situations which are meaningful to children:

Of Time

a. The clock

b. A child must check the time for practicing his music lesson, or his dancing lesson, meal time, bed time, school time, recess time, class time, study time.

c. The calendar
d. People tell their ages.

Of Length

a. Yards of material such as cloth, ribbon, or lace

b. Measuring height
c. Mother uses a tape measure when sewing clothes.
d. Father measures the space for a garden and the distance between the rows he plants.
e. Father tells the number of miles to a certain place.
f. The speedometer tells how many miles an hour the car is going.
g. Father knows the mileage of his car.
h. People use road maps to learn distances and directions.
i. The ruler, yardstick, or tape measure
j. People measure when they build things.

Of Weight

a. The scales for weighing coffee, lard, meat, sugar, etc.
b. The scales for weighing people
c. Use of pounds in weighing coffee, bananas, butter, lard, meat, or people
d. Tons of coal
e. We speak of weight gained or lost.
f. The school nurse weighs you to see if you weigh enough according to the chart.

Of Capacity

a. Pint and quart of milk
b. Bushels of corn or potatoes
c. Measuring things for baking or cooking
d. Mother uses measuring cups or spoons in baking.
e. The filling station attendant measures gasoline with a gasoline pump.
f. Father buys gasoline by the gallon.
g. There are oil and gasoline gauges on cars.
h. Some people buy gallons of oil for heating their homes.

Of Temperature

Thermometer tells how hot or cold the day is.

Of Quantity

Dozen of oranges, eggs, cookies, or doughnuts

VI. MAKING COMPARISONS

Children unconsciously make numerous comparisons. At times their comparisons are deliberately and thoughtfully made in order to achieve their ends. Below are some of the more common comparisons which enter into the daily experiences of young children:

a. larger  i. deeper  p. win  w. hotter
b. taller  j. older  q. lose  x. colder
c. higher  k. younger  r. faster  y. many
d. smaller  l. nearer  s. slower  z. few
e. longer  m. farther  t. fatter  aa. lower
f. shorter  n. more than  u. thinner  bb. just fits
g. wider  o. less than  v. heavier  cc. the same
h. narrower

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VII. DEFINITE LOCATION

Mother and father have many occasions to acquaint children with the terms used in locating things. Children, themselves, use the following terms among themselves when describing something or in giving directions to one another:

- a. top
- b. bottom
- c. middle
- d. around
- e. above
- f. below
- g. over
- h. under
- i. first
- j. second
- k. third
- l. next
- m. front
- n. back
- o. up
- p. down
- q. beginning
- r. end
- s. left
- t. right

VIII. SHAPES

Certain shapes and their names are common to children's experiences. Some of them are listed here:

- a. Forming a circle for games
- b. Squares, triangles, oblongs, circles in sets of building blocks
- c. Kindergarten children strike the triangle for musical note.
- d. A line
- e. A straight line or road
- f. A curved line or road
- g. People bend wire or sticks.

IX. GROUPS

Children meet situations in which number combinations are apparent. They also learn names for groups. Sample or type situations are suggested below:

- a. Two boys and three girls
- b. Two large dolls and one small doll
- c. I have three pennies. I spend one penny.
- d. Pairs of shoes, gloves, mittens, or stockings, rubbers
- e. A herd of cows
- f. A flock of sheep, chickens, or birds
- g. A team of horses
GROUPING NUMBERS

h. A team of children in a game
i. A group of people
j. A crowd of people
k. A duet, trio, or quartette of singers

X. GROUPING OR DIVIDING NUMBERS

Situations also arise in which a number of children or objects may be grouped.

a. Dividing materials among a group of children
b. Carrying a group of 2 or 3 objects at a time so as to make fewer trips
c. Counting materials by 2’s in order to save time
d. Grouping children into pairs for a game
e. Choosing partners

XI. PARTS OF A WHOLE

Children are often confronted with the problem of sharing something such as an apple, a cookie, or a piece of cake with another child. Or again, they are happy when a playmate or a brother or sister unselfishly shares something with them. For this reason, they meet a need for dividing a whole into parts very early in their experience.

a. One half of something good to eat, such as an apple, candy, a piece of cake, etc.
b. One half of a piece of paper
c. They see mother cut a whole pie into parts.
d. Mother cuts a whole cake into parts.
e. The black line divides the concrete highway into halves.
f. The rim of a wheel is divided by the spokes. This is true of bicycle, tricycle, wagon, and automobile wheels.
CHAPTER TWO

SUGGESTED ACTIVITIES FOR SECOND-GRADE NUMBER

THE COURSE OF STUDY

The major objective of a primary number curriculum is to provide through enriching experiences a background of attitudes, appreciations, facts, and skills that will aid in the understanding of the formal arithmetic of later grades and in the meeting of child situations in which a need for number arises.

The activities listed in this chapter are of two kinds:

(1) Those from which the children will gain the idea of how number functions in their own lives

(2) Those from which they will gain an idea of how number functions in the lives of the adults with whom they come in contact

Many of the activities may be initiated by the teacher. She should, however, be watching constantly for leads that will provide stimuli for individual or group activities planned by the children. The extent, both quantitatively and qualitatively, to which children initiate activities will be determined to a large degree by the individual abilities and home backgrounds of the children in any class.

The activities of this chapter are designed to make use in an effective manner of those community, home, and school experiences in the work and play of children that provide for worth-while number experiences which will aid the child in his daily life and to teach thereby the facts which are essential to computation in arithmetic in later grades. Good teaching requires that primary number shall be introduced as far as possible in connection with the child’s own needs. This has been made the foundation of this course of study.
FIRST-GRADE NUMBERS

No attempt is made in kindergarten or first grade to fix memory facts concerning number. The first-grade teacher, however, can constantly utilize the opportunities to use number in the interest, the work, and the spontaneous play activities of children both in and out of school. She can arouse a consciousness and an appreciation of the quantitative side of everyday experiences. She can build up a body of mathematical imagery. She can help her pupils to acquire a large meaning vocabulary which is rich in associations built up through rich and repeated experiences. Through all this incidental work with number she can help her pupils to gain the idea that number is a means of expressing ideas in a definite way.

It is suggested that the first-grade teacher consider Chapter I as a field of child contacts with number upon which she may draw for suggestions of how to achieve the goals set for her in the foregoing paragraph. In the opening exercise period, the language period, the recess period, and before and after school she can encourage pupils to discuss experiences in which number plays a part. In the reading period, free activity periods, physical education classes, and in nearly every school activity she should be alert to situations in which she can call the child’s attention to a need for number or bring about an occasion where the child uses number in some of the ways described in Chapter I. Incidental number should not be regarded as accidental number work. While she has no set outline of work to cover, the first-grade teacher will not leave number experiences entirely to chance. She will provide activities in which she knows this need for number will arise.

SECOND GRADE—FIRST HALF YEAR

I. Counting from 1 to 100

A. Rhythmic Counting of Numbers from 1 to 100

Rhythmic counting should precede counting with objects. Rimes help in getting the proper sequence of numbers from 1 to 10, as:
One, two, three, four, five,
I caught a hare alive.
Six, seven, eight, nine, ten,
I let him go again.

One little, two little, three little Indians,
Four little, five little, six little Indians,
Seven little, eight little, nine little Indians,
Ten little Indian boys.

B. Rational Counting

1. Counting in games provides practice in rational counting by individual children or by the class in unison. The following situations are illustrative:

**Ball Game**

One child bounces the ball while the other children in the class count aloud until he misses. The child's score is the number of times he bounced the ball. Children take turns with the ball.

**Jump the Rope**

Children count while the child is jumping to see who can jump the longest. The child's score is the number of times he jumped.

2. The teacher should utilize every possible natural situation in which a need for counting arises in the classroom.

   a. Counting children present or absent
   b. Counting boys present
   c. Counting girls present
   d. Counting out supplies used in class, such as: number of papers needed for class, number of scissors, books, etc., needed for the class, or for each row
   e. Counting chairs needed for the class circle or for the rows for recitations at the front of the room
   f. Counting the number of windows, walls, doors, pictures in the room
g. Counting number of bottles of milk needed in rooms where milk is supplied to school children

h. Counting number of children who have come to school with clean hands and faces or with handkerchiefs, or clean finger nails, or whatever health habit the teacher happens to be stressing

i. Counting the number of children who have brought bank money in rooms where school banking is carried on

j. Having children numbered for playing games

k. Counting flash cards won in a reading game

l. Counting building blocks used in constructing a project

m. Counting the number of children sitting in each row

3. Special practice in counting by 10's to 100 will aid the child in accurate counting from 1 to 100. The following activities are suggested for this work:

   It would be well if the teacher would prepare ten groups of bundles of tens, such as ten little bundles of 10 toothpicks or splints each, held together with rubber bands; ten bead strings each of which is strung with 10 wooden beads; or ten flash cards on each of which has been pasted 10 circles or squares which may be called marbles, pennies, or stamps for added interest.

   Pupils may be taught to count them by placing the bundles or bead strings or cards in a row, and touching each group of ten as they count:

   ten, twenty, thirty, forty, fifty, sixty, seventy, eighty, ninety, one hundred

II. Recognizing Numbers from 1 to 100

   A. Recognizing Numbers from 1 to 10

   Children should be taught first to recognize the numbers from 1 to 10. By passing out many little oak tag cards on which the numbers from 1 to 10 have been written, an interesting game may be played. It is suggested that there be three to five duplicates of each number to derive most fun and profit from the game.
Teacher: 1. (Writing a 2 on the blackboard.) “All children with 2's on their cards may stand in a line at the front of the room.”
   (After the class has examined the line for errors, the children may take their seats.)
2. (Writing a 5 on the blackboard.) “All 5's may run to the door and back to their seats.”
3. (Writing an 8 on the blackboard.) “All 8's may stand in the back of the room.”
4. (Writing a 3 on the blackboard.) “All 3's may come to me and shake hands with me.”

The fun in this game will depend largely on the interesting things the teacher suggests for the children, as:

- Hop to me.
- Stand and turn around three times.
- Skip to the blackboard.
- Stand and tell your name.
- Stand and clap hands.
- Hold the cards high above your heads so I may see them.
- Change seats with each other.
- Stand and make a low bow.
- Stand and whistle.

Later when children are ready to recognize these numbers without her blackboard model, the teacher will no longer write the number on the board when she names it, but will merely say:

“The 5's may all stand and make a low bow.”

B. Recognizing Numbers—the 10's from 10 to 100

Use the game described in A for the following numbers:

10  20  30  40  50  60  70  80  90  100

C. Recognizing Numbers from 1 to 100

The “100 chart” helps to fix the numbers in the number scale. It is suggested that the teacher prepare a large chart
similar to the following, which she may print on cardboard, or
draw with yellow or green chalk on the blackboard. The chart
should be large enough to be seen readily from all parts of the
room.

<p>| | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>21</td>
<td>31</td>
<td>41</td>
<td>51</td>
<td>61</td>
<td>71</td>
<td>81</td>
<td>91</td>
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<tr>
<td>2</td>
<td>12</td>
<td>22</td>
<td>32</td>
<td>42</td>
<td>52</td>
<td>62</td>
<td>72</td>
<td>82</td>
<td>92</td>
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<td>3</td>
<td>13</td>
<td>23</td>
<td>33</td>
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<td>63</td>
<td>73</td>
<td>83</td>
<td>93</td>
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<td>74</td>
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<td>94</td>
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<td>75</td>
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<td>95</td>
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<tr>
<td>6</td>
<td>16</td>
<td>26</td>
<td>36</td>
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<td>56</td>
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<td>76</td>
<td>86</td>
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<td>7</td>
<td>17</td>
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<td>37</td>
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<td>97</td>
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<td>8</td>
<td>18</td>
<td>28</td>
<td>38</td>
<td>48</td>
<td>58</td>
<td>68</td>
<td>78</td>
<td>88</td>
<td>98</td>
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<tr>
<td>9</td>
<td>19</td>
<td>29</td>
<td>39</td>
<td>49</td>
<td>59</td>
<td>69</td>
<td>79</td>
<td>89</td>
<td>99</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>

The question may be raised as to why at this time the above
form is used, when other arrangements of the above numbers are
often seen, such as:

```
0 10 20 30 40 50 60 70 80 90
1 11 21 31 41 51 61 71 81 91 etc.
```
or the following:

```
1  2  3  4  5  6  7  8  9 10
11 12 13 14 15 16 17 18 19 20 etc.
```
The authors suggest the first arrangement because it ties up
closely with the child’s sense of groups of 10, and it has been found
that the vertical form seems easier at the beginning since it seems natural for children to write numbers in columns. Later for review purposes and for variety of practice the numbers may be written across horizontally as is done in the review provided on page 8 of the Triangle third-grade textbook.

For some time children should be asked to count aloud as the teacher points to the numbers. Then pupils may be asked to point to the numbers as other pupils count.

Teacher (selecting pupil to follow her directions): "Find the row that begins with 21. In this row, point to 26. Now point to 21; 28; 24; 27."

(Selecting another pupil.) "Find the row that begins with 51. In this row point to 53; to 57; to 51; to 59."

The exercise may be continued with other rows, by calling on other children in the class. Finally, the teacher may call for a number such as 48 and ask a pupil to step to the chart and point to the number.

Following such chart exercises it is well to provide practice in naming numbers out of their regular order, as:
Teacher: "Who can roll this hoop very fast by naming the numbers around the hoop without making a mistake?"

Note that the numbers are so arranged that the ones digits range from 0 to 9, and also that the tens digits range from 1 to 9, thus providing a complete test of reading of numbers.

Other tests the teacher might use are suggested below:

(1) 68; 84; 57; 31; 12; 49; 73; 96; 50; 25
(2) 15; 53; 92; 20; 46; 61; 87; 74; 39; 28

Many natural situations in which the recognition of numbers from 1 to 100 arise should be utilized by the classroom teacher, such as:

1. Reading page numbers in reading textbooks and library books
2. Finding page numbers in books
3. Room numbers in building where each room is given a number
4. Calendar numbers. (Always mark the day of the week on the schoolroom calendar as a means of keeping a calendar record.)
5. Locker numbers in buildings where children are provided with lockers
6. Numbers on clock faces bearing Arabic numbers
7. Reading numbers placed on cloakroom hooks

III. Writing Numbers from 1 to 100

The chart which was made by the teacher for number recognition should be utilized as a pattern or guide for the writing of numbers.

A. Writing Numbers from 1 to 10

Pupils should not write numbers beyond 10 until every child makes the first 10 figures accurately. Numbers such as 2, 3, 4, 5, 6, 7, 8, and 9 cause some children genuine difficulty. They sometimes write them backwards, or begin at the bottom of the
number and draw it by some roundabout or patched process. Teach the correct writing of numbers as carefully as you teach the correct writing of letters. The following is suggested as the form which may be used:

The teacher should demonstrate on the board the correct strokes and directions to take in making these numbers. Provide interesting situations calling for the writing of numbers, such as:

**Numbers to Write**

1. How many eyes have you?
2. How many fingers have you in all?
3. How many days are there in a week?
4. How many school days are there in a week?
5. How many years old are you?
6. How many feet has a dog?
7. How many hands has a clock?
8. How many shoes are there in a pair?
9. How many feet has a cow?
10. How many pennies are there in one nickel?
11. How many pennies are there in one dime?
12. How many colors are there in our flag?
13. How many fingers have you on both hands?
14. How many fingers have you on one hand?
15. How many feet has a duck?
16. How many toes have you on one foot?
17. How many toes have you on both feet?
18. How many mittens are there in a pair?
19. How many wheels has an automobile?
20. How many wheels has a tricycle?

