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# MOTIVATION OF ARITHMETIC

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II

## LETTER OF TRANSMITTAL

DEPARTMENT OF THE INTERIOR,  
BUREAU OF EDUCATION,  
*Washington, January 18, 1926.*

SIR: One of the outstanding problems of the teacher is to motivate the work of the schoolroom—to provide situations of vital interest to the child.

While working out such problems of teaching practice it is helpful to collect the better solutions devised by successful teachers and to use them as reservoirs of material significant for all. This method of pooling the experiences of teachers was illustrated in a bulletin recently published by this bureau on Games and Other Devices for Improving Pupils' English, and was so enthusiastically received by teachers that I asked Mr. G. M. Wilson, professor of education, Boston University, to make a similar study of motivation in arithmetic.

Questionnaires were sent out requesting teachers to submit illustrations of motivation through (1) games and devices and (2) larger life situations. Replies, which were received from about 5,000 teachers throughout the country, have been carefully examined and analyzed. The accompanying manuscript contains the results of this study. I recommend that it be published as a bulletin of the Bureau of Education.

JNO. J. TIGERT,  
*Commissioner.*

The SECRETARY OF THE INTERIOR.

III

# MOTIVATION OF ARITHMETIC

By G. M. WILSON

## INTRODUCTION

*Growth of the idea of motivation.*—Rousseau is generally credited with starting the modern movement toward the school situation in which the child and his vital interests are the real basis of education. The force of tradition, however, is exceedingly strong, and after several generations it is safe to say that most of our school work is formal and subject-matter-centered instead of child centered.

Froebel and Pestalozzi in Europe (more recently Montessori, Decroly, and others) and McMurry, Parker, Dewey, and a host of their students in America have been able, however, to make very great progress. The leaders for at least a generation have accepted the idea that the formal subject-matter viewpoint is not only inadequate but in many respects deadening, that the child and his interests must become the real center of school work, and that the chief problem confronting educational leaders is not that of working out a better philosophy of education but rather that of selecting the better practices and bringing these to the attention of all teachers in such appealing form that they may become the basis of schoolroom procedure everywhere.

The idea of making the child the center of school work has been variously expressed. Rousseau called it "natural education." DeGarmo and McMurry urged the idea under the doctrine of interest. Dewey harmonized interest and will, and urged self-chosen interests and motives. Since 1916 the term "motivation" has been in common use. The term "project" has also been applied to pupil activity when thoroughly motivated. In this bulletin the term "motivation" will be given preference, but readers will understand that other expressions, such as "pupil activity," or "project," may have approximately the same meaning. The terms "motivation" and "interest" are somewhat broader than the term "project," as the latter is used in a specialized sense and refers to undertakings carried out on an actual life basis. However, the term "project" is loosely used by many at the present time, and as commonly used is intended to mean the same as vital interest or motivation.

*Force of tradition.*—The young teacher, unless specially trained, fails to conceive purpose. She imitates the textbook procedure used upon her when she was a pupil. She is overawed by courses of study, State examinations, and standard requirements. She works heroically, often frantically, for end results. She forgets that the simpler facts would be better mastered if subordinated to larger purposes, and that indirection (especially in problem and appreciation subjects) is frequently the better road to sweetness and light. The total result is that the schools are doing to-day what they did a generation ago, frequently without any other reason than the example of the past. Teachers as a class are not in close touch with large business and social movements, but continue to live in books and behind the walls of their schoolrooms. They act frequently as if their task were to hand down the accumulated knowledge of the race, conceived in terms of minimum essentials, regardless of present usage or application. Thus school practices are carried forward by the mere force of tradition, and the real issue, the child, is forgotten.

*Professional training.*—The professionally trained teacher, however, not only knows her psychology for learning processes involved, but she knows her sociology. She understands the larger purposes of school work and the fact that learning takes place effectively only when the child is thoroughly in the game. The professionally trained teacher should not be hampered by fixed requirements, either in courses of study or set examinations. She should be considered as the diagnostician who understands the children, their interests; the community, its interests; the learning processes, their requirements; and who, guided by all these, adapts her work to accomplish the true aims of education. This means greater and greater freedom for the classroom teacher. It also means more and more responsibility for the classroom teacher. In general, it is a recognition of the professional viewpoint, bestowing upon the trained teacher the same confidence and responsibility that are bestowed upon the physician or surgeon.

*The learning processes.*—The steps in effective learning, as shown by actual experimental studies, have been generally agreed upon as essentially the following:

1. *Interest or motive.*—This means vital interest, or a motivation that grows out of the child's own life purposes and daily contacts. It does not mean an artificial scheme to get the child to do something that the teacher wants done.