Study each number as it occurs on the calendar, for example, on the third day of the month practice writing 3’s. On the fourth day of the month practice writing 4’s, etc.

When the first ten digits are mastered, pupils may begin writing the numbers from 1 to 20; later from 1 to 30; then from 1 to 40, and so on until the numbers from 1 to 100 can be accurately written.

It is helpful to give pupils hectographed or mimeographed sheets containing 100 squares arranged as follows:

![100 squares grid]

This form aids children in their early efforts to write numbers from 1 to 100, since the ten rows of ten numbers each keep their work orderly and parallel the number chart they have been
studying. If rows do not end with the same numbers as the chart, errors may be more easily traced with the above form. Also, teacher correction is simplified very materially.

As a final test teachers may read numbers out of their regular order, requiring children to write the numbers which are being dictated.

IV. The Meaning of Numbers as Symbols for Quantities

A. Groups from 1 to 10

Up to this point the child has thought of numbers as symbols used in counting. To them 3 is the number that comes after 2, and 8 is the number that comes after 7. The number 3 in counting refers to the third object in a series. Children should also understand the meaning of numbers as symbols for quantities or groups, such as a group of three objects.

1. Much practice in grouping children or objects, such as books, blocks, pebbles, buttons, etc., is advised. The teacher may give directions such as:

   Bring me 3 books. Put 6 buttons in my hand.
   Show me 5 blocks. Choose 4 girls to stand in a row.
   Show me 2 pencils. How many seats are in John’s row?

2. The teacher may show domino flash cards on which circles have been pasted in groups. Pupils try to recognize the picture of the group and name it without counting.

3. Picture cards on which pictures of children, birds, trees, etc., have been cut out and mounted to represent various number groups, such as three boys, two trees, five eggs, etc., also provide practice in group recognition and add to the interest of the work.

4. As a preparation for the work which is to be done later in number combinations, it is also suggested that the teacher begin to teach the number groups pictured and described on pages 45 to 49 of this manual.
B. The Meaning of the Numbers from 11 to 20

When children understand the meaning of number quantities for numbers from 1 to 10, they may learn the meaning of the teens and the number twenty. The following diagram may be drawn upon the board for a presentation of this work:

<table>
<thead>
<tr>
<th>The Name of the Number</th>
<th>A Picture of the Number</th>
<th>What the Number Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eleven</td>
<td>••••• •</td>
<td>1 ten and 1 more</td>
</tr>
<tr>
<td>Twelve</td>
<td>••••• •</td>
<td>1 ten and 2 more</td>
</tr>
<tr>
<td>Thirteen</td>
<td>••••• ••</td>
<td>1 ten and 3 more</td>
</tr>
<tr>
<td>Fourteen</td>
<td>••••• ••</td>
<td>1 ten and 4 more</td>
</tr>
<tr>
<td>Fifteen</td>
<td>••••• •••</td>
<td>1 ten and 5 more</td>
</tr>
<tr>
<td>Sixteen</td>
<td>••••• ••••</td>
<td>1 ten and 6 more</td>
</tr>
<tr>
<td>Seventeen</td>
<td>••••• •••••</td>
<td>1 ten and 7 more</td>
</tr>
<tr>
<td>Eighteen</td>
<td>••••• ••••••</td>
<td>1 ten and 8 more</td>
</tr>
<tr>
<td>Nineteen</td>
<td>••••• •••••••</td>
<td>1 ten and 9 more</td>
</tr>
<tr>
<td>Twenty</td>
<td>••••• ••••••••</td>
<td>1 ten and 1 ten</td>
</tr>
</tbody>
</table>

Teacher: "The next number after ten is eleven. It means ten and one more. This picture (pointing to the 10 dots) is a picture of ten. This (pointing to the 1 dot) is a picture of one. The two pictures together make a picture of eleven." (Continue in this way with the other numbers.)
Another means of presentation is to fasten a bundle of ten splints or small sticks together with a rubber band and to let the bundle represent the ten. Then with 10 other separate sticks the teacher may show 10 and 1, or 11; 10 and 2, or 12; etc.

In the absence of these, ten children may be asked to form a line or circle. Then 2 children in a second line or circle could show 10 and 2 or 12; 4 additional children could show 10 and 4, or 14. In other words, a group of 10 children together with 10 separate children could represent each of the numbers from 11 to 20.

C. The Meaning of Numbers from 1 to 100

The teacher may prepare a blackboard square of 100 dots as pictured here, or she may hectograph or mimeograph copies of it for each pupil in the class.
Two cardboard strips, depending for their size upon the size of the square used, should be made the exact length of the square.

Teacher (holding a strip under the first row of 10 dots): “Here is a picture of 10 dots.”

(Then moving the strip down so it is under the first two rows of dots.) “Here is a picture of 20 dots. Now with my second strip of paper I shall cover all but 3 of the dots in the second row.

```
  o o o o 
  o o o o 
```

“I now have made a picture of 13, for I have made a picture of ten and 3 more.”

Teacher (picking up both strips and laying a strip under the third row of dots): “Here is a picture of 30. Watch me while I cover all but 5 of the dots in the third row. Now I have a picture of twenty and 5 more. For 25 dots means 2 rows of tens and 5 dots more.”

Continue in this way with other numbers such as: 28; 23; 34; 39; 46; 48; 57; 71, etc. Continue this development until pupils are able to take the two strips and show the picture of any number from 1 to 100 that the teacher may name. This exercise is highly important in its visual contribution to a child’s sense of numbers as quantities.

V. The Meaning of Ordinal Numbers from First to Fifth

Children have become acquainted with the term first as applied to the first grade, and second as applied to the second grade. Other situations should be provided in which they are able to locate third, fourth, and fifth. The following activities are suggestive:

T. I & II-3
1. Ask five children to stand in line. Ask, "What is the name of the first child?" "the third child?" "the fifth child?" etc.

2. Name the children who sit in the first row, the second row, the fourth row, the third row, the fifth row.

3. Write five numbers in a horizontal row, as: 9 4 1 8 3. Name the third number; the first number, etc.

4. Take your reading book. Tell me the number of the page on which you find the first picture in the book; the third picture, etc.

5. Take your reading book or a library book. Turn to page 10. What is the first word in the third line? What is the fourth word in the second line?

6. Fill in the blanks. Use one of these words: first, second, third, fourth, fifth.
   I am in the ________ grade.
   Next year I want to be in the ________ grade.
   Last year I was in the ________ grade.
   John Brown sits in the ________ seat in his row.
   Mary Jones sits in the ________ row in our room.
   If Sunday is the first day of the week, then Tuesday is the ________ day of the week.
   If my thumb is the first finger on my hand, then my little finger is my ________ finger.

7. Tell the answer to these questions:
   What is your first name?
   Who sits in the third seat in your row?
   Look at the pictures of toys I have set up along the chalk tray. (Teacher has placed the pictures of these toys in a row: kite, football, boat, ball, automobile.)
   What game could you play with the second toy?
   What game could you play with the fourth toy?
   What could you do with the first toy?
What can a boy do with the third toy?
What is the name of the fifth toy?
What is the name of the third child in the second row?
What is the name of the fifth child in the first row?

VI. The Days of the Week

Teach the children the names of the days of the week. Teach them that Sunday is the first day of the week. Show them where the days of the week are indicated on a calendar. Provide exercises similar to the following:

1. Tell the answer:
   What day is today?
   What day will tomorrow be?
   What day was yesterday?
   What is the first day of the week?
   What is the last day of the week?
   How many days are there in one week?
   Name the school days in the week.
   Name the first school day of the week.
   Name the last school day of the week.
   What is the day before Monday?
   What is the name of the day after Wednesday?
   What will day after tomorrow be?

2. Mark off the numbers of the days on the calendar.

3. Keep a weather record. Use terms such as warm, hot, windy, rainy, fair, sunny, cloudy, stormy, etc. Record the weather in a little book heading each day’s record with the name of the day.

4. Print a little daily newspaper on the blackboard and head each day’s news with the name of the day.

VII. The Names of the Months and the Seasons of the Year

Prepare an attractive chart on which you have indicated in four sections the four seasons of the year.
In each division of the chart paste an attractive picture to illustrate something a child enjoys doing in that season. Use this chart as a basis for learning the names of the seasons and of the months of the year. Teach the children to name the months of the year in their correct order. The following activities are suggested for this work:

1. Tell the answers:
   How many months are there in a whole year?
   How many seasons are there in a year?
   Name the seasons.
   Name the months in the winter season.
   Name the months in the spring season.
   Name the months in the summer season.
   Name the months in the autumn or fall season.
   What is the first month of the year?
   What is the last month of the year?
   How many months are there in each season?
   In what season is December?
   In what season is April?
   In what season is June?
   In what season is November?
   In what month is your birthday?
   Christmas comes in what month?
School begins in what month?
Which month of the year do you like best? Why?
Which season of the year do you like best? Why?
In what month does St. Valentine’s Day come?
In what month does school begin?
In what month will school close?
In what month does Thanksgiving Day come?

2. Study the calendar to see where the names of the months may be found on it. Learn that there is a page of the calendar for each month of the year. On the calendar find:

   This month
   Last month
   Next month
   The first month of the year
   The last month of the year
   A spring month
   An autumn month
   A summer month
   A winter month

VIII. An Understanding of Terms of Comparison Related to Number

Children have met many of these terms in natural ways in their home, school, and community experiences. It is the privilege of the second-grade teacher to enrich the child’s understanding of terms of comparison and also to correct any vague or inaccurate ideas which individual pupils may have acquired. Provide situations in which children are required to judge using the following terms:

more than  less than  win  faster  lose  few
larger  longer  deeper  farther  heavier  lower
taller  shorter  older  slower  hotter  just fits
higher  wider  younger  fatter  colder  the same
smaller  narrower  nearer  thinner  many
1. Many questions may be asked in comparing things, such as:

**Larger or Smaller**

Which is smaller, your house, or our schoolhouse?
Which is smaller, a ball or a marble?
Which is larger, a chick or a hen?
Which is larger, your desk or the teacher’s desk?
Which is larger, a clock or a watch?
Which is smaller, a girl or her doll?
Which is larger, a duck or a duckling?
Which is smaller, a bird or a bee?
Which is smaller, a robin’s egg or a hen’s egg?
Which is larger, a cat or a mouse?
Which is larger, a child or a giant?
Which is smaller, a toy train or a real train?
Which is smaller, a balloon or a marble?
Which is larger, your house or a bird house?
Which is larger, a goat or an elephant?
Which is smaller, a mother rabbit or a baby rabbit?
Which is smaller, a squirrel’s tail or a rabbit’s tail?

**More or Less or Most**

Which is more, one or a dozen?
Which is more, 4 or 2?
Which is less, a day or a week?
Which is more, a dime or a penny?
Which is less, one or a hundred?
Which is more, one or a pair?
Which is less, an hour or a minute?
Which is less, a day or a year?
Which is more, a dozen or a pair?
Which is most, a pair, a dozen, or one?
Which is most, a penny, a nickel, or a dime?
Which is most, two, or five, or three?
MISCELLANEOUS COMPARISONS

Miscellaneous Comparisons

Which is older, a girl or her mother?
Which is taller, a camel or a monkey?
Which is faster, a street car or an airplane?
Which is faster, a sailboat or an airplane?
Which is longer, a hammer or a nail?
Which is higher, the roof of the house or the sidewalk?
Which is farther, 2 miles or 5 miles?
Who lives farther from school, Mary or Ruth?
Who lives nearer to the school, Bob or Harry?
Who sits farther from the front of the room, Ted or Joe?
Who sits nearer the door, Margaret or Jane?
Who is younger, a boy or his father?
Which is deeper, a pond or the sea?
Which side won the game?
Who lost the race?
Which is heavier, the tablet or the book?
Which is hotter, boiling water or warm water?
Which is colder, rain or snow?
Who is thinner, Helen or Grace?
Who is fatter, Jack or Billy?
Which goes slower, a boy walking or a boy running?
Which is shorter, my pencil or your pencil?
Which is wider, your desk or the teacher’s desk?
Which is narrower, your finger or your hand?
Who received many cards in the reading game?
Who received few cards in the reading game?
Which is longer, your hand or your arm?
Which is thinner, the cover of your book or a page inside your book?
Which is wider, the street or the sidewalk?
Which is lower, a kindergarten chair or a teacher’s chair?
Which is higher, the door or the windows in our room?
Name the tallest girl in the room.
Name the shortest girl in the room.
Name the shortest boy in your row.
Name the tallest boy in your row.
Which plant in our room has the most flowers?
Which plant has the smallest leaves?
Which animal is heavier, an elephant or a monkey?
Whose back is wider, a cat’s or a mouse’s?

IX. An Understanding of the Arithmetical Terms of Location

Provide opportunities for children to use the following terms:

<table>
<thead>
<tr>
<th>top</th>
<th>bottom</th>
<th>middle</th>
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The following activities are suggestive:

1. Arrange a diagram similar to the following on the board:

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Use it as a basis for questions such as:

Name the numbers in the top row.
Name the first number in the top row.
Name the last number in the top row.
Name the middle number in the top row.
Name the numbers in the bottom row.
Name the third number in the bottom row.
Name the first number in the bottom row.
Name the second number in the bottom row.
Name the number in the upper left-hand corner.
Name the number in the upper right-hand corner.
Name the number in the lower left-hand corner.
Name the number in the lower right-hand corner.
Name the number in the square above the 5.
Name the number in the square below the 6.
Name all the numbers in the left-hand row.
Name all the numbers in the right-hand row.

2. Miscellaneous questions.
   Show me your left hand.
   Show me your right hand.
   Point to the front of the room.
   Point to the back of the room.
   Who is standing at the end of the line?
   What is the beginning of the story?
   What number comes before 10?
   What number comes after 4?
   Who sits in the seat next to John?
   Who sits in the next to the last seat in your row?
   Draw a line under this word.
   Put a cross over the word.
   Who sits in the fourth seat in your row?
   Touch the last boy in the fifth row.
   Walk up six steps.

X. Arithmetical Shapes—the Square, the Circle, the Triangle

In playing with kindergarten blocks the child has come in contact with the square, circle, and triangle. The kindergarten teacher has used the triangle as a musical instrument in toy symphony bands and to strike a musical note for attention. Children have cut circles to represent many things, such as balls, oranges, balloons, etc.

It is the purpose of the second-grade teacher to sum up these experiences and to provide additional ones so that children will use these three terms correctly.
ACTIVITIES FOR SECOND GRADE

1. Ask questions such as:
   Name as many things as you can that have the shape of a circle.
   
   wagon wheel  balloon  bicycle wheel
   coins         ball      round plate
   auto wheels   orange   marble
   checkers      hoop     round saucer

   Name as many things as you can that have the shape of a square.
   
   handkerchief  top of a square table
   square cracker square blocks
   checker board  square boxes

   Name as many things as you can that have the shape of a triangle.
   
   triangle (used in kindergarten toy symphony)
   building blocks that are the shape of a triangle
   a garden bed made in the shape of a triangle
   the gable of the roof of a barn or house

2. Provide opportunities to use these shapes in art lessons and in construction and hand work.

XI. Common Coins—Penny, Nickel, Dime

   The child is already familiar with the appearance of these coins and their names. In this grade stress the values of these coins by discussing things which can be bought for each.

1. Ask questions such as:
   Name as many things as you can that you can buy with a penny.
   
   stick of gum       stick of candy
   marble             penny pencil
   penny valentine    penny post card
   one-cent stamp     sucker
Name as many things as you can that you can buy with a nickel.

- ice-cream cone
- tablet
- eraser
- package of gum
- a chocolate bar
- a box of cracker-jack
- a rubber ball
- a bag of peanuts
- a bag of pop corn
- an ice-cream bar
- a top and many other small toys
- a box of crayons

Name as many things as you can that you can buy with a dime.

- a loaf of bread
- many toys
- very thick tablets
- Jumbo crayons
- a balloon
- a movie ticket
- handkerchiefs
- a box of water-color paints

2. The teacher may permit the children to make little stores and shops in their room either with mounted pictures, articles which they make, or articles which they bring from home. Mark the prices from 1¢ to 10¢. Permit a child to buy only one article with toy money. Each child might be given 1 dime, 2 nickels, and 5 pennies. This would allow him some freedom in buying an article priced at 4¢ or 7¢. In this semester it is suggested that pupils be required to hand the clerk the exact change, since giving change is presented later in the year's work.

Stores and shops which might be built are:

- Fruit or vegetable market
- Grocery store
- Toy shop

3. It is suggested that during this half year the teacher should take the children on excursions to a grocery store, a toy shop, or a fruit and vegetable market so as to provide the first-hand experience of the store, its prices, and activities as a background for later work.
XII. Parts of Wholes—Half

Utilize situations such as:

1. Tear your paper in half.
2. Fold your paper in half.
3. Cut the circle in half to make the top of the umbrella.
4. Share half of something with another child.
5. Saw the board in half in building something.
6. The black line divides the concrete highway in halves.

SECOND-GRADE—SECOND HALF YEAR

I. Counting, Reading, and Writing Numbers from 100 to 200

Since the child finds a need for the numbers from 100 to 200 in finding page numbers in his reading and library books, it is advised that these numbers be taught. In reading a number of three figures, do not allow the use of “and.” Thus, 156 should be read one hundred fifty-six, and NOT one hundred and fifty-six.

Introduce counting of these numbers first, then the reading of the same numbers, and finally the writing of the numbers. It is suggested that much practice be given in asking pupils to locate pages in books. Vary by asking, “What is the name of the story on page 132?” “What picture do you find on page 146?” “On what page does the story end?” Correlate this work with reading by using the Table of Contents for practice in the reading of numbers.

II. Vocabulary of Arithmetical Terms of Comparison and Location

Continue further activities with terms of comparison and location listed in the work for the previous half year. More emphasis may be placed on terms such as tallest, shortest, highest, longest, etc., which require the child to compare more than two objects. The previous semester’s work stressed taller, shorter, higher, longer, etc., referring to two objects only.
In the directions calling for definite location aim to include more than one term in the direction, such as:

Name the first boy in the last row.
What is the upper left-hand figure on the chart?
What is the next to the last word in this line?
Name the middle number in the bottom row, etc.

III. Arithmetical Shapes—Oblong, Straight Line, Curved Line

Review square, circle, and triangle.
Teach children that the shape of their tablets, books, etc., is called oblong.

Ask pupils to name as many things as they can that have the shape of an oblong.

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<tr>
<th>tablet</th>
<th>pencil box</th>
<th>paper money</th>
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<tbody>
<tr>
<td>book</td>
<td>sheet of paper</td>
<td>stamp</td>
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<tr>
<td>chocolate bar</td>
<td>many gardens</td>
<td>envelope</td>
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<tr>
<td>crayon box</td>
<td>tops of some tables</td>
<td>box of wagon</td>
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<tr>
<td>a door</td>
<td>a window</td>
<td>floor of schoolroom</td>
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<tr>
<td>stick of gum</td>
<td>box of cracker-jack</td>
<td>ruler</td>
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Utilize every opportunity to call attention to the use of straight lines and curved lines.

IV. Addition and Subtraction Combinations Through the 10's

In this half year the 64 easiest of the 100 facts in each process are taught. This includes the following:

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ACTIVITIES FOR SECOND GRADE

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The entire presentation of this work is outlined in detail in Chapter III of this manual, beginning with the first presentation step through to the testing on final mastery. Games to provide interest and needed practice are provided in Chapter V of this
Playing Store Activities manual. For the teacher who wishes guidance as to difficulty ratings of combinations, such ratings together with a summary of available studies is given in Chapter IV of this book. The material has been placed in these last three chapters so as to provide as much detail on each phase of the work as possible. Teachers are advised to read Chapters III, IV, and V before beginning the teaching of addition or subtraction combinations.

It will be noted that subtraction has been presented as a taking away process. This has been done because children seem to grasp the taking away idea quicker than the additive process. However, once mastered, the additive method is equally good, and there is no evidence that pupils in either process excel the other after final mastery. Therefore, because of greater gains made in early presentations, the taking away process has been described. Teachers, however, preferring the additive process, will find it a simple matter to adjust the presentation described here, and to substitute the additive method of subtraction for the taking away method described in Chapter III. There are really three subtraction ideas:

I have 5. I take away 2. (Taking away idea.)
I have 5. You have 2. How many more have I than you? (Comparison idea.)
I have 2. I want 5. How many more do I need? (Additive idea.)

Before he has mastered subtraction in grades three and four the child should have met all three of these situations. The authors recommend, however, that until pupils have mastered one subtraction idea, it would be better to present only one in the second grade. Teachers should therefore select either the taking away or the additive idea, preferably the former.

V. Coins: Extended Use of Penny, Dime, and Nickel in Play Store Activities

In the second half year, store activities may be extended to include the purchase of two articles, each of which cost from
1¢ to 10¢, or the purchase of one article and receiving change from a dime or nickel.

The store may be constructed of orange crates with a low table for a counter. Toy money and a change drawer complete the store equipment. Merchandise may consist of mounted pictures, objects made by the children, or materials brought from home such as empty cans and packages for a grocery store, or old toys for a toy shop.

A store activity may be carried on at any time in the year adapting the difficulties to the number knowledge which the children have acquired. Arrange the articles on the shelves and mark each with a price mark from 1¢ to 10¢. Children are given either ten pennies, two nickels, or a dime at first. Later more money may be given out if the teacher so desires. A child is told that he may buy either one or two articles, but he must not spend more than ten cents in all.

1. **Customer:** “Good morning.”
   **Clerk:** “Good morning. What can I do for you today?”
   **Customer:** “I will take a bar of soap, for 4 cents.” (He counts out four pennies, and hands them to the clerk.)
   **Clerk:** “4 cents. That is correct. No change.” (He places money in the money drawer.)

2. **Customer:** “Good morning.”
   **Clerk:** “Good morning.”
   **Customer:** “I should like a box of matches for 7 cents.” (He hands the clerk a dime.)
   **Clerk:** “Is there anything else?” (He places dime in cash drawer, takes out 3 pennies and hands them to customer.) “Here is 3 cents change. Good day.”

3. **Customer:** “Good morning.”
   **Clerk:** “Good morning. What would you like today?”
   **Customer:** “I would like a grapefruit for 5 cents and yeast for 2 cents. 2 and 5 are 7. That will be 7 cents.” (Hands clerk a nickel and 2 pennies.)
CLERK: "7 cents. That is correct. No change." (He places the money in the cash drawer.)

4. CUSTOMER: "Good morning, Mr. Brown."
CLERK: "Good morning."
CUSTOMER: "I wish to buy an orange for 3 cents and a package of gum for 5 cents. 3 and 5 are 8. That will be 8 cents." (Hands clerk a dime.)
CLERK: "8 cents. That is correct." (He places the money in the cash drawer and takes out 2 pennies.) "Here is 2 cents change. Thank you. Come again."

The above four situations are typical of those which would arise in the play store activities for this grade. In the third grade, pupils will not only have greater purchasing freedom, but will learn to count change as is done in actual store situations.

VI. Counting by 2's, 5's, 10's to 100 and Recognition of Odd and Even Numbers to 20

Children count by 2's for games such as hide-and-go-seek. They learned to count by 10's in the first half of the second grade as part of their mastery of counting from 1 to 100. Explain to them how counting by 5's is often used in counting nickels. It is also a short way of counting to 100 for their games.

AN ODD AND EVEN GAME

Stand 20 children in a row. Number them in order from 1 to 20. The first time begin with one and the Odds speak up, 1, 3, 5, 7, etc., and all the evens remain silent. The next time all the Evens speak up, 2, 4, 6, 8, etc., and the Odds remain silent.

An excellent Odd and Even game for out-of-school play is suggested in Chapter V on page 114 of this manual.

VII. Common Units of Measure

All units of measure taught should be presented objectively and used in real situations. Measures in this grade should be taught as occasions arise for a need of a knowledge of them.
Use of calendar: day, week, month, year
Use of ruler: the inch if needed in measuring for a building project
Use of liquid measure: pint and quart, and half pint (provided half-pint bottles of milk are served in the school)
Telling time: the hour and half hour (provided occasions arise in which pupils express a need for or a desire to learn to tell time)
Weight: the pound. This may be taught through weighing of children in school, or through common experiences children have with scales in grocery stores and meat markets.
Dozen: in measuring eggs, cookies, doughnuts, etc.
Blocks and miles: in speaking of distance to school or to another city

VIII. Terms Used in Expressing Groups

Pair: shoes, gloves, mittens, stockings, rubbers
Herd: cows
Flock: sheep, chickens, birds
Team: horses
Team: children in a game
Group: objects, people
Crowd: people
Duet, Trio, Quartette: in music classes or at musical programs
Dozen: eggs, cookies, doughnuts, buttons

The above terms may be introduced incidentally as natural situations arise in which they are involved. Many of them will be used in the stories read in the reading class, or in stories told in the story hour or language period.
SUMMARY

The work in second-grade arithmetic should be based upon the experiences which children of that age have with number in their home, school, and community activities. At no time should it become a formal drill period in which the interest and enthusiasm of these children is permitted to lag. It should be one of the really enjoyable periods of the school day. It should create in the child a desire for and a curiosity about the number experiences he will have in the third grade. It should lay the foundation of sensory impressions and rich experiences upon which the work of the third grade may be based.
CHAPTER THREE

TEACHING THE ADDITION AND SUBTRACTION COMBINATIONS

A complete and detailed technique for presenting the 100 addition combinations and the 100 subtraction combinations is provided in this chapter for teachers who need such guidance. The presentation of this work is divided into eight parts, as follows:

A. Presenting Numbers as Groups
B. The First Combination Lesson
C. Introducing the Combination Form
D. First Steps in Testing
E. The First Subtraction Combination Lesson
F. Introducing the Subtraction Combination Form
G. Presenting Addition and Subtraction Together
H. Special Aids to Mastery and Speed of Response

Each of the above parts constitutes a step in the combination teaching process and one cannot be introduced until the preceding one has been taught. Together they constitute a development which, under the direction and supervision of the authors, has been thoroughly tried and tested and which has secured uniformly excellent results in all types of primary number classes.

The success of this technique is based primarily on the extent to which visual aids to number learning are employed together with the excellent provision made for the transfer from the concrete situation to the abstract combination symbols. But important as are these factors, even more so is the interest factor which seems to remain undiminished all during this work.
A. Presenting Numbers as Groups

When pupils enter school they have learned to use numbers in counting. To them 3 is the number that comes after 2, and 5 is the number that comes after 4. Teachers sometimes interpret a child’s ability to use numbers in counting as full comprehension of the meaning of such numbers. This is not a correct assumption to make. A child who uses the number 5 freely in counting may not have any sense of the group that the name five stands for:

5 in counting refers to the fifth object in a series.
5 as a quantity refers to all the objects together as a group.

It is highly essential that children who are to combine groups into combinations have a clear understanding first of all of what a group such as 2, 3, or 4 really is. Pupils who have experienced genuine difficulty in learning number combinations have often been found to be pupils of normal intelligence who have no sense of threes, sixes, or nines as quantities. It is no wonder that such children would find it difficult to master an abstract memory fact such as \( \frac{6}{8} \) or \( \frac{14}{9} \). It is reasonable that children who give impossible answers such as 4 for the first and 17 for the latter are the children who lack this sense of numbers as symbols for groups.

The first step in the presentation of combinations, therefore, is the development of the meaning of numbers as symbols for groups. The following procedure is suggested because of the excellent results which have been secured by teachers who have used it.

The teacher should paste brightly colored one-inch squares of construction or poster paper on nine 9” x 12” sheets of cardboard or oak tag to make the following pictures. Use the same color for all the squares so that color does not become a factor in identification.
This set of cards becomes the teacher's presentation equipment. The ideal equipment to place in the hands of the children is the brightly colored one-inch cubical counting blocks which may be purchased from school-supply houses. In the absence of these, primary teachers may borrow the small square wooden beads found in the bead supply of nearly every kindergarten. Other materials which may be used are one-inch squares or circles of cardboard or oak tag, or buttons. If buttons are used, a child
should have a set of buttons of uniform size and shape. Different children, however, would not necessarily have to use objects of the same size or shape. One might have nine buttons, another might get nine small wooden beads or cubical counting blocks, and still another might use a set of nine cardboard squares or circles:

To avoid using time to pass and count out the objects each time, pupils may be asked to bring an empty large size match box from home. In this way they may keep their objects in their desks at all times.

The First Grouping Lesson

Children will remain at their desks for this lesson. See that each child is provided with a set of nine small objects of uniform size and shape and a sheet of 9" x 12" drawing paper or oak tag. The objects are laid in a row across the top of the child's desk where they will be out of his way.

The teacher stands before the class holding the set of group picture cards she has made. (The directions here given assume that each child is using cubical counting blocks for objects.)

Teacher (holding up her picture of one): "Here is a picture of one. Make a picture just like this one by laying one block in the center of your paper. Whenever I ask you to show me a picture of one, that is the kind of picture you will make."

The teacher should walk up and down the aisle to see that every child has followed directions accurately.

"Now put your block back at the top of your desk."

Teacher (holding up the picture of two): "Here is a picture of two. Make a picture just like this one by laying your blocks in the center of your paper just as the squares on my paper are laid."

Again the teacher should walk up and down the aisle to be sure that every child's blocks are correctly laid. Help pupils who do not understand.
After each picture is made the blocks are returned to the top of the desk before a new picture is started. This avoids confusion. Continue in the manner just described until all the children have been shown how to make each of the nine pictures. In slow-moving groups it is best not to introduce more than five pictures in the first lesson, and introducing the others in later presentations. After each picture has been shown, the teacher should walk up and down the aisle and check each child’s grouping so that every child makes the correct picture from the start.

Later Grouping Lessons

Spend as much time as is needed to master the picture groupings. The following procedure is suggested:

TEACHER (without showing the picture card): “Make a picture of four with your blocks.”

After the pictures have been made, the teacher holds up her picture card for the class to see.

TEACHER: “Does your picture look like this one? If not, change your picture to look like this one.”

Be certain before going on to another picture that each child’s grouping is correctly placed. The above procedure should be continued for all the nine pictures.

Do not hurry this work. Continue this practice in grouping until pupils can make the correct grouping picture for any number from one to nine.

It has been found in observations made by Merton and Banting over a period of several years that pupils who have mastered this work in grouping before any work in combinations is started encounter far less difficulty in later stages of the work due to the number sense which has been strengthened through the grouping experiences.

The particular group pictures recommended here are not necessarily arbitrary. Other group pictures such as
for three, for eight, and for nine might also be used. The authors have suggested the ones which children under their observation have found easiest to comprehend.

B. The First Combination Lessons

The following detailed procedure is given for the benefit of inexperienced teachers and for such teachers who have not worked out a satisfactory presentation of their own.

On one side of the 9" x 12" sheet of paper which has been used by each child in the grouping lessons, the teacher will draw a heavy black line across the middle as in this illustration: Begin the work with five blocks, since five is an early number experience in the history of the race. Pupils will remain at their desks for this lesson. On each child’s desk are five blocks (or other objects) and the sheet of paper with the line through the middle.