Vital interest furnishes the motive power—the gasoline, if you please—that makes the engine go. Without it, the work is ineffective at the time, and so lacking in permanency that the time required for doing it is not justified. Interest or motive is therefore the first essential in effective learning.

2. *Mental set.*—This point is closely related to point 1. If the child has a vital motive for doing a piece of work, he develops a favorable attitude or mental set, so that when he approaches his task his full spirit goes into it. There is no division. It is done willingly, joyously, and more easily because of the favorable attitude or mental set.

3. *Attention.*—Without attention, little or no learning takes place. With divided attention, the results of the learning processes are greatly reduced. Attention is the steering wheel that keeps the car on the road. It means regular progress forward. Attention is easy if the motive is strong enough. Motive is the chief factor in securing attention.

4. *Understanding, association, and apperception.*—The human machine is different from a gasoline engine; it asks "why." It wants to know the reason, it wants to see the relationship of each new thing to something known. It interprets in terms of previous experience. Without such understanding or association, learning at best is very ineffective and insecure. The old notion, that the child can learn to-day and understand at some future time, has been abandoned in the schools because psychology is against it. There are enough real and worth-while problems to challenge thoroughly the efforts of the child, and such problems are best for educative purposes.

5. *Repetition.*—Repetition is the effective factor in learning. Learning and doing are the same. In the case of tennis, the doing is more evident; but the same sort of thing takes place even in learning that 2 and 3 are 5. It is the doing with understanding, attention, and interest, all of these things combined, which makes an effective result-securing process. Repetition may be compared to the engine. The turning over of the engine gets the car forward. Even here, however, it must be kept in mind that the gasoline furnishes the power, and in the learning process the gasoline is motivation.

The principle of repetition is of dominant concern in drill, but it is applicable in problem and appreciation work. In drill the specific responses are repeated again and again. In problem and appreciation work the idea is repeated in different forms, the purpose being not the building up of automatic responses but the gradual inculcation of attitudes and ideals. The principle of repetition is frequently applied in the wrong way, particularly in subjects other than drill.

6. *Use and application.*—This is really a further point in repetition. It is extending the process of repetition to new situations. It increases the interests and the associations. However, it may be thought of as a separate step for purposes of analysis.

It is evident from the foregoing review of the steps of the learning process that the vital interests or motives of children are not unimportant details. The teacher who says she does not have time to wait upon child needs, or to give attention to them when they appear, is missing a fundamental consideration of the educative process. Rather, she should say, "I can not go forward without considering children's interests, their purposes, and their life activities." This is the true view. She *can not* go forward without it. She may carry on a mechanical process, but little or no true education results.

*Purpose of this study.*—The United States Bureau of Education in the spring of 1924 requested teachers to submit instances or illustrations of motivated work in arithmetic. The 5,000 or more replies received are doubtless a typical cross section of what is happening the country over. Replies have come from all parts of the country, especially, as was to be expected, from the more progressive teachers. The cross section therefore is doubtless above the median of common practice and fairly representative of the best practice. The samples have been studied and thoroughly analyzed. The purpose has been to see how fully work in arithmetic is motivated and by what means and, conversely, to what extent the work in arithmetic is on the basis of requirements or mere incentives, even though the most recent term "project" be applied to it.

*Results.*—Careful study of the returns shows that thousands of teachers are making a very definite effort to realize the principle of interest or motivation in their work, but that in spite of these efforts much of the work remains formal. Actual life situations are not very common in school work. The total number listed in this study is small. The motivated situations based closely upon life situations are more common, but the most common means of all used for holding attention is the game or game device. Some games are used in all grades but more in the lower grades.

It is apparent, however, that the bulk of the work even in the lower and intermediate grades is in the form of exercises largely unmotivated. The following expressions from teachers are typical and indicate clearly that many teachers do not yet appreciate the place of vital motivation in the educative process:

"Supplementing the work of the book."

"Arousing interest among pupils."

"A means of securing attention."

"It teaches them the practical significance of their arithmetic."

"While this is not a part of the regular work in arithmetic, it may be given as a reason for work and thus furnish the incentive for greater effort."

These expressions indicate that many teachers regard the bringing in of life situations as an intrusion on the regular work. Teach-

ers are urged to think over the question: "Should life be brought in to illustrate arithmetic, or should arithmetic be subordinated and become a means for the interpretation of life?" In theory the answer is easy, but in practice we have not yet realized our ideal of school work on a real life basis. There is much work ahead.