Teacher: “Today we are going to learn to make new pictures of numbers. On this sheet you see a black line. Lay the paper on your desk so that the black line goes across from left to right. Show me the top half of your paper by laying your hand on that part. Raise your hand. Now show me the lower half.

“You have five blocks on your desk. Make a picture of one in the top half of your card.

“Make a picture of four in the lower half with the blocks that are left.

“You had five blocks in all. You put one at the top of the card. You put four in the lower half. This shows you that 1 block and 4 blocks are 5 blocks. Let us learn to say this story like this:
"Cover the one block with your hand and say, 'One block.'
"Raise your hand and lay it over the four blocks and say, 'and four blocks.'
"Now put your two arms around the whole card so the card lies inside your arms and say, 'are five blocks.'"

The teacher should repeat this step until all children thoroughly understand what to do and say.

Teacher: "Who can touch the blocks and say this story alone? (Permit individual pupils to repeat the step alone.)

"Now put all the blocks back at the top of your desk. You made a picture of five with a one at the top. Now we are going to make a picture of five with a four at the top.

"Put four blocks in the top half of your card.
"Now put one block in the lower half.
"Let us touch the blocks and say this story like this:
"Cover the four blocks with your hand and say, 'four blocks.'
"Raise your hand and lay it over the one block and say 'and one block.'

"Now put your arms around the whole card and say, 'are five blocks.'"

The teacher should see that this step is practiced until all children understand. Then ask, "Who can touch the blocks and say the story alone?"

Teacher: "Let us make a new picture of five with a two at the top.

"Place two blocks in the top half of the card.
"Place three blocks in the lower half.

"Let us touch the blocks and say this number story like this:
"Cover the two blocks with your hand and say, 'two blocks.'
"Raise your hand and lay it over the three blocks and say, 'and three blocks.'
"Now put your arms around the whole card and say, 'are five blocks.'"

When the teacher finds that pupils can do this step alone she should have them make another picture of five with a three at the top. Develop this combination as the preceding ones have been developed.

The zero combinations are left for the latter part of the lesson and are introduced in this way:

Teacher: "Make a picture of five with a five at the top. You have no blocks left for the lower part of the card. There will be no blocks in the lower part of your card. In number work we call none or not any blocks zero.

"Let us touch the blocks and say this story like this:
"Cover the five blocks with your hand and say, 'five blocks.'
"Raise your hand and lay it over the empty half and say, 'and zero blocks.'
"Now put your arms around the whole card and say, 'are five blocks.'"

When the teacher finds that pupils understand this picture she should have them make another picture of five with a zero at the top.

Pupils will then touch the blocks and say the combination thus: "Zero blocks and five blocks are five blocks."

The above procedure is the one suggested for two to four lessons to follow, depending upon the ability of the class. The teacher should note the following important principles on which this technique is based:
1. The children are not allowed to use the abstract numbers in the early work, as: 3 and 2 are 5. Instead they deal in terms of concrete quantities of things which they see and touch and name. This is the first preventive step against failure to comprehend combinations. This also paves the way for the solution of concrete problems. Later the child is taught to drop the name such as: 3 blocks and 2 blocks are 5 blocks and to use the numbers only.

2. No written work is introduced in the early presentations. Too frequently teachers introduce the printed combination before the child has sensed the situation for which the combination is a symbol. At least two or three lessons in which all oral work and dramatization are used are essential. Make the picture, touch the parts and learn to say the number combination correctly, and visualize what it means—these constitute the foundation on which effective later work must be built.

3. Children actually see and touch the number groups they are studying, thereby sensing the situation. This makes for vividness and clarity, which are powerful factors in attention and comprehension. By placing his arms around the whole card the idea of total amount is impressed upon the child.

4. The groupings used in picturing the combinations are those which the child has learned in the grouping lessons. He therefore senses that 4 and 1 are 5 means that a group of four and one more make a group of five. This is the situation which so many other types of presentation fail to make clear to the child.

5. The child is unconsciously seeing a picture of an actual number combination: 1

\[
\begin{array}{c}
\boxfill \\
\boxfill \\
\boxfill \\
\end{array} + 4
\]

which will later aid him in interpreting combinations meaningfully. Each card picture is a picture of a number combination which the child will later learn to think of as the combination itself. Until the written form
FIRST COMBINATION LESSONS

of the combination is introduced the term combination should not be used. The term number pictures or number stories is better for the first lessons.

6. The teacher presents all work in combinations by starting with the sum or total amount and separating the whole into different groupings or combinations. Buckingham, Morton, and others have found that this procedure tends to eliminate and prevent counting. A child knows the sum or the total number at the start. He therefore has no need of counting to get the sum. Contrast this procedure with the faulty one still practiced by many teachers:

Take 2 blocks in one hand.
Take 3 blocks in the other hand.
How many have you in all?

The child has no way of knowing how many there are in all without counting. In this way he actually develops the habit of counting to find the sum and this crutch is used in later work in addition.

In all presentation of combinations, the teacher should always begin with the total amount and help pupils to find in how many ways this total number may be grouped.

7. No subtraction is introduced in the early stages of the work, since it is confusing to introduce the reverse process of subtraction until a child comprehends the addition situation itself. It is suggested that the child be taught the addition combinations of fives, fours, threes, twos, ones, and zeros, by which we mean all the facts that make 5, those that make 4, and so on before any work in subtraction is introduced at all. This would mean teaching the following combinations:

```
    0  5  1  4  2  3  0  4  1  3  2
  5  0  4  1  3  2  4  0  3  1  2
  0  3  1  2  0  2  1  0  1  0
  3  0  2  1  2  0  1  1  0  0
```
Then introduce the subtraction step and begin over and proceed forward with the ones, twos, threes, and so on to the eighteens teaching addition and subtraction together taking \( \frac{2}{3} \) as one teaching unit.

8. It is recommended that throughout the work the teacher present combinations in groups having the same sum or minuend. All the combination facts that make any given number is a comprehensive and orderly way of presenting so great a mass of memory facts as the two hundred facts, 100 in addition, and 100 in subtraction.

C. Introducing the Combination Form

After two to four oral presentations, pupils may be shown the number combination symbol for the picture they have made. The following technique will be found to present this step in a clear, organized, and effective manner.

Children will remain in their desks for this work. The teacher will see that each child is supplied with five blocks or other objects, the 9" x 12" sheet of paper on which the black line is drawn, a pencil, and a sheet of tablet paper that has lines. Before work is begun have the children fold the tablet paper lengthwise into four sections as indicated by the dotted lines in this illustration. On the blackboard the teacher will have drawn a large duplicate of a sheet of ruled paper, and have indicated the four creases by drawing dotted lines as in the illustration. If it is available, the teacher will have a piece of yellow or light-green colored chalk so that the numbers she writes will stand out vividly on the white chalk lines she has drawn.
Teacher: "With your blocks make a picture of **five** on your card, putting a **one** at the top. Who will touch the blocks and say this number story? Today we are going to learn to make this picture with numbers. How many blocks are in the top part of your picture? I am going to write this number on the top line of the first street on my blackboard paper like this. (Note the illustration at the right.)

"You may take your pencils and put a **1** on your paper just as I have done on my blackboard paper.

"How many blocks are in the lower part of your picture?
"Watch me while I put a number **4** below the number **1** on the board. (See illustration.)

"You may take your pencils and write a **4** below the **1** on your papers as I have done."

It is very essential that the teacher walk up and down the aisles **each time she has asked pupils to write on paper** to be sure that the children are following her instructions. Do not go on with the work until every child's paper is correctly written.

Teacher: "This is how the picture of your blocks looks when it is written with numbers. The top of your picture has **1** block. The top number you have written is **1**.

"In your picture there are **4** blocks under the **1** block.

"You have written a **4** under the **1** on your paper."
"When we touch the blocks we say 4 and 1. We can make the numbers say and if we put this little sign in front of them. (Place a plus sign before the numbers.) You may make the and sign on your paper to the left of the 4 and on the same line with the 4.

"Your numbers now say: 1 and 4. (Point to the symbols as you say this.) Read what you have written. (Pupils read: 1 and 4.)

"When we touch the blocks we say: 1 and 4 are 5. We can make our numbers say this, too. When I draw a line under the 4, the line says are. When I put the 5 under the line the story says 1 and 4 are 5. (Point to the symbols as you say this.)

"On your papers draw the line that says are under the 4. Put the 5 under the line in a straight row with the other numbers.

"Touch the blocks in your picture and let us say the number story. Let us just say the numbers alone this time without calling them blocks each time. Say: 1 and 4 are 5.

"Now read what you have written on your paper: 1 and 4 are 5."

Teacher: ‘With your blocks make a new picture of 5 with a 4 at the top. Let us make this picture with numbers. How many blocks are at the top of your picture? Watch me write a 4 on the top line of the second street of the blackboard paper. (See illustration.)

"You may write the 4 on your paper just as I have done.

"How many blocks are in the lower part of your picture? Watch me write the 1 under the 4 in the number picture. (See illustration at top of page 57, left.)

"You may write the 1 on your paper under the 4.
"What little sign must I make so the numbers will say 4 and 1? Watch me make the sign that says and. (See illustration above, right.) You may make this sign on your paper. Be sure to write it to the left of the 1 and on the same line with the 1.

"Who can tell what I must write next to make the numbers say 4 and 1 are 5? Watch me draw the line that says are under the 1 and put the 5 under the line in a straight row with the other numbers. (See illustration.) You may draw the line and write the 5 on your paper.

"Let us read what these numbers say as I point to them on the board:

4 and 1 are 5

"Touch the top half of your picture. Now touch the top number on your paper. They are the same.

"Touch the bottom half of your picture. Now touch the number you have written under the 4. They are the same.

"Put your two arms around your picture of the blocks. There are 5 blocks in all in your picture. Now touch the 5 on your paper. This number tells you there are 5 in all on your paper.

"The 4 tells you there are 4 in the top of your picture.

"The 1 tells you there is 1 in the bottom of your picture.
"The 5 tells you there are 5 in all in your picture."

Teacher: "With your blocks make a new picture of 5 with a 5 at the top.

"Touch the blocks and say this number story saying just the numbers:
5 and zero are 5

"What does the picture tell me to write for the top number on my paper?

"Watch me as I skip a line in the first street of the paper and write 5 for the top number. (See illustration.)

"You may write the 5 in the first street of your paper as I have done. Before you write be sure that you skip a line as you see on the board.

"What does the picture tell me to write for the lower number on my paper? Watch how I write 0 under the 5 of the paper. (See illustration below, left.) You may write the 0 on your paper.

"Who knows what we must write to make the numbers say 5 and 0? Watch me write this sign. (See illustration below, right.) You may write the sign on your paper as I have done.
"Let us make the numbers say 5 and 0 are 5. (See illustration.) Write on your papers what I have written on the board. Who can read the story that these numbers tell?" (Child reads as teacher points to symbols 5 and 0 are 5.)

The teacher should then repeat the above technique with placing \( \frac{0}{5} \) placing it in the second column beside \( \frac{5}{0} \).

If time permits, continue the lesson with \( \frac{2}{3} \) and \( \frac{3}{2} \). If not, these combinations will be presented in the next lesson. These combinations should be written below the combinations already on the board, care being taken to skip a line to avoid the confusion which arises when numbers are written too closely together.

After all the combinations that make 5 have been completed in the way described, the teacher may introduce the term combination.

Teacher (writes \( \frac{1}{4} \) on the board): "Who can read what these numbers say?"

Pupil: "One and four."

Teacher (adds line below the numbers \( +\frac{1}{4} \)): "Who can read what the numbers say now?"

Pupil: "One and four are."

Teacher: "Can anyone tell me what is missing in this number story? One and four are how many?"

Pupil: "5."

Teacher: "You may write the 5 where it belongs. This number story (pointing as she reads) One and four are five is.
called an addition combination. An addition combination is an addition number picture made with figures instead of with blocks.”

The teacher has now covered the second step in the presentation of combinations. As much time must be spent on this step as is necessary to train pupils to make a combination with blocks and then write the pictures in figures without help. At no time at this stage of the learning process does the teacher introduce testing of the answer in any way. The whole attention is upon making a picture and then writing a combination for it. Use this technique with the combinations that make four, then three, two, one, and even the combination \[ \frac{0}{0} \].

The great emphasis placed upon the teacher’s blackboard model worked out with the children is due to the firm belief of the authors that the fixing of right habits from the start in written work in arithmetic saves much time in later work.

D. First Steps in Testing

After sufficient training in the three preceding steps, namely, forming number groups such as the group 4, 5, or 8, making number combination pictures with objects, and in writing with figure symbols combinations for which a picture has been made so that pupils are able to carry on this work accurately and independent of teacher help, then steps may be taken to introduce simple forms of testing.

The following precautions must be taken at this stage of the work:

(1) To avoid occasions in which pupils may give incorrect responses. Every time a child gives an incorrect answer much re-teaching and practice is necessary to erase this wrong response from his memory, for once having given a wrong response to a combination, confusion is bound to occur each time that the combination is met unless sufficient practice is given on the correct response to establish it as the natural response to the combination stimulus.
(2) To test only on such combinations as are so thoroughly understood and on which the pupil has had so much practice in concrete situations that he is not confronted with the need for counting on fingers, cheating, guessing, discouragement, or an actual dislike for the work. For the mental attitude which is the outcome of assurance and success in primary numbers has won half the battle for the learner.

(3) To watch carefully for pupils who show any of the above handicaps and to substitute re-teaching for further testing for these children. Consider errors on a child’s paper a warning signal that individual re-teaching is necessary.

The following suggestions are offered as effective means of taking the above precautions:

1. Writing Number Twins

The children should have on their desks the same materials described in Step C on page 54 of this book.

Teacher: “With your blocks make a picture of 5 with a 2 at the top. Touch the blocks and say the number combination. Write the combination on your paper. It is not necessary to take the blocks off your card to make a combination of 5 with a 3 at the top. Watch me while I hold John’s card carefully at the top and bottom and slide the card around until the 3 is at the top and the 2 is at the bottom. How many can do this so carefully that no blocks will fall off? (Pupils turn their cards.) Touch the blocks and say this new number combination. Write the combination beside the first one on your paper.

“Let us look at these two combinations. They are like twins. Twins have the same family name and they often look so much alike that it is difficult to tell them apart. These combinations both make 5, and they look so much alike we can hardly tell them apart.

\[
\begin{array}{c}
3 \\
+2 \\
\hline
5 \\
\end{array} \quad \begin{array}{c}
2 \\
+3 \\
\hline
5 \\
\end{array}
\]
"Where is the 3 in the first combination?
"Where is the 3 in the second combination?
"Where is the 2 in the first combination?
"Where is the 2 in the second combination?
"Here are two more number twins. (Write the following on the board.)
\[
\begin{array}{cc}
1 & 4 \\
+4 & +1 \\
\hline
5 & 5 \\
\end{array}
\]

"Who can tell what has happened to the 1 and the 4 in the second combination?
"Here is another combination. (Write on the board.)
\[
\begin{array}{c}
0 \\
+5 \\
\hline
5 \\
\end{array}
\]

"Who can tell me the twin for this combination? (Call on pupil.)
"Let us prove if he is right. With your blocks make a picture of 5 with a 0 at the top. Now turn the card around until the 5 is at the top. Was he correct? Is 0 the right twin?
\[
\begin{array}{c}
5 \\
\end{array}
\]

"Let us name the twins for these numbers. (Write the following combinations on the board.)
\[
\begin{array}{cccc}
1 & 2 & 2 & 4 \\
+3 & +1 & +2 & +0 \\
\hline
4 & 3 & 4 & 4 \\
\end{array}
\]

"What do you see that is funny about the twin for \(\frac{2}{4}\)?"

Following two or three presentations such as this, teachers may begin the first work in testing by asking pupils to write the twins for combinations. Such a test is shown on the next page.
Write the twins for each of these combinations.

\[
\begin{array}{cccccc}
4 & 2 & 0 & 1 & 2 & 5 \\
+1 & +3 & +3 & +1 & +2 & +0 \\
5 & 5 & 3 & 2 & 4 & 5 \\
0 & 1 & 2 & 1 & 1 & 0 \\
+4 & +2 & +0 & +3 & +0 & +0 \\
4 & 3 & 2 & 4 & 1 & 0 \\
\end{array}
\]

It can readily be seen that this exercise enables a child to do his first independent writing of facts without a chance to write a wrong sum, for when he writes the twin +4 for the first combination in the test, the sum of the combination he is writing is before him. In this exercise we have taken precautions (1) and (2) previously mentioned, and the writing of these correct responses will aid greatly in fixing them on the child’s mind. This is an exercise children enjoy since it permits them early successes in the work.

### 2. I-Will-Help-You Cards

After Step C explained on pages 54 to 60 has been covered, the teacher will find I-Will-Help-You Cards of great help to the child. As a child makes a number picture and its twin and after he has written them both, the teacher may hand him two little oak tag cards 2” x 3” in size. Teach him to use his black crayon in writing the combinations on these little cards. One card will be needed for each combination. On one side of the card the pupil will write the combination without the answer. Turning the card over he will write the same combination with the answer. Following is shown how to prepare a card for +2.
Teach pupils to keep these little cards in a pack fastened together with a rubber band. Give them the following suggestions for using the cards:

1. Turn up the side that has no answer. Say the answer to yourself. When you look at $\frac{3}{2}$ say "5" at once. If you stop to say, "3 and 2 are 5," you will be slow in your addition. Then turn the card over to see if you have given the correct answer.

2. If you have given the correct answer, put the card on the right side of your desk. If you do not know the combination or if you gave an incorrect answer, put the card on the left side of your desk.

3. When you are through, study the combinations that you did not know or that you gave incorrectly, by writing the combination and its twin and by making a picture of the combination with your blocks.

4. Now test yourself again on all your cards.

5. Choose a partner. Test your partner with each card. Hold up the card so he can see the combination and you can see the combination and answer. Make a pile of the cards he knows and another pile of the cards he does not know. Let your partner test you. Then each of you should study the combinations that you missed.

For teachers whose groups are not too large it is much more satisfactory if the teacher prepares these I-Will-Help-You cards herself, putting on the numbers with a black marking pencil or
crayon. The cards made by the teacher are naturally neater and more uniform in appearance, a factor which aids in learning.

These cards provide countless opportunities for self testing on the part of the individual pupils. At all times the child can check his answer immediately with the correct answer on the back of the card. Train pupils to make a habit of making the number picture with blocks for any combination for which they name an incorrect answer. This will provide the imagery needed for re-learning which was mentioned in precaution (1) on page 60. The constant exposure to the combination and answer which these I-Will-Help-You cards provide is a further aid in fixing a correct response or in replacing an incorrect one.

3. Formal Tests with Answers Given for Reference

Below is given a suggestive first formal test. It may be given in hectographed or mimeographed form, or written on the blackboard, in which case pupils would copy the combinations on paper.

| Study the combinations and answers at the left of this row before you write the answers. |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 2 | 1 | 0 | 2 | 0 | 1 | 2 |
| 3 | 2 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 2 | 0 | 2 | 1 |

It will be observed that this test has these advantages:

1. The answers are before the child so that at no time must he resort to undesirable attitudes or habits as mentioned in precaution (2) on page 62.

2. The test provides for repetitions from the start, so that though a child might have to refer to the answers at the left early in the test, he probably will not need to rely on them toward the close of the test.
3. Early successes are assured, thus bringing about right attitudes of confidence and assurance and **pleasure**.

### A Possible Second Test

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Again facts that are being tested for the first time are given with answers at the left. Note the repetitions of both new and review facts that this test provides.

### A Possible Third Test

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</table>

These three tests are intended as guides or models for the tests to be employed throughout the work whenever new or difficult facts are being tested. It is hoped that teachers will prepare tests carefully basing the repetitions on the needs of the group they are teaching as well as on the general difficulty ratings listed in Chapter Four on pages 77 to 85.
4. Look at combination such as \( \frac{4}{2} \). Make your picture with blocks and get your answer from the picture. This exercise is strongly recommended for slow pupils who need much work in visualizing combinations.

E. The First Subtraction Combination Lesson

The following detailed procedure is given for the benefit of inexperienced teachers and for such teachers who have not worked out a satisfactory presentation of their own.

Work in this lesson will proceed more rapidly and smoothly than in the first combination lesson in addition due to the experience that the children have had during a series of lessons in making pictures of, writing, and learning addition combinations. The materials needed for this lesson are the 9" x 12" sheet of paper with the black line described on page 49 and five cubical counting blocks or other objects.

Teacher: “Today we are going to learn a new kind of number combination. With your blocks make a picture of five with a one at the top.

“If John had five pennies and wished to spend one penny, he would take one of the pennies away.

“Let us make believe that the five blocks on your card are John’s pennies. He has five pennies in all. Show me 5 in all by putting your two arms around the whole card. Raise your arms and cover the 1 block with your hand so we cannot see the block at all. This shows that John took away the penny that he spent. Keep your hand over the block and look at your card to see how many blocks are left. Who can tell how many pennies John would have left?

“Let us touch the blocks and say this number story like this: ‘Put your two arms around your whole card and say, ‘five blocks.’

‘Raise your arms and cover the one block with your right hand and say, ‘less one block.’
“Now look at the blocks that are left and say, ‘are four blocks.’

“When we say 5 less 1, we mean 5 take away 1.”

The teacher should see that this step is practiced until all children understand. Then ask, “Who can touch the blocks and say the story alone?” Then, “Who can touch the blocks and say the story and call the blocks pennies, like this: 5 pennies less 1 penny are 4 pennies.” Then, “Who can touch the blocks and say the story with just the numbers, like this: 5 less 1 are 4.”

Teacher: “Let us make believe that John had five pennies in all and spent four of them. How many pennies would he have left?

“Let us touch the blocks and say the story to find out.

“Put your two arms around the whole card and say, ‘five blocks.’

“Now raise your arms and cover the four blocks with your right hand and say, ‘less four blocks.’

“Now look at the blocks that are left and say, ‘are one block.’”

The teacher should provide much practice in touching and saying this combination. Ask pupils to say the story calling the blocks “pennies.” Ask for the story with numbers only, as: 5 less 4 are 1.

When the teacher finds that pupils can do this step alone she should have them make a picture of 5 with a 2 at the top. Develop this combination as the previous combinations were developed. Use a concrete problem such as: Mary had five peanuts. She ate two of them. How many did she have left? Then, later: She had five peanuts. She ate three of them.

When the teacher has developed both 5 less 2 and 5 less 3 she should have the pupils make another picture of 5 with a 5 at the top, thereby developing 5 less 5 and 5 less 0. Use a simple problem such as: James had five marbles. He gave away five of them. How many had he left? or: James had five marbles. He gave away none of them.
The above procedure is entirely oral, and aims to impress upon the child the basic idea that the new step he is learning is a **taking away** process in which you do something to get **less than** you had at first.

**F. Introducing the Subtraction Combination Form**

After two or three oral presentations of the subtraction process in which the combinations which make **five, four, three, etc.**, are used, pupils may be shown the number combination symbol for the process they have dramatized.

Children will remain at their seats for this work. The teacher will see that each child is supplied with five blocks or other objects, the 9" x 12" sheet of paper on which the black line is drawn, a pencil, and a sheet of ruled tablet paper which has been folded into four sections as was done for the addition combination presentation on page 54. The teacher will have drawn a large duplicate of a sheet of ruled paper on the board and have indicated the creases by means of dotted lines.

**Teacher:** "With your blocks make a picture of **five** with a **one** at the top. Here you see **5 blocks in all**. Let us see how many blocks would be left if **1 block were taken away**.

"Who will touch the blocks and say this number story? (Pupil touches blocks as he says: **5 less 1 are 4**.)

"Today we are going to learn to make this picture with numbers. How many blocks have you in **all**? I am going to write this number on the top line of the first street on my blackboard paper, like this: (See illustration at the right.)

"You may take your pencils and put a **5** in your paper just as I have done on my blackboard paper."
"How many blocks did you cover with your hand?"

"Watch me while I write this number below the 5 on the board. (See illustration above, left.) You may take your pencils and write a 1 below the 5 on your paper as I have done.

"When we touch the blocks we say 5 less 1. We can make the numbers say less if we put this little sign in front of them. (Place a minus sign before the numbers.) You may make the less sign on your paper to the left of the 1 and on the same line with the 1. Your numbers now say: 5 less 1. (Point to the symbols on the board as you say this.)

"Read what you have written. (Pupils read: 5 less 1.)

"When we touch the blocks we say: 5 less 1 are 4. We can make our numbers say this, too. When I draw a line under the 1 and put a 4 under the line, the story says: 5 less 1 are 4. (Point to the symbols as you say this.) On your papers draw the line that says are and put the 4 under the line in a straight row with the other numbers.

"Touch the blocks in your picture and say the number story. Let us just say the numbers alone, like this: 5 less 1 are 4. Now read what you have written on your paper: 5 less 1 are 4."

**Teacher:** "Let us now find how many blocks would be left if we had 5 blocks in all and took away 4 of them."
SUBTRACTION COMBINATION FORM

"Who can touch the blocks and say this number story? (Pupil touches blocks as he says: 5 less 4 are 1.)

"Let us make this picture with numbers."

The teacher should develop this combination in the same manner as has been described for 5 less 1 are 4. The facts should be written step by step on the board in the second column on the paper as shown in the illustration. The following might be said as the teacher presents the work:

"How many blocks are there in all? Watch me write a 5 on the top line of the second street on my paper. You may write the 5 on your paper just as I have done.

"How many blocks did you cover with your hand this time? Watch me write the 4 under the 5 on the board. You may write the 4 on your paper under the 5.

"What little sign must I make so that the numbers will say 5 less 4? Watch me make the sign that says less. You may make this sign on your paper. Be sure to write it to the left of the 4 and on the same line with the 4.

"Who can tell what I must write next to make the numbers say 5 less 4 are 1? Watch me draw the line that says are under the 4 and put the 1 under the line in a straight row with the other numbers. You may draw the line and write the 1 on your paper.

"Let us read what these numbers say as I point to them on the board: 5 less 4 are 1.

"The 5 tells you there are 5 in all in your picture.

"The - 4 tells you that you have covered 4 with your hand.

"The 1 under the line tells you that there is only 1 left in your picture."

Teacher: "With your blocks make a new picture of five with a two at the top."
The teacher should repeat the development as given above writing the combination on the board, first skipping a line and then writing it in the first column as in the illustration. Continue in like manner with making pictures and writing combinations for the following:

\[
\begin{array}{ccc}
5 & 5 & 5 \\
-3 & -5 & -0 \\
2 & 0 & -5 \\
\end{array}
\]

After all these combinations have been written, the teacher may introduce the term subtraction combination.

TEACHER (writes $\underline{5}$ on the board):

"Who can read what these numbers say?"

Pupil: "Five less one."

TEACHER (adds the line below the numbers $\underline{5}$): "Who can read what the numbers say now?"

Pupil: "Five less one are."

TEACHER: "Can anyone tell me what is missing in this number story? Five less one are how many?"

Pupil: "Four."

TEACHER: "You may write the 4 where it belongs. This number story (pointing to the symbols as she reads) five less one are four is called a subtraction combination. A subtraction combination is a taking away number picture made with figures instead of with blocks."

The teacher has now taken the steps needed to present the addition process and the subtraction process. She has practiced on each process separately until pupils thoroughly understand its meaning. Pupils have learned to make the combination pictures with objects, to touch and say them and to write them
correctly, but most important of all they have learned to interpret the number symbols and signs meaningfully.

The teacher is now ready to present the final step, which will become her major teaching technique for the remainder of all lessons in the presentation of addition and subtraction combinations.

G. Presenting Addition and Subtraction Facts Together

Economy in learning as well as organized thinking are both secured by presenting addition and subtraction together as reverse processes. The child who is to learn $+5$ should learn $\frac{3}{8}$ as a unit of work and fully comprehend why these combinations are so closely related. By using the block pictures on the card the child sees this readily since all of these facts can be learned from a single picture on his card.

Below is given a suggestive procedure for introducing the facts together. The pupils should have four blocks, the card with the line, a piece of tablet paper folded into four columns, and a pencil. The teacher has made a duplicate sheet of paper with dotted lines to indicate the creases on the blackboard.

**Teacher:** “With your blocks make a picture of a four with a one at the top. Who can touch the blocks and say the two addition combinations?

“Who will touch the blocks and say the two subtraction combinations?

“Who can touch the blocks and say all four combinations together, like this:

“Let us write these combinations in a row across our papers.

“Touch and say: 1 and 3 are 4. Write this combination in the first street.”
"Touch and say: **3 and 1 are 4.** Write this combination in the next street.

"Touch and say: **4 less 1 are 3.** Write this combination in the third street.

"Touch and say: **4 less 3 are 1.** Write this combination in the last street on your paper.

"You have now written all the four combinations about this picture on your card. Let us write the four combinations for another picture."

**Teacher:** "With your blocks make a new picture of **four** with a **zero** at the top."

The teacher will repeat the above process, skipping a line on the board before writing the four facts

<table>
<thead>
<tr>
<th>+3</th>
<th>+1</th>
<th>-1</th>
<th>-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Continue with **+2** and **−2** and with any other combinations the teacher selects.

**Teacher:** "Today let us make a picture with our blocks of a **five** with a **two** at the top. Who can make up a story about this picture like this: I see 2 black kittens and 3 gray kittens. How many kittens are there in all?"

**Pupil 1:** "I have 2 black chicks and 3 yellow chicks. How many chicks have I altogether?"

**Pupil 2:** "I have 2 big dolls and 3 little dolls. How many dolls have I in all?"

**Pupil 3:** "I had 2 pennies. My daddy gave me 3 more pennies. How many pennies have I in all?"

**Teacher:** "Touch the blocks and say: **5 less 2 are 3.** Who can make up a story about this picture like this: I had 5 pennies. I spent 2 of them. How many pennies are left?"
PUPIL 4: "I had 5 rabbits. I sold 2 of them. How many rabbits have I left?"

PUPIL 5: "I had 5 candy eggs. I ate 2 of them. How many eggs are left?"

PUPIL 6: "I had 5 dishes. I broke 2 of them. How many dishes did I have left?"

The above exercise provides a splendid background for the understanding of thought problems in arithmetic in the later elementary grades. Tie up each new memory fact with interesting little thought problems made by the children to illustrate the combination they are studying.

From this point on the following steps may be taken in presenting any new combination. Teach the combinations in family groups having the same sum or minuend. That is, present the facts that make 7: 3 4 2 5 1 6 7 0 and their corresponding subtraction facts as one large teaching unit. Below are listed the activities undertaken in presenting 3/4 in the order which would secure the best learning results:

1. Make the combination of 7 with a 3 at the top with the blocks or objects.

2. Touch the blocks and say the four combinations:

\[
\begin{align*}
+4 & \quad +3 & \quad -3 & \quad -4 \\
7 & \quad 7 & \quad 4 & \quad 3 \\
\end{align*}
\]

3. Write the four combinations on paper.

4. Make little stories or thought problems about any one of the four combinations that the teacher may designate, or for all of them.