*Definitions.*—In classifying the illustrations supplied by teachers, the following five divisions were recognized:

1. The *actual life situation*, or actual experience; such, for example, as the accounts of a boy who manages a paper route.

2. The *idealized situation*, copied closely after a life situation, as the school "store."

3. The *game*, such as "The Wise Man," "Ten Pins," and "Old Witch." The game as used in arithmetic is often a mere device for getting drill, but it is often so devised that the children are really interested in the game, the arithmetic being from their standpoint more or less incidental. In the discussion a distinction is made between real games and game devices.

4. *The device.*—This means a scheme for getting drill, or review, which is more or less self-carrying, more or less appealing to interest, though the definite purpose is to accomplish a previously determined result in tool material. Illustrations are: The clock, the staircase, the ladder, stepping-stones, and the policeman.

5. *The exercise.*—Exercises are merely plans for drill work. Some of those submitted are skillful, but at best they carry little motivation. A large number of such drill plans were submitted. They are not included in this bulletin. Textbooks are full of them. In the planning of exercises, teachers should avoid a situation that is too artificial, too far-fetched. Such situations merely annoy the children.

*Eliminations.*—Following McMurry, but going a step further, the following may be accepted as a basis for elimination:

1. Omit material unless it appeals to the children as worth while, unless its use is evident. It may serve a useful aim in general without being useful to the particular group of children.

2. Omit material not within the comprehension of the children.

3. Omit material not appealing to the interests of the children.

4. Omit material not connected in some vital way with large problems or activities of the children. Omit isolated details.

Material meeting these requirements has at least some of the fundamental features of motivation. An exercise may be in the form of simple drill work, but when the need is evident, and when the above conditions are met, it can be carried forward with interest even when unsupported by a game or life situation.

*General conclusion.*—It is impossible to avoid the general conclusion that arithmetic, in spite of isolated attempts at motivation,



is still largely a formal subject. The individual problem or process is the unit of instruction. Arithmetic needs a thorough reorganization and proper subordination to worth-while life needs. In time the school must involve more real living and become richer in experiences worth while in themselves. The arithmetic should grow out of these experiences, supplementing, interpreting, but not dominating.

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## ACTUAL LIFE SITUATIONS

Actual life situations reported by teachers, together with the grades in which they occur, are as follows:

1. Measuring material for a marble bag (grade 1).
2. Weekly personal accounts (grades 4 and 8).
3. Keeping the milk account for the school (grades 3 and 8).
4. Window boxes for the school (grade 4).
5. Planning a picnic lunch (grade 5B).
6. Filling an Easter basket (grade 5A).
7. Planning a school garden (grades 4 and 5).
8. Buying the field-day ribbon and dividing it (grade 5A).
9. A school savings bank (grade 5A).
10. Purchasing shrubbery for the school grounds, apportioning costs, and collecting money (grade 5A).
11. Figuring and constructing a baseball diamond (grades 7 and 8).
12. Manual-arts work (boys, upper grades):
  - Figuring and buying the lumber.
  - Reading scale drawings.
  - Estimating a paint job.
13. Manual-arts work (girls, upper grades):
  - Figuring goods for a slip.
  - Using an individual recipe for 30 persons.
  - Changing a cake recipe which will provide 12 servings to one which will provide 18 servings.
14. Figuring the results of a spelling test (grade 7).
15. Furthering a school-benefit movie night (grades 6 and 7).
16. Buying our hot-lunch equipment.
17. A hot-lunch benefit sale.
18. Guessing height and verifying (grade 4):
19. Noting attendance (grade 2).

Brief descriptions of the 19 life situations follow herewith.

1. *Measuring material for marble bag (grade 1).*—At the opening of the marble season the children brought marbles loose in their pockets. Of course they were constantly falling on the floor. Finally we made the rule that each marble which fell should be turned over to the teacher. This we did not like. Then we decided that the safest way to carry marbles was in a bag; so the following day, during the free-choice period, we made marble bags.

The bags were made of blue percale. Each child measured his own material, which was 12 inches long and 4 inches wide. An inch hem was turned down at the top. The side seams were made. A 12-inch white tape was run in the hem for a draw string. Then we put our marbles in the bags, counting them by twos and threes. The game of marbles was then introduced, and it was suggested by one of the children that we go out in the school yard and play marbles. In order to do this we first had to measure and mark off the boundaries. We decided upon a 2-foot circle for the center shooting. The two lag lines were 5 feet from the center. Then we divided the 30 children into groups of 6 children. Each group marked its own boundaries and proceeded with the game.