5. Make the four I-Will-Help-You cards, one for each combination.

6. Use the combinations in games in which the new facts are mixed with review fact.

7. Meet the new facts in tests in which the new facts are mixed with review combinations.
Following the completion of these seven steps the teacher would then proceed with another of the new combinations that make 7, such as \( \frac{5}{7} + 2 \), using the same outline of activities.

H. Special Aids to Mastery and Speed of Response

After combinations have been taught, the teacher may aid pupils by calling their attention to special tricks about dealing with zeros. These frequently aid slow pupils in speeding up the memorization of their combinations.

**Tricky Number Zero**

The number zero is a tricky little number. It means **none, not any, or nothing.**

1. If you add a zero to another number, the number stays the same because you have added nothing.

\[
\begin{array}{cccccccccccc}
5 & 4 & 3 & 2 & 9 & 7 & 8 & 6 & 0 & 1 \\
+0 & +0 & +0 & +0 & +0 & +0 & +0 & +0 & +0 & +0 \\
\hline
5 & 4 & 3 & 2 & 9 & 7 & 8 & 6 & 0 & 1 \\
\end{array}
\]

2. If you add another number to a zero, the number stays the same because you have added nothing to the number.

\[
\begin{array}{cccccccccccc}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
+8 & +3 & +9 & +7 & +2 & +6 & +0 & +5 & +1 & +4 \\
\hline
8 & 3 & 9 & 7 & 2 & 6 & 0 & 5 & 1 & 4 \\
\end{array}
\]

3. If you subtract a zero from another number, the number stays the same because you have subtracted nothing.

\[
\begin{array}{cccccccccccc}
7 & 5 & 0 & 9 & 2 & 4 & 8 & 3 & 6 & 1 \\
-0 & -0 & -0 & -0 & -0 & -0 & -0 & -0 & -0 & -0 \\
\hline
7 & 5 & 0 & 9 & 2 & 4 & 8 & 3 & 6 & 1 \\
\end{array}
\]

4. If you subtract a number from itself, the answer is always zero because you have nothing left.

\[
\begin{array}{cccccccccccc}
2 & 7 & 1 & 9 & 0 & 6 & 4 & 8 & 5 & 3 \\
-2 & -7 & -1 & -9 & -0 & -6 & -4 & -8 & -5 & -3 \\
\hline
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
\]
CHAPTER FOUR

DIFFICULTY RATINGS OF THE ADDITION AND SUBTRACTION COMBINATIONS

There have been two types of investigations carried on by research workers in an attempt to determine the difficulty of the 100 addition combinations and the 100 subtraction combinations given below:

<table>
<thead>
<tr>
<th>The 100 Addition Combinations</th>
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</thead>
<tbody>
<tr>
<td>0  1  2  3  4  5  6  7  8  9</td>
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<td>0  0  0  0  0  0  0  0  0  0</td>
</tr>
<tr>
<td>0  1  2  3  4  5  6  7  8  9</td>
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<tr>
<td>1  1  1  1  1  1  1  1  1  1</td>
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<tr>
<td>0  1  2  3  4  5  6  7  8  9</td>
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<td>2  2  2  2  2  2  2  2  2  2</td>
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The 100 Subtraction Combinations

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</table>

One type of study, of which the Clapp\(^1\) investigation is representative, is based on the responses of upper-grade pupils. This type of investigation determines errors made, and therefore bases its classification of difficulty of combinations on the frequency of errors. The limitations of this type of practice have been

ADDITION AND SUBTRACTION COMBINATIONS

summed up by Knight and Behrens who say, "The limitations of this type of investigation are mainly due to the fact that the relative difficulty of combinations for upper-grade children is a product of the inherent difficulty of the combination plus unknown amounts of practice, both successful and unsuccessful, upon the several combinations in the past experience of these children. Based on this type of investigation, if one combination is harder than another, its difficulty is due to an unknown amount of influence of the inherent difficulty of the combination plus unknown amounts of successful and unsuccessful practice. There seems little question that the influence of unequal amounts of practice seriously disturb the validity of difficulty ratings based on the work of upper-grade pupils. It seems sensible to assume that had this unknown immediacy and success in correction of error and unknown types of distribution of the practice, as far as time of practice is concerned, been different, the difficulty ratings reported would have been significantly changed. That is, difficulty ratings based on upper-grade children are meaningless unless we know the cause of those difficulties. To assume that such difficulty rating even closely corresponds to the inherent difficulty of the combinations is exceedingly questionable."

To a certain extent this criticism is just, but it must be realized that the experimenters were in reality dealing with different matters. Clapp's was a test of the results of teaching. It revealed the inadequacies and failures of the teachers' methods of the past, while Knight and Behrens made their study as a teaching situation, making a scientific study of the difficulties observed in the mastery of the various combinations by the pupils. There is, moreover, a significant contribution which the Clapp study made, namely, it proved conclusively that the so-called "45 combinations" long regarded as the content for second-grade number development were not adequate to teach the whole

1 "The Learning of the 100 Addition Combinations and the 100 Subtraction Combinations." Knight and Behrens. Longman's Monographs in Education. Longmans, Green & Co., 1928.
background needed for upper-grade computation in addition and subtraction. At the time of the Clapp investigation the great majority of upper-grade children had received their primary training from teachers who made it their aim to teach “the 45 combinations” in each process. The remaining combinations were left to chance or to luck, it seems, for the 45 facts did not include the zero combinations and assumed that to teach a child \( \frac{9}{3} \) was a guarantee that he would know \( \frac{3}{9} \) without practice or even presentation. Below is given the old list of 45 addition combinations, so the teacher of today may see how inadequate this work was, and why Clapp secured the ratings which he gave to combinations, such as the zero combinations.

<table>
<thead>
<tr>
<th>The Former 45 Combinations in Addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>2 3 4 5 6 7 8 9 2 2 2 2 2 2 2 2 2</td>
</tr>
<tr>
<td>3 4 5 6 7 8 9 3 3 3 3 3 3 3 3 3</td>
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<td>4 5 6 7 8 9 4 4 4 4 4 4 4 4 4 4</td>
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<tr>
<td>5 6 7 8 9 5 5 5 5 5 5 5 5 5 5 5</td>
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<tr>
<td>8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9</td>
</tr>
</tbody>
</table>
Since the Clapp investigation the erroneous idea that 45 facts are adequate for the mastery of all combinations has been discarded, and textbooks, courses of study, and actual classroom practice have been changed so that all the 100 facts in each process are carefully taught and thoroughly mastered. This, then, may be regarded as the real contribution which his study made.

The second type of investigation to determine difficulty ratings has been based upon learning difficulties checked through carefully controlled "first learnings" in which important factors of learning are closely observed and recorded. Such studies attempt not only to determine which combinations are more difficult than others but also to determine how much practice each combination seems to require for mastery for bright, normal, and dull pupils. An outstanding contribution in this field of investigation has been made and recorded in detail by Knight and Behrens\(^1\) who offer a scientific and helpful report of the learning difficulties of addition and subtraction combinations which is the best guidance available at the present time. Their ratings are given below as an aid to the teacher in determining general emphasis both in presentation and review. However, every teacher will supplement a list of ratings such as this with her own observations of specific difficulties met by individual children within her own group. For convenience we have grouped the combinations in quartiles, so that the ratings are even more apparent.

**Addition Combination Difficulty Ratings**\(^2\)

"Rank" is general difficulty rating derived from pooling all factors considered: number of responses to learn, number of errors encountered in learning, time of first successful response, time of final learning response, and time of review responses.

---

1 Knight and Behrens, "The Meaning of the 100 Addition Combinations and the 100 Subtraction Combinations." Longman's Monographs in Education. Longmans, Green & Co., 1928.

2 Ibid., pp. 17–20.
A striking difference occurs in the ratings given to the zero combinations in the two types of investigations as carried on by Knight-Behrens and by Clapp.

<table>
<thead>
<tr>
<th>Combination</th>
<th>Knight-Behrens</th>
<th>Clapp</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 + 0(^1)</td>
<td>47</td>
<td>18</td>
</tr>
<tr>
<td>8 + 0</td>
<td>36</td>
<td>60</td>
</tr>
</tbody>
</table>

\(^1\) That Knight-Behrens found 4 + 0 relatively hard is probably because it was the first zero combination taught.
The Knight-Behrens investigation indicates that the inherent difficulty of the zero combinations is not as great as the errors made by upper-grade children would indicate. This has been partly accounted for by the previously mentioned practice of teaching only 45 combinations instead of 100, the former list disregarding zero combinations entirely. It may also be partly due to the fact that the Clapp test was administered by naming combinations orally at a uniform speed and requiring pupils to write responses quickly in rows of squares so as to keep up with the tester. Some of the zero errors may have been made by pupils who respond more accurately to a visual stimulus, such as flash cards and written exercises rather than by hearing combinations called in rapid succession, by pupils who for some reason did not hear the combination accurately, or by pupils who lost their place, thereby omitting an answer or placing it in the wrong square on the answer sheet.

Following are given the combination ratings for the 100 subtraction combinations as given by Knight-Behrens:

<table>
<thead>
<tr>
<th>Combination</th>
<th>Knight-Behrens Learning Difficulty</th>
<th>Clapp Learning Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 + 2</td>
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<tr>
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</tr>
<tr>
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<td>1</td>
</tr>
<tr>
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</tr>
<tr>
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### Subtraction Combination Difficulty Ratings

<table>
<thead>
<tr>
<th>Most Difficult Quartile</th>
<th>Second Most Difficult Quartile</th>
<th>Third Most Difficult Quartile</th>
<th>Easiest Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination Rank</td>
<td>Combination Rank</td>
<td>Combination Rank</td>
<td>Combination Rank</td>
</tr>
<tr>
<td>15 - 6 100</td>
<td>12 - 7 75 ( \frac{1}{2} )</td>
<td>5 - 2 50</td>
<td>7 - 6 25</td>
</tr>
<tr>
<td>15 - 8 99</td>
<td>8 - 5 74</td>
<td>5 - 3 49</td>
<td>8 - 8 24</td>
</tr>
<tr>
<td>13 - 8 97 ( \frac{1}{2} )</td>
<td>16 - 8 73</td>
<td>10 - 2 48</td>
<td>2 - 0 24</td>
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<tr>
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<td>12 - 5 72</td>
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<td>12 - 9 65 ( \frac{1}{2} )</td>
<td>4 - 2 41</td>
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<td>12 - 8 65 ( \frac{1}{2} )</td>
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<td>11 - 2 59 ( \frac{1}{2} )</td>
<td>2 - 1 35</td>
<td>8 - 0 10</td>
</tr>
<tr>
<td>8 - 3 84</td>
<td>6 - 4 59 ( \frac{1}{2} )</td>
<td>9 - 8 34</td>
<td>3 - 0 9</td>
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<td>11 - 8 83</td>
<td>7 - 5 58</td>
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<td>8 - 1 29 ( \frac{1}{2} )</td>
<td>3 - 3 5</td>
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<tr>
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<td>5 - 0 4</td>
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<td>8 - 2 75 ( \frac{1}{2} )</td>
<td>10 - 6 51</td>
<td>5 - 4 26</td>
<td>0 - 0 1</td>
</tr>
</tbody>
</table>

An interesting feature of the Knight-Behrens addition and subtraction combination ratings is the fact that they show that inherent difficulty parallels quite closely the size of the numbers to be added or subtracted. Note the following comparisons:

---

1 "The Learning of the 100 Addition Combinations and the 100 Subtraction Combinations," pp. 29–33. Knight and Behrens. Longmans, Green & Co.
### Addition Combination Ratings

<table>
<thead>
<tr>
<th>Ten Most Difficult Combinations</th>
<th>Middle Group of Ten Combinations</th>
<th>Ten Least Difficult Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Rank</td>
</tr>
<tr>
<td>$5 + 9$</td>
<td>100</td>
<td>$4 + 2$</td>
</tr>
<tr>
<td>$7 + 9$</td>
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<td>$7 + 7$</td>
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<td>98</td>
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<td>$8 + 9$</td>
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<tr>
<td>$9 + 7$</td>
<td>95</td>
<td>$5 + 4$</td>
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<td>$2 + 5$</td>
</tr>
<tr>
<td>$6 + 8$</td>
<td>91</td>
<td>$3 + 8$</td>
</tr>
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</table>

### Subtraction Combination Ratings

<table>
<thead>
<tr>
<th>Ten Most Difficult Combinations</th>
<th>Middle Group of Ten Combinations</th>
<th>Ten Least Difficult Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Rank</td>
</tr>
<tr>
<td>$15 - 6$</td>
<td>100</td>
<td>$11 - 6$</td>
</tr>
<tr>
<td>$15 - 8$</td>
<td>99</td>
<td>$6 - 5$</td>
</tr>
<tr>
<td>$13 - 8$</td>
<td>$97\frac{1}{2}$</td>
<td>$8 - 6$</td>
</tr>
<tr>
<td>$13 - 4$</td>
<td>$97\frac{1}{2}$</td>
<td>$10 - 2$</td>
</tr>
<tr>
<td>$14 - 8$</td>
<td>96</td>
<td>$5 - 3$</td>
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</tr>
<tr>
<td>$14 - 6$</td>
<td>90</td>
<td>$10 - 7$</td>
</tr>
</tbody>
</table>

It is recommended that teachers refer to this chapter repeatedly during the time that combinations are being taught and reviewed. Upper-grade teachers will also find it a source of help in giving remedial work to slow moving groups. The ratings given here will help greatly in preparing the combination set-ups for the games and devices described in the next chapter. The 100 combinations were included in this book so that difficulty ratings may be secured from it by third-grade teachers who will teach the combinations from 11’s through 18’s in the first half of the third grade.
CHAPTER FIVE

THE USE OF GAMES IN TEACHING NUMBER COMBINATIONS

Games provide an excellent means of motivating the needed practice on memory facts. By means of them the child’s interest is much greater than in a formal drill exercise from which the play element has been eliminated. To master the memory facts of the addition and subtraction combinations there must be constant repetition and practice. Mere drill in fixing number facts without interest is monotonous and does not result in learning economically and effectively.

One means of sustaining interest is to provide such a variety of games that whenever pupils show any lack of enthusiasm for a particular game or exercise a different one may be substituted. In this way the number period is kept so interesting that pupils look forward to it with eager anticipation.

Many games, thoroughly tried and tested in many classroom situations, are included in this chapter. Part of the games are intended for second-grade teachers. A few of them are intended for third-grade teachers who will need many games in reviewing the 100 addition and the 100 subtraction combinations. Such games are labeled Grade 3. The thirty-eight games have been grouped into three classes: (1) classroom games; (2) “make-believe” devices; (3) out-of-school games. The first two groups are both intended for use in the class period, since they are of such a nature as to provide a maximum of controlled practice in a minimum of time. The out-of-school games, on the other hand, provide fun and profit, but do not always provide a maximum of practice on the most difficult facts. Each of the three groups is described in detail preceding the games themselves. It is expected
that in all cases teachers will adapt the numbers used in the exercises to the work which their own pupils have covered.

FIRST GROUP

Classroom Number Games

The games below have been selected as ideal number games for classroom use because they have the following advantages:

1. They do not have distracting features which divide the child's attention between the play activity itself and the thinking of accurate number responses. Games, for example, in which a teacher throws a ball for a child to catch while she calls a number combination for him to answer are distracting, for frequently the attention of the child and of the whole class is centered more on catching the ball than upon answering the combination correctly. Games of this kind divert too much of the child's attention away from the computation of numbers. In class periods where time is limited, these games are too time consuming for the value which can be derived from them. It is suggested that such games can best be used by pupils in their out-of-school play.

2. The games given here permit the teacher to regulate the number facts upon which the child will practice. They also permit her to provide as many repetitions as the difficulty of the combinations would warrant. In a game in which pupils throw bean bags at numbers, counting the sum of the two numbers on which their bag falls as their score, the children compute, it is true, but the teacher has no way of regulating the combinations which are formed by the throwing of the bags. For this reason, the game is not useful to teachers who wish to use the time of the class period in practice upon specific number combinations. The most difficult facts should receive many more repetitions than the easier combinations. The bean-bag game is an excellent out-of-school game where economic use of time is not as necessary as it is in the class period.
3. The classroom games here selected provide for motivation and interest, since they permit wholesome competition between groups or with an individual pupil's own past record. Games which stress competition between individuals are to be discouraged in the classroom for too frequently such competition favors the bright pupil and discourages the slow pupil and also centers the attention of the child on trying to beat another individual. This is not the attitude we wish pupils to develop since our efforts should be directed toward cooperation in a group rather than toward the selfish motive of trying to excel over another individual. Games stressing competition between individuals are extremely harmful to nervous children whose nervous condition is increased by such activities.

4. These number games provide for the activity of the entire class. In no case is the slow pupil eliminated, so that bright pupils who do not need the practice are the active participants. In ineffective games, for example, a pupil is permitted to name combinations until he makes a mistake. The pupil who sees the mistake is permitted to go on until he makes an error. Unfortunately, too often the mistake is detected by the bright pupil who does not need the practice. No games in which the slow pupils are eliminated should be used in the arithmetic period in the classroom, since this period should provide practice for the children who are in need of such practice.

5. Many of the games given here provide for responses by the entire class or by a group rather than for responses of a single individual. When a single individual is reciting, a teacher cannot be certain that the attention of every child in the class is focused upon the number responses. Not every child may be computing mentally with the child who is reciting. For this reason, games which require every child in the room to write or to indicate in some other way a response for every combination are more valuable for class games than games which call for the responses of a single child. Teachers should use as many multiple response
games as possible in class periods, so as to make the practice effective for every pupil in the group.

I. AN AUTO RACING GAME

Prepare hectographed or mimeographed sheets containing the number combinations upon which you wish to practice. Cut strips of plain paper about two inches wide and as long as the width of the hectographed or mimeographed sheet. These strips will be used to lay under the printed rows of combinations. Prepare enough of these strips so each child may have two or three.

Pupils remain at their seats for this game. Place the same number of pupils in each row if this is possible. Each row may choose the name of a good fast car. List the names of the cars on the blackboard. Ask the pupils to lay a strip of paper under a row. Lay it so the answers to the combinations can be written on the strip of paper as in the following illustration. Pupils will write all the answers for the combinations in the row.

\[
\begin{array}{cccccccc}
1 & 3 & 4 & 0 & 2 & 1 & 3 & 4 \\
4 & 2 & 0 & 3 & 3 & 2 & 1 & 1 \\
\hline
5 & 5 & 4 & 3 \\
\hline
5 & 2 & 4 & 1 & 4 & 3 & 0 & 2 \\
1 & 4 & 3 & 6 & 2 & 3 & 5 & 5 \\
\end{array}
\]

Ask the children to stand by their desks as soon as they have finished a row. The first row with every child standing wins a point for speed.

Have the pupils exchange papers with the child across from them. The teacher should read the correct answers slowly for them. Ask them to put a ring around any answer that is wrong. Then the papers should be returned.

T. I & II-7
Permit children who made no mistakes to stand. The row that has the most perfect papers wins a point for having no accidents.

To record combinations which need further practice ask pupils who have a ring on their paper to lay the strip back under the row. Have them find the combination missed and copy it on a sheet of paper to be studied later.

Continue the race on the same or on other rows in this same way. Use all long straight edges of the strips on both sides. In this way a strip will permit for testing of four rows.

II. I-Am-Thinking-of-Two-Numbers Game

Provide all children with pencil and paper.

LEADER: “I am thinking of two numbers that make 8. One of them is 2. Can you name the other number?”

The children all write the other number on a piece of paper. The leader then calls on some child to read his number. All pupils who have written the correct number raise hands. This is a small reward for accurate work.

When the teacher desires to direct the number facts which are to be used, she acts as the leader herself. When a general review is desired she may permit the children to act as leaders. The child who is called upon and gives the correct number may act as the next leader.

III. How-Many-Have-I-in-My-Other-Hand Game

Use wooden beads, small pieces of chalk, pegs, or any available small objects for this game. Provide pupils with pencil and paper.

Pupils are asked to close their eyes while the leader places 2 objects in one hand and 4 in the other. He then places his hands behind him. As he calls “Ready” pupils open their eyes.

LEADER: “I have 6 things in all. I have 2 in my left hand. Who can tell how many are in my right hand?”

The children in the class all write this number on a sheet of paper. The leader calls upon some child to read his number.
All pupils having written the correct answer may stand. This is a small reward for accurate work.

When the teacher desires to direct the number facts which are to be used, she acts as leader herself. When she is having a general review, she may permit pupils to act as leaders. The child who gives the correct answer may act as the next leader.

IV. Writing-Partners Game

This game is excellent following the presentation of the combinations having the same minuend. Supposing the children have just learned:

\[
\begin{array}{cccccccccc}
8 & 8 & 8 & 8 & 8 & 8 & 8 & 8 & 8 \\
8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\
\end{array}
\]

Place these subtraction combinations with their remainders as you see above on the board for quick review.

The teacher calls a number such as 2. Pupils write its partner 6 on their papers. Then they look up at the board to check to see if they were correct.

The teacher calls number, 5. Pupils write its partner, 3, on their papers, and check with the remainders on the board.

After sufficient practice has been given with the facts on the board before the pupils, erase the remainders leaving only the combinations. From now on the teacher writes the numbers on the blackboard, requiring pupils to write the partners on their papers from memory. Pupils will race by rows. For example:

<table>
<thead>
<tr>
<th>Teacher Writes on Board</th>
<th>Pupils Write on Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 1</td>
<td>1 7</td>
</tr>
<tr>
<td>6 5</td>
<td>2 3</td>
</tr>
<tr>
<td>3 2</td>
<td>5 6</td>
</tr>
<tr>
<td>0 8</td>
<td>8 0</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Pupils exchange papers.

The teacher looks at her list and calls the partners. Pupils correct papers by placing a ring around any incorrect partner.
Papers are returned. Pupils with perfect papers stand. The row having the most perfect papers wins a point.

To check for needed practice ask, "Who missed the first?" "the next?" "the next?" If hands are raised for any fact, rewrite the remainder under the row of combinations originally used and leave it there so pupils may refer to it if necessary. Repeat the game, changing the order of the numbers which the teacher writes.

V. Writing-Remainders Game

The directions given here are those needed for playing the "Game of Five." Any minuend, however, may be used instead of five.

The teacher says, "I am thinking of two numbers that make five." The children all write 5 on a piece of paper. The teacher says, "One of the numbers is three." The children all write 3 below 5. Then the teacher asks, "What is the other number?"

The children write the answer like this: $\begin{array}{c} 5 \\ 3 \\ \hline 2 \end{array}$

Use any combination for this game. It provides excellent opportunities for review.

VI. Finding-Number-Combinations Game

Prepare the following cards:

```
0 1 2 3 4 5 6 7 8 9
```

Place these cards in the chalk tray of the blackboard.

Divide the class into two teams. The leader will say the answer for any combination the class has studied. Pupils sit in their seats and look for two numbers that make this sum. They raise their hands when they find two such numbers. Call upon pupils, choosing slower pupils as often as possible. A child who can find two cards that make this number wins a point for his side.
VII. Making-Number-Combinations Game

For the Game of Five use 6 cards like these:

```
[0] [1] [2] [3] [4] [5]
```

Give each card to some child. The leader calls one of the numbers on the cards: "Two."

The child who has card 2 comes to the front of the room. The child who has card 3 comes to the front of the room also because 2 and 3 make five.

**Leader:** "Four."

Children who have cards 4 and 1 must stand.

This is a fine game for practice upon combinations with the same sum. Below are given the cards needed for other numbers:

- **Game of Four**
  - 0 1 2 3 4

- **Game of Six**
  - 0 1 2 3 3 4 5 6

- **Game of Seven**
  - 0 1 2 3 4 5 6 7

- **Game of Eight**
  - 0 1 2 3 3 4 4 5 6 7 8

- **Game of Nine**
  - 0 1 2 3 3 4 5 6 7 8 9

- **Game of Ten**
  - 1 2 3 4 5 5 6 7 8 9

VIII. Help-Me-Make-a-Number Game

The teacher has written on the blackboard:

```
0 1 2 3 4 5 6 7 8 9
```

She also has a set of cards bearing these same numbers which she holds in her hand.

The teacher holds up a card with 4 written on it and says, "Who will help me make 9?" The children all write the number needed to make 9 on a sheet of paper. The teacher then names some child. The child named goes to the blackboard and points to 5, and says, "Here is 5. It will help you make 9."
All pupils who have written the correct number may stand. This is a small reward for accurate work. Holding up another card, the teacher continues by asking for a new combination.

IX. Fencing Game

Divide the children into two teams. Permit them to stand in two rows facing each other, or, if the class is large, permit pupils sitting in each two rows of seats to sit facing each other.

Each child asks the child opposite him a number combination. If the child cannot answer, any one from the other team may answer. One point is scored for his side each time a pupil can catch a pupil on the opposing team, provided the correct answer can be given by some one on his own side.

X. Circle Game

Ten children stand in a circle holding cards bearing the numbers from 0 to 9. One child steps in the center of the ring and says, “I am 7. Who will help me make 10?”

The child with the card numbered 3 steps into the ring and says, “I am 3. I will help you make 10.”

The child with the card numbered 3 remains in the ring and the child with number 7 goes back to the circle. The child with the card numbered 3 says, “I am 3. Who will help me make 8?”

The game proceeds as before.

XI. A Matching Game

This game will help children to associate the name, the number, and the quantity of the figures from one to ten.

Prepare thirty 6” x 9” cards. On ten of these cards print the numbers from 1 to 10. Print one number on each card. On another ten cards print the names of the numbers, “one,” “two,” “three,” “four,” etc. Print one name on each card. On the remaining ten cards prepare pictures of these numbers. It is suggested that the following pictures be used:
Distribute these cards among the children. Call upon a pupil. He comes to the front of the room and shows his card to the class. The other two pupils holding the same number come to the front and "match" his card.

XII. **May-I-Have-Your-Place Game**

Distribute combination cards upon which you desire special practice among the members of the class. Pupils may remain at their seats for this game. One pupil stands at the front of the room, selects one of the cards in his mind, for example \( \frac{3}{+5} \) and says, "May I have your place, Eight?"

The child having the card \( \frac{3}{+5} \) now comes to the front of the room and hands his card to the leader, who goes to the seat. The new child now acts as leader. Pupils change cards with a child nearby and the game continues.

In case the child at the front of the room calls an incorrect number the child is asked to name the combination he has in mind. The child is then told the combination and he steps to
the board and writes it three times as a means of studying it. He then returns to the class and continues to play the game.

Be sure to have pupils change cards each time, since this requires pupils at their seats to think a new combination every time a new child asks the question, thus providing much practice.

XIII. The Train Game

The teacher places a number of combination cards which need special practice along the chalk tray of the blackboard. On these cards the combination is printed on the front and the combination and answer is printed on the back. The cards are placed with the combination side of the card facing the pupils. A child is chosen to be the engineer of the train. He decides where he wishes to run his train. He aims to get his train to this destination without accidents by naming all the combinations without error. After he names a combination he turns the card over so that the combination-and-answer side faces the class. If his answer is correct he goes on to the next “station.” If, however, he has made an error he takes the card to his seat and studies it. Another engineer is chosen. When the child who has missed thinks he knows the combination he returns to the class and has another chance to be the engineer.

There is a special advantage in this game in that the engineer as well as the class see both combination and answer repeatedly in this game. It is well for the teacher to change the position of the cards each time an engineer is chosen so pupils will not memorize the order in which the combinations are placed.

XIV. Finding-a-Seat Game

This game is helpful in practicing on all combinations having the same sum. Children remain at their seats to play the game. One child must stand. He is “it.” He stands by a child’s desk. Assume that the class is practicing giving all the combinations that make 10. The teacher says one of the two numbers that make 10. The first of the two children to say the other number
needed to go with the one named by the teacher to make 10 may have the seat. The other child must stand and be "it" until he can beat some child who has a seat.

In this game the bright child is eliminated and the slower pupils have more active participation.

XV. Cat-and-Mice Game

Choose one child who does not need practice to be the cat in this game. The rest of the class stand in line and play they are the mice. The cat holds a pack of combination cards. The first mouse whose name is called gives the required sum or remainder for the first combination card exposed. The teacher counts to herself, "1, 2, 3, 4, 5" and then says aloud, "Stop." If the mouse has not given the correct answer by the time the teacher has said "stop" he is caught and must take the card to his seat and study it by writing the combination and answer three times. He may return to the line when he is sure he has learned the combination. If a mouse gives the incorrect answer and the cat does not know it, the cat must also go to his seat and study the combination and another cat is chosen. At all times permit children to re-enter the game as soon as they have studied a combination.

XVI. Combination-Grouping Game

The teacher distributes cards upon which she wishes to give special practice. In her own hand she holds a pack of cards like those below:

\[
\begin{array}{cccccccc}
5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 \\
\end{array}
\]

The numbers on the cards depend on the combinations which have been taught.

As the teacher holds up the card 8 the pupils who have cards
whose sums or remainders are 8 come to the front of the room, where the class may check for errors.

The following cards are an example of what they might see:

\[
\begin{array}{c}
4 + 4 \\
10 - 2 \\
3 + 5 \\
9 - 1 \\
2 + 6
\end{array}
\]

Pupils making an error must study the combination missed by writing it three times and then continue with the game.

The game may be played by having the teacher write the number on the board instead of showing it on a card.

XVII. A Relay Race

This game may be used for practice in addition or subtraction. The teacher writes two sets of combinations on two parts of the blackboard as follows:

\[
\begin{array}{cccc}
2 & 3 & 5 & 2 & 4 \\
6 & 4 & 3 & 5 & 3
\end{array}
\quad
\begin{array}{cccc}
5 & 3 & 4 & 6 & 3 \\
2 & 5 & 3 & 2 & 4
\end{array}
\]

Divide the class into two teams with a captain for each team. Assign one set of combinations to each team. Have each team form a line. When the teacher calls "Go," the two captains run to the board and write the answers to the first example in their assigned group. Each captain then gives the chalk to the pupil next in line. He writes the answer to the next combination and takes his place at the end of his line.

As each pupil receives the chalk, he runs to the blackboard and writes his answer, passes the chalk to the child next in line, and takes his place at the end of the line. The team that finishes its set first wins the race.

Repeat the game after the teacher has changed the order of the combinations in each set.
XVIII. Which-Combination-Did-I-Write Game

Choose some child to stand and face the back of the room. The teacher writes a combination on the blackboard such as \( 3 + 4 \) and then erases it. The children call “Seven.” The child then tries to guess which combination was written.

Pupil: “Is it 2 and 5 are 7?”
Class: “No, it is not 2 and 5 are 7.”
Pupil: “Is it 0 and 7 are 7?”
Class: “No, it is not 0 and 7 are 7.”
Pupil: “Is it 3 and 4 are 7?”
The pupils clap their hands.