Through this game the children acquired the use of the ruler and yardstick, mastering the inch, foot, and yard. They received practice in accurate measuring. They had drill in counting to 50 by twos and to 36 by threes. Obedience to rules was given emphasis.

2. *Weekly personal accounts (grades 4 and 8).*—A weekly account was made by each child in grade 4B. A sample of the work follows:

1924 RECEIPTS		1924 EXPENSES		
May 5.	On hand.....	\$0.30	May 5. Hospitals.....	\$0.15
" 6.	Allowance.....	.10	" 6. Candy.....	.05
" 7.	Waste paper.....	.25	" 7. Theater.....	.25
" 8.	Tin foil.....	.10	" 7. Car fare.....	.20
" 9.	Errands.....	.20	" 8. Plant.....	.10
" 11.	Errands.....	.40	" 11. Church.....	.10
			" 11. Car fare.....	.20
	Total receipts.....	1.35		
	Total expenses.....	1.05		1.05
	Balance.....	.30		

It is not what you make,  
It is not what you spend,  
It is what you save  
That counts in the end.

*Cash account of Nunzia Corrao (Grade 8)*

Date		Received	Paid
Feb. 1	Received allowance.....	\$1.25	
" 2	Paid for handkerchiefs.....		\$0.25
" 3	Paid for car fare.....		.20
" 4	Paid for church.....		.10
" 5	Paid for magazine.....		.15
" 6	Received for household duties.....	.25	
" 7	Paid for notebook.....		.10
	Balance.....		.70
		<u>1.50</u>	<u>1.50</u>

Date		Received	Paid
Feb. 8	Balance on hand	\$8.70	-----
" 8	Received allowance	1.25	-----
" 10	Paid for sharpening skates	-----	\$0.25
" 11	Paid for soda and candy	-----	.15
" 13	Paid for car fare	-----	.25
" 14	Paid for concert	-----	.50
	Balance	-----	.80
		1.95	1.95
Feb. 14	Balance on hand	.80	-----
" 15	Received allowance	1.25	-----
" 16	Paid for church and Sunday school	-----	.15
" 18	Received for doing errands	.15	-----
" 20	Paid for rubbers	-----	.60
" 21	Paid for book	-----	.50
	Balance	-----	.95
		2.20	2.20
Feb. 21	Balance on hand	.95	-----
" 22	Received allowance	1.25	-----
" 24	Paid for car fare	-----	.25
" 26	Paid for notebook	-----	.20
" 28	Paid for gloves	-----	.75
	Balance	-----	1.00
		2.20	2.20
Feb. 28	Balance on hand	1.00	-----

NOTE.—This account was continued throughout March and April. Each pupil kept a similar account.

3. *Keeping the milk account for the school (grades 3 and 8).*—Grade 3: Milk is served to the children in our school twice daily. This custom affords an excellent opportunity to teach the children to work with the table of liquid measure, at least the pints and quarts.

The milk is delivered in half-pint bottles. Each child has the problem of finding how much milk (pints and quarts) he drinks in a day, then in a week. If any child does not take milk, he is usually interested to know how much one of his playmates drinks.

Then comes the problem, which will be the same for every child in the class, namely, given the number of half-pint bottles delivered, find how many pints, then how many quarts of milk are delivered to the school each day. The next problem is to find the quantity used by the school in a week. Finding the amount used by the class is an interesting part of this problem.

A study of dollars and cents may be based on the milk problems. The pupils can find the cost of the milk per day and per week for individuals, for the class, and for the school.

This utilization of the school milk service not only creates the desired interest in arithmetic but also provides a means of motivation for a health project in the hygiene class.

Grade 8: Milk is furnished to our school children, principally those underweight. Real arithmetic is used by the eighth-grade pupils, as they get the morning orders from the different rooms, add the numbers to be included in order phoned to the dairy, reckon the amount of money to be collected from each room, distribute the milk to the rooms, count and wrap the money, make out deposit slips, deposit the money at a bank, reckon the amount due the dairy each week, and write the check ready for the signature.

4. *Window boxes for the school (grade 4).*—The children decided to have window boxes for our room. The suggestion followed that all window boxes in the building should be uniform. It became necessary to involve other rooms in the enterprise. Our room undertook to lead off; we made the boxes for our windows, made a drawing showing details of a box, determined on the materials, and ascertained the cost. We then gave to the other rooms all necessary details, so that they might at once place their order for materials, proportion the cost, and collect the money.

5. *Planning a picnic lunch (grade 5B).*—Grade 5B class, consisting of 42 pupils, decided to have a picnic. The cost of the lunch, not to exceed 20 cents per pupil, had to be figured.

The lunch decided upon was: Hot dog sandwiches, lemonade, ice cream, cake, and bananas. The girls of the class figured the number of buns and frankfurts needed for sandwiches and the number of lemons and amount of sugar needed for lemonade. The boys figured as to the ice cream, cake, and bananas.

Results showed:

7 dozen rolls,	at 10 cents.
7 dozen frankfurts,	at 15 cents.
3 dozen lemons,	at 30 cents.
2 pounds sugar,	at 10 cents.
7 quarts cream,	at 50 cents.
3 cakes,	at 50 cents.
3½ dozen bananas,	at 20 cents.

Final problems to be solved were obvious: (1) What is the total cost? (2) What is the cost per pupil?

6. *Filling an Easter basket (grade 5A).*—Our class sent an Easter basket to a little child in the open-air school. The children, after deciding what was to be sent, figured out how much each one should give. After this was done, one boy was appointed to go down town to make the purchases. He had his list, as well as his specified amount to spend for the class. He made the purchases and brought the goods to us, with the price and the list.

The children were much interested. They gained the knowledge of the actual prices of real things as well as the desire to do kind acts for others less fortunate than they. Practical problems using the prices mentioned were then given for oral and written work.

*a. Planning a school garden (grades 4 and 5).—a.* Situation out of which it grew: Spring of the year and children restless indoors; some children did not know a hoe from a rake; some did not know how to plant. So we decided on a garden in the school yard.

*b.* Course of study used: Spelling, language, art, nature study, geography, and arithmetic.

The school garden was easily made the basis for real work in arithmetic, as shown by the following list of questions:

- (1) Our garden is to be 12 feet long and 12 feet wide. What will be its shape? How do we know that?
  - (2) How many square feet in the plot?
  - (3) How many inches long will the plot be?
  - (4) If we divide the plot in two parts, how long will each part be; how wide?
  - (5) Divide the plot in two again. What size will each small plot be?
  - (6) John had 50 cents and spent 15 cents for beet seeds. How much change did he receive?
  - (7) We spent 90 cents for seeds. How much change did we get from \$1?
- (Same kind of problems for flower seeds.)

Full amount, or total, spent for seeds and its deduction from amount in treasury formed basis for other questions.

Subtracting 6 inches from length and width of each plot in order to make a walk gave another set of questions.

*An arithmetic lesson:*

- (a) Find length and width of the garden.
- (b) Estimate the area.
- (c) Estimate the amount of money spent for spading, seeds, and fertilizer.
- (d) Keep record of time the hired man spent in the garden and estimate its value at 10 cents an hour. Was his time worth more?
- (e) If it took him five hours to spade the garden, about how many square feet did he spade in one hour?
- (f) A record was kept of sales of the vegetables and flowers raised. Similar problems also interested the pupils.
- (g) Booklets were made for problems on the school garden.

*8. Buying the field-day ribbon and dividing it (grade 5A).—*Field day is a most important event in our school. Each class chooses field-day colors. As an application in linear measure, children figure out how much ribbon will be needed for the entire class. A committee is appointed whose duty it is to get color samples, prices from various stores, etc. Their report is made. Then the price of the total amount of ribbon and of each child's piece is figured by the class. Committee takes charge of money and buys the rib-

bon. As another application in linear measure, the ribbon is measured and cut into strips by children appointed by the class.

The result is keen interest on the part of the children, as well as a clearer conception of an inch, a foot, and a yard.

9. *A school savings bank (grade 5A).*—We have a banking system in our schools. I taught the pupils of my grade, especially the depositors, how to make out their deposit slips, how to make out a check, and how to indorse a check.

10. *Purchasing shrubbery for the school grounds, apportioning costs, and collecting money (grade 5A).*—During the past month our school spent \$40 for shrubbery to beautify our school grounds. The money was obtained by volunteer contributions from children and by selling papers. Each room is the proud possessor of eight of the hedge plants and one forsythia bush. I used the transaction for a life problem in arithmetic, basing my questions on the actual purchase. It took three lessons, 15 minutes each, and I covered the fundamentals—the addition and subtraction of dollars and cents and a little work in fractions. Given the entire cost of the shrubbery, I put such questions as the following:

What was the cost of the shrubbery belonging to our class?

Find what amount each room should pay were it apportioned equally.

After selling the papers and receiving ———, how much would remain to be collected by contribution?

We collected ——— in our class; were we over the quota, and if so how much?

If we were over the quota, how many plants could we buy with that amount for another room which did not reach its quota?

A great many more questions were used. The children were allowed to formulate some.

11. *Figuring and constructing a baseball diamond (grades 7 and 8).*—The problem is to make a baseball diamond of regulation size. The boys had a disagreement over the layout of their baseball diamond. The question was referred to the teacher. The following plan of work was carried out:

*First.* Ask class the distance from home plate to first base. After class knows the distance from base to base, ask the degrees of angles made at the bases. Draw figure on board. Now what kind of figure is this? Some will say square and others diamond shape. Since it is diamond shape from home plate, then have pupils plot out the field on paper, making right angles at the bases and the distances between bases 90 feet.

*Second.* Ask class the distance pitcher's box is from home plate. After that is given, have class find the distance of diagonal from home plate to second base. This must be solved by square root or careful measurement. The line from first to third base would be the same.

*Third.* Have the class prolong for the proper distance the lines over home plate coming from first and third bases and this will make up the batter's and catcher's box.

12. *Manual arts work of boys.*—The following problems are based on work in the manual-arts shop:

a. Figure the following lumber bills:

1 piece of oak—1 by 8 by 30 inches.

2 pieces, pine— $\frac{1}{2}$  by 6 by 24 inches.

3 pieces, oak— $\frac{1}{4}$  by 10 by 15 inches.

1 piece of pine—2 by 4 by 60 inches.

Oak to sell at 20 cents a square foot, pine at 14 cents.

Any lumber less than  $\frac{1}{2}$  inch to be figured as  $\frac{1}{2}$  inch, and lumber between  $\frac{1}{2}$  inch and 1 inch to be figured as 1 inch.

NOTE.—Suggested for the 7A or the 8B grade.

b. A drawing of a bird house is to be made on the scale of  $\frac{1}{4}$  inch to 1 inch. Two boards are nailed together at right angles to form the roof. Full measurements of these boards are  $\frac{1}{2}$  by 5 by 9 inches and  $\frac{1}{2}$  by  $4\frac{1}{2}$  by 9 inches. The two boards which are nailed at right angles to form the floor of the house are  $3\frac{1}{2}$  by  $6\frac{1}{2}$  inches. The overhang of the roof is  $1\frac{1}{2}$  inches on the ends and 1 inch on the sides. What will be the actual measurements of your drawing?

NOTE.—Suggested for the 8A or the 8B grade.

c. A boy has enamel for which he paid \$2.40 a quart. He wants to know the cost of enameling a lamp stand with two coats. There are about 150 square inches of painting surface on the lamp. A  $\frac{1}{2}$ -pint can of the enamel will cover about 2,000 square inches.

NOTE.—Suggested for the 8A or the 8B grade.

13. *Manual-arts work of girls.*—The following problems are based on home economics work.

a. How many yards of cambric will Mary need for a slip, and how much will it cost if the cambric is 22 cents a yard? The front and the back are the same length; the full width of material is needed. Measurement from top of shoulder to bottom of slip is 45 inches. A finished hem of  $4\frac{1}{2}$  inches is desired; allow  $\frac{1}{4}$  inch for the first turning.

b. Recipe for cocoa (one cup)—

$\frac{1}{2}$  cup milk.

$\frac{1}{2}$  cup water.

$1\frac{1}{2}$  teaspoons cocoa.

2 teaspoons sugar.

Figure the quantity required for 30 cups. Figure the milk by quarts and the cocoa and sugar by tablespoons. The following table may be useful:

4 cups=1 quart.

3 teaspoons=1 tablespoon.

16 tablespoons=1 cup.

NOTE.—All measurements are level.

c. Plain cake (12 servings)—

$\frac{1}{4}$  cup butter.

1 cup sugar.

$\frac{1}{2}$  cup milk.

$1\frac{1}{2}$  cups flour.

$2\frac{1}{2}$  teaspoons baking powder.

2 eggs.

1 teaspoon vanilla.

Write recipe for 18 servings.



14. *Figuring results of a spelling test (grade 7).*—Harrison School recently had a test in spelling in which 45 pupils were tested on 25 words. The problems given are based on actual work done by the pupils in making up a report on results of the test.

Results of the test were as follows:

25 words correct—3 pupils.	16 words correct—2 pupils.
24 " " —9 "	15 " " —3 "
23 " " —8 "	12 " " —2 "
22 " " —4 "	11 " " —1 "
20 " " —1 "	10 " " —1 "
19 " " —1 "	9 " " —1 "
18 " " —3 "	8 " " —1 "
17 " " —4 "	2 " " —1 "

- Find the average per cent of the class.
- Find the median of the class.
- Find the average of the upper half of the class.
- Find the average of the lower half of the class.

15. *Furthering a school-benefit movie night (grades 6 and 7).*—Our school had an entertainment and picture show April 21. The pupils sold tickets and the proceeds were used for the benefit of the school. The following problems were given to the class during the week that preceded the entertainment:

There are 300 pupils on the first floor of the school, 325 pupils on the second floor, and 350 pupils on the third floor.

- If every child on the third floor sold two adults' tickets at 30 cents each and two children's tickets at 20 cents each, what would the amount be?
- If every child on the second floor sold one ticket of each kind, what would the total amount be?
- If every child on the first floor would sell just one child's ticket, what would the total amount be?
- What would be the total amount realized from all these sales?
- If the school had to pay \$250 for each of the two nights, and other expenses amounted to \$75, what would the school realize from the total sales?

NOTE.—This should have been followed up by using actual data and results after the show was over.

16. *Buying our hot-lunch equipment (rural school).*—Last year the hot-lunch question came into prominence in our county. Whether or not hot lunches were served became the test of a successful school.

The community in which I taught was not wealthy, and we had to earn our own money; so we put on a masquerade box supper at Hallowe'en. The children decided on the selling price for each article, and for several days we had quick, snappy drills in making change.

We made \$35 at this supper. We deposited the money in the bank, and then in the arithmetic class figured our expenses and our profit. We had lessons in check writing and paid our bills by check.

Then we decided on what we wished to serve for the hot lunch and learned the best brands and the prices of various articles. The pupils took checks and bought the groceries and curtains for a cupboard.

We had lessons in measuring ingredients, in cooking, and in the prices of articles. The reasons for such prices and the study of adulterated food and of food values made interesting subject matter not only in arithmetic but in grammar and physiology as well.

We did this work on Fridays in the arithmetic class and called it the "home problem corner." It caused so much interest in the community that soon the parents were submitting problems to us.

The housewives sent problems in curtain making, linoleum, wall paper, and rug buying. They sent us also orders which we filled in on order blanks, totaling the cost.

The farmers sent problems in fencing, painting, finding the number of bushels in a crib, and other practical material.

Thus our hot-lunch project led to many an interesting and valuable lesson for the children.

17. *A hot-lunch benefit sale.*—The domestic-science equipment in our school was not adequate for our demands. The trustee did not feel that he could furnish any more equipment; so the school decided to see what it could do.

We left the situation in the hands of the pupils of the eighth grade. They planned to have a bake sale. As our school is in the country, we thought it best to hold the sale somewhere else. A committee of boys was appointed to rent a place in town for the purpose. They had a meeting and decided upon a fair rental price before trying to find a place.

The class voted upon the most tempting articles to serve to city people, and each family represented in the school was asked to donate one or more of these articles. The class then determined the approximate total cost and fixed upon a fair per cent of profit. After this, they found what the sale price on each article per pound, per quart, etc., should be. They then appointed advertising and selling committees.

After the sale, which was successful, the pupils figured the net proceeds and the actual profits. All problems which called for arithmetical solution were discussed and solved in the regular arithmetic recitation.

The proceeds of the sale were much more than the cost of the equipment needed in the domestic science department, so a school bank account was established, and a school secretary and treasurer appointed.

The eighth-grade pupils were allowed to suggest and discuss the need of any materials by the school, and the secretary was authorized to do the actual buying. This led to lessons in making out checks and receipts.

Eventually the school established a school-supply store, which is operated entirely by the eighth grade and which is a great help to both teachers and pupils.

18. *Guessing weight and verifying (grade 4).*—Have one pupil stand in front of the room. Let members of the class estimate his height. After getting exact measurement, compare the estimates and see which is nearest.

This can be repeated any number of times. The idea of estimating height can be applied to doors, windows, desks, lights, etc.

19. *Noting attendance (grade 2).*—The number showing our total enrollment is always kept on the blackboard. Children know that that number should be present. The number of absentees is determined. A member of the class writes the two numbers on the blackboard and subtracts them aloud. The daily attendance is then written on the blackboard. If borrowing is involved, no child is called upon until that has been taught.

## LIFE SITUATIONS USED AS A BASIS FOR SCHOOL EXERCISES

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Though the actual life situation has superior value for educative purposes, it is evident from the reports sent in by teachers that actual situations are not used to any considerable extent. "Play-like" situations based upon actual life situations and connected directly with pupils' present interests are more common. The illustrations which follow have been chosen as least artificial and most worthy of imitation. It is evident that the idea of a school store has been widely accepted. Special sales as advertised through the newspapers are used freely. The furnishing on paper of a room, or a home, the making of a family budget, the imitation bank, and the building of a home—these are ideas which can readily be traced as illustrations of motivation in the subject of arithmetic during the past few years. They are spreading effectively from school to school, and they are undoubtedly modifying school practices in the right direction. In this connection teachers need to be encouraged, first, to use more actual life situations, and, second, to bring more reality into "play-like" situations. Teachers should make sure that a "play store" uses the prices which are current, and that a "play bank" uses the practices which are current. In fact, these school imitations should be accompanied by a study of the actual situations in the community. In this way the children are brought nearer to reality.

Several illustrations of the same thing, such as the "play store," are given to show the many variations in practice that are possible with a usable idea.

1. *A play cafeteria (grade 2).*—First, the class plans a trip to a local cafeteria. The trip is made and careful observation is encouraged. On the return much discussion follows and a cafeteria for the second grade is planned. It is decided that food prices shall be lower at this cafeteria than at the one visited.

Posters are made representing meats, vegetables, salads, bread, desserts, and milk. Prices are mounted on small frames which stand on the table.

The waiters stand behind the various foods as they are arranged on a long table. A child takes a tray and starts along the table. "I'll take roast beef," he says; "three cents," the waiter calls out; then "I'll take potatoes"; "two cents," says the next waiter; etc. At the end of the line sits a child who serves as cashier. He hands a

slip to the child with the tray. On the slip is the amount the meal costs. The child with the tray then turns to the class. "What is my bill, Mary?" "Tom?" "Anna May?" etc. Finally, "How many made it nine cents?" "Nine cents is right. I shall pay it with a nickel and four cents;" or, "I shall pay a dime and the cashier will give me a cent." He then pays out of the toy-money box.

*Note.*—It would be better to defer this until third grade, and then use actual prices.

2. *Keeping store (grade 4).*—Empty boxes are collected and pictures of articles are cut out for our stock of goods. Boxes with shelves are obtained to place the stock in. Price lists from the nearby grocery are put up about the room. Paper money is used, and each child is given a certain amount. One child acts as clerk, and others are allowed to come as customers. The bill must be calculated correctly before the goods can be taken.

3. *The school grocery (grade 2A).*—The pupils go to the grocery store and buy three articles, such as bread, 9 cents; milk, 5 cents; and rice, 8 cents. Count up the cost of all. Prices must be the correct current prices.

4. *Grocery store (grade 3A).*—Pictures of grocery packages are cut from advertisements in magazines (colored ads. preferred) and pasted on oak tag. Price lists for daily "specials" are obtained from local stores and posted in the room.

One child is clerk. One is manager. Members of class ask prices and give orders. Clerk finds cost. Class also do so at the same time and verify. Manager makes the change. Points emphasized are dozen, half dozen, and prices of three, two, or four articles. With lemons at 30 cents per dozen, find the cost of two, etc.

5. *A dry-goods store (grade 4).*—As a means of connecting the knowledge of the children with the everyday world in which they live, I used the following class exercise in the sixth-grade arithmetic. The exercise involves common fractions and is based on the use of money. The business of a dry-goods store is conducted; several pupils act as clerks, others as customers. A piece of cardboard 20 by 30 inches is procured, and carefully cut samples of cotton, woolen, linen, silk, velvet, and ribbon are pasted on it in rows. By home questioning and the reading of advertisements the current prices per yard and the names of the different materials are procured and written beneath each sample. Girls find how much material is used in their dresses, aprons, coats, etc., and the boys learn the number of yards of cloth in their suits and blouses. Each pupil then finds the exact number of yards of material needed for at least three articles of clothing and proceeds to purchase the same from the clerk in charge. The clerk in turn has to find the total number of yards purchased, the amount of the bill, and to make change if necessary.

6. *The grocery store (grade 5).*—We use two large tables in our room, one for the groceries and the other for the dry goods. The children bring empty cereal boxes, fruit cans, receptacles for sugar, flour, butter, and spices, and such articles as are sold in a grocery store. When it is not convenient to have the articles we use pictures. One of the stores gave us some advertising material consisting of small sacks of salt, flour, soap, and loaves of bread. The children are asked to find out the customary price of each article and then print the price on pieces of cardboard.

7. *A dry-goods store (grade 5).*—For dry goods we use samples of silk, wool, lace, etc., with prices attached. The table is marked off in inches, feet, and yards; and when customers buy "cloth" string is substituted to give the children practice in actual measuring. The children make out the list of supplies they need; then go to the store and select them. The storekeeper makes out his bill, which is verified by the customer. We use money made from cardboard. Some pay by check. The storekeeper keeps books and at the end of each day makes a statement of the amount of money taken in and of the amount expended during the day. Each child is storekeeper