Each child is permitted two turns before he takes his seat. Should a child make an error have him study this combination by writing it before he continues in the game.

XIX. Holding-Up-Cards Race

Prepare cards with the answers for the combinations which are to be practiced. Two duplicate sets of these answer cards are needed.

Two teams are chosen. Distribute the two sets of answer cards among the children, giving each child a card. Each team should have an answer for each combination to be used.

The teacher holds the set of the combinations to be used for practice. She holds up a card such as \( 3 + 4 \). The child who first holds up the right answer card gets a score for his team. When the two children hold up the right card at the same time, it is a tie, and each side gets a score.

When a child holds up a wrong answer card, his team must lose one point and the point is erased from the score.

Have the pupils exchange answer cards frequently so as to provide more practice for each pupil.
XX. Making-Number-Combination Game

Print ten cards, placing on each one of the following numbers:

\[0 1 2 3 4 5 6 7 8 9\]

Set them up along the blackboard ledge out of their regular order.

The leader is given a pointer and told to touch any two cards whose answer when added is not greater than 10. The remainder of the class sit at their seats with pencil and paper. They write the sum of the two numbers as the leader touches the cards.

The leader then names the sum so all may hear. All pupils having the correct sum raise their hands. This is a small reward for accurate work. The game then continues.

When the teacher desires to control the combinations made or to provide certain repetitions, she will act as the leader herself. When a general review is desired a pupil may act as leader.

SECOND GROUP

Make-Believe Games and Devices

Many devices provide keenly interesting games for children when they are called by some well-known game played by children or by adults. Children derive almost as much fun from such “make-believe” games as they do from some of the real games after which these devices are named. An advantage in using such games is that the teacher can regulate the practice both as to combinations used and as to repetitions required for mastery.

In all the games below, the numbers must be chosen so that the sum or minuend does not exceed the facts a child has studied. Only type exercises, which the teacher must adapt to her needs, can be given here.
1. Baseball Game

(A) For miscellaneous combinations. (Grade Two)

Draw a baseball diamond on the blackboard. Write the numbers desired for practice around the diamond as follows:

An Addition Diamond

Divide the class into two teams. A pupil starts at the home plate and goes around the diamond, trying to reach first base, second base, third base, and if possible to make a home run, by giving the correct answers to the combinations around the diamond.
While the pupil is naming the numbers around the diamond all of the children on the opposing team watch for errors. If an error is made, the children call "Out." The child must go to his seat and write the combination he has missed with its correct answer. He may then return to the group for another chance to score. If no error is made, they call, "Home Run," and a score is made for the team. Only home runs are counted in scoring.

(B) For general review of all the combination facts. (Grade Three)

Draw a baseball diamond on the blackboard, writing the numbers desired for practice around the diamond as follows:
Place the number to be added or subtracted in the center of the diamond in the pitcher’s box.

Divide the class into two teams and play the game in the same manner as described in (A).

II. Football Game

(A) For practice on specific combinations. (Grade Two)

Draw a diagram to represent a football field on the board.
Divide the class into two teams. A pupil carries the ball by adding or subtracting the combinations on the field. He may begin at either end of the field.

While a pupil is carrying the ball by naming answers the members of the opposing team watch for errors. If an error is made, they call, "Tackled." The child who has made the error then writes the combination and correct answer as a means of studying it, and returns later to try again. If no error is made the children call, "Touchdown," and a score is made for the team. Only touchdowns are counted in scoring.

(B) For general review of all the combination facts. (Grade Three)

Draw a diagram to represent a football field on the board.

Instead of writing the entire combination, write the numbers to which a number is to be added, or from which it is to be sub-
tracted. Place the number to be added or subtracted on a football drawn at the left.

Divide the class into two teams and play the game as described in (A) above.

III. Hopscotch Game

(A) Draw a hopscotch diagram on the board. (Grade Two)

<table>
<thead>
<tr>
<th>An Addition Hopscotch</th>
<th>A Subtraction Hopscotch</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 +3 4 +3 3 +3</td>
<td>5 -3 7 -4 -7</td>
</tr>
<tr>
<td>1 +4 5 1</td>
<td>6 -4 7 -6 -2</td>
</tr>
<tr>
<td>2 +4 7 3</td>
<td>5 -4 6 7</td>
</tr>
<tr>
<td></td>
<td>-4 -3 -3</td>
</tr>
</tbody>
</table>

Choose two teams. Children make believe they are hopping from square to square on one foot. They try to name all the answers without missing. This enables them to score a point for their team. Require pupils who miss to study the combination and try the squares again.

(B) This game may also be played with single numbers instead of the whole combination. The number to be added or subtracted may be written in the center of the diagram. (Grade Three)

<table>
<thead>
<tr>
<th>An Addition Hopscotch</th>
<th>A Subtraction Hopscotch</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 9 3 4</td>
<td>4 9 12 5</td>
</tr>
<tr>
<td>8 +5 6</td>
<td>11 -4 7</td>
</tr>
<tr>
<td>2 0 1 5</td>
<td>8 13 6 10</td>
</tr>
</tbody>
</table>

IV. Crisscross Game

(A) Draw a crisscross diagram similar to the following on the board: (Grade Three)

T. I & II-8
Divide the class into two teams. The object of this game is to begin with any number and follow the line over and under from point to point by adding or subtracting a designated number. To score a point for their team, pupils must get back to the number from which they started without making a mistake. Pupils making errors should be required to study the combination missed and then return for another trial.

(B) This game may also be used for specific combinations by writing the whole combination instead of a single number above the points in the crisscross. (Grade Two)

V. WALKING THE TIGHT ROPE

(A) Draw a diagram representing a tight rope on the blackboard. (Grade Three)
Children thrill at the feats performed by the tight-rope walkers at the circus. In this game they try to imitate these thrilling performers by getting from one end of the rope to the other without falling off. To do this they must give the correct answers to the combinations placed on the rope.

A child who falls off from the rope takes the combination and answer to his seat, studies it, and returns to the circus ring to try over again after he is certain he has learned the troublesome combination. In the meantime, other performers are tried out.

(B) This game may also be used for practice on specific combinations by writing the whole combinations instead of single numbers on the rope. (Grade Two)

VI. The Pin Wheel

(A) Draw a pin wheel similar to the following on the blackboard. Write the number to be added or subtracted in a circle at the left. (Grade Three)

An Addition Pin Wheel

A Subtraction Pin Wheel

Children enjoy making their real pin wheels spin fast. Here, by adding or subtracting a number to or from the numbers in the
wheel, they may make this pin wheel spin fast, also. By starting
with the center number and working outward they can gain in
speed as they work to the outside. The repetitions provided in
the wheel as illustrated in the diagram make the gain in speed
possible, for the child who may have to hesitate on a combination
the first time he encounters it may not have the same delay when
he meets it the second time in the same wheel.

A child who cannot get the wheel to spin from start to finish
takes the combination he has missed to his seat and studies it.
When he has learned it, he returns to the class and tries again.
In the meantime, other pupils try to make a perfect record of
accuracy and speed.

(B) This game can also be used for practice upon specific combina-
tions by writing the whole combinations in place of the single
numbers in the wheel. (Grade Two)

VII. FOLLOWING THE TRAIL

(A) Draw a trail diagram similar to the illustration upon the board.
Place the number to be added or subtracted in the upper right
corner of the diagram in a circle. (Grade Three)

An Addition Trail

\[
\begin{array}{cccc}
7 & 9 & 1 & 4 \\
3 & 9 & 5 & 6 \\
6 & 8 & 1 & 4 \\
8 & 2 & 5 & 6 \\
\end{array}
\]

\[+5\]

A Subtraction Trail

\[
\begin{array}{cccc}
12 & 14 & 6 & 9 \\
8 & 14 & 10 & 11 \\
11 & 12 & 13 & 14 \\
13 & 7 & 10 & 11 \\
\end{array}
\]

\[-5\]

In this game the children play that they are following a
trail to find treasure. They try to get to the end of the trail
and back again without getting lost. Have them begin where the
arrow points. A child who gets lost by missing a combination
goes to his seat and studies the combination. After he has learned it he tries to follow the trail again.

(B) This game may also be used for practice on specific combinations instead of single numbers in the trail paths. (Grade Two)

VIII. Rolling Hoops

(A) (Grade Two) Draw a large hoop on the blackboard similar to the following:

An Addition Hoop
A Subtraction Hoop

Pupils try to roll their hoops as far as possible by naming the combinations outside the circle from a designated starting point around the hoop and back to the starting point. They try to roll their hoops as fast as possible.

A child who misses a combination steps to the board and writes it three times as a means of studying it. He then returns to try again. In the meantime, another child is called upon to try.

(B) This game may also be used by writing single numbers around the circle, and placing the number to be added or subtracted in the center of the circle. (Grade Three)
IX. Fireman’s Ladder

(A) Draw a ladder similar to those shown here on the blackboard:

(Grade Two)

<table>
<thead>
<tr>
<th>An Addition Ladder</th>
<th>A Subtraction Ladder</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>+3</td>
<td>-5</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>+5</td>
<td>-2</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>+2</td>
<td>-6</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>+5</td>
<td>-1</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>+4</td>
<td>-5</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>+3</td>
<td>-4</td>
</tr>
</tbody>
</table>

Pupils play they are firemen and try to reach the top of the ladder. If a child makes a mistake, he falls off and must return to his seat and study the combination. Later he is given another trial.

(B) This game may be varied by writing single numbers between the rungs and placing the number to be added to or subtracted from these numbers in a circle or square at the left of the ladder.

(Grade Three)
Some games provide excellent opportunities for number experiences. However, not all the practice needed by a group of pupils can be gotten through the games. There is a danger that certain combinations will receive more attention than is really needed, while others will get less attention than their difficulty would warrant, while still others may not happen to appear in the game at all.

The interest taken by children in these games and the use of number combinations in a natural way which these games provide make them worthy of the attention of the primary teacher. It is suggested that teachers show pupils how to play the following games and urge the children to play them with their friends after school or at recess time.

I. **Bean-Bag Game** (Grade Three)

This game is excellent for general review. Use two bean bags and a circle similar to the following drawn with chalk on a sidewalk (other than a public sidewalk) or a private concrete driveway:
Each child has two turns. He stands at a distance from the circle and tosses the bags trying to get them on the largest numbers in the ring. His score is the sum of the two numbers on which his bag falls. A bag falling outside the ring scores as 0.

II. A Target Game (Grade Three)

Like the bean-bag game, this target game is excellent for review purposes. The teacher cannot regulate the combinations which the children will use, therefore it is suggested that the teacher recommend this as a fine game to play with friends after school.

A target is made of beaver board or soft wood. On it is placed the following diagram:

Arrows may be made in this way. Select medium-sized corks. Stick three chicken feathers into the large end of the cork like this: . Place a sharp nail into the small end of the cork so the sharp point projects out from the cork. The arrow now has a sharp point to enable it to stick fast to the target and the feathers make it sail smoothly toward the numbers.

The object of the game is to throw the arrows at the target. The target is fastened to a tree trunk or the side of a shed or garage. Each pupil has two turns. His score is the sum of the two numbers his arrow hits. If an arrow falls outside the target the throw counts as 0.

III. Ring-Toss Game (Grade Two)

To prepare a ring-toss game drive four large spikes or nails into a board. Place the nails in a straight row six or eight inches
apart. Number each nail with any numbers the players may care to use. Make two rings out of heavy wire and wrap them with string. The rings should be four or five inches in diameter.

Each child takes two turns or throws. His score is the sum of the two numbers he rings. When a ring does not fall over a nail, the turn counts as 0. The distance at which a child stands from the board may be regulated by what the players determine a fair distance at which successful throws may be made.

IV. Odd-or-Even Game (Grade Two)

This is an ideal game for two children to play together. It is purely a guessing game, but gives excellent practice on odd and even numbers. The game may be played with marbles, grains of corn, pebbles, or other small objects.

The two children alternate having turns. The leader hides several of these small objects in his hand and asks, “Odd or Even?” His partner answers either “Odd” or “Even.” The leader then opens his hand and the objects are counted. The child is given a point if he has guessed correctly.

The game continues as the second child takes his turn as leader.

V. Ninepins Game (Grade Three)

Print or paste one of the numbers from 1 to 9 on each pin. Stand the pins in a row. Do not place the pins so the numbers on them come in regular order. This would be a good line-up:

```
5 6 4 3 9 7 2 8 1
```

Each child may have two trials. He rolls a ball and tries to knock down a pin. The distance between the pins should be greater than the diameter of the ball so that there are chances to miss and also so that not too many pins will fall at a single roll of the ball. The distance at which the players shall stand to roll should be agreed upon by the players themselves. A child’s score is the sum of the numbers on the pins he knocks down. If
the ball does not knock down a pin, the trial counts as 0. If two pins happen to fall at one time, the child will select the pin with the larger number and disregard the other pin. He will then proceed with his second turn, provided he has not already had it.

VI. Rolling-the-Ball Game (Grade Two)

Make the following diagram with chalk on a floor or sidewalk (not a public sidewalk) or on a private concrete driveway provided it has a level surface. In the very center of the diagram place an object such as a ninepin club, an empty milk bottle, or a brick set upright. Two balls or two marbles may be used for this game. Pupils stand at a distance which they determine among themselves to be a fair one, and roll the balls or marbles toward the object in the center. If the ball or marble touches the object, the turn counts 5; if it stops in the circle, the score is 4; if it stops in the oblong, the score is 3; and if it stops anywhere outside the oblong, the score is 0.

Each child has two turns. His score is the sum of the two numbers his balls or marbles have indicated.

VII. The Ladder Game (Grade Two)

Lay a ladder down on the ground or on the sidewalk. Each space between the rungs of the ladder is given a number. The following order is illustrative of what might be used provided the
child stands at the point indicated by X and throws toward the 6. The number of spaces used would depend somewhat upon the size of the ladder. However, only as many rungs need be used as the players wish to use.

| X | 1 | 2 | 3 | 4 | 5 | 6 |

Two bean bags are used for this game.

The children throw the bean bags at the ladder, trying to get them to fall between the rungs of the ladder. Each child has two turns. His score is the sum of the numbers on which the bag falls. If the bag touches any rung of the ladder so that there is a question as to the number to be counted, the throw counts as 0. If the bag falls outside the ladder, the throw counts as 0.

VIII. Dominoes (Grade Two)

Many children have received sets of dominoes as birthday or Christmas gifts. Play with dominoes should be encouraged by teachers and parents, because of the fine number grouping experiences the game provides. Directions for playing the game are not given here since a set of printed directions is enclosed with each set sold.

IX. Lotto (Grade Two)

A splendid game possessed by many children is the game of lotto, which consists of cards covered with numbers and a set of small discs. As an appointed leader calls numbers, the players cover the number with a disc, provided that number happens to be on their card. The first player to have covered all the numbers on his card wins the game. This game should be encouraged, as it trains in recognizing numbers from 1 to 100.
<table>
<thead>
<tr>
<th>Date Due</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 28</td>
<td></td>
</tr>
<tr>
<td>Aug 25</td>
<td></td>
</tr>
<tr>
<td>Nov 26</td>
<td></td>
</tr>
<tr>
<td>Dec 4</td>
<td>RETURN</td>
</tr>
<tr>
<td>Dec 7</td>
<td></td>
</tr>
<tr>
<td>Apr 2</td>
<td>RETURN</td>
</tr>
<tr>
<td>Mar 29</td>
<td>RETURN</td>
</tr>
<tr>
<td>Nov 27</td>
<td>RETURN</td>
</tr>
</tbody>
</table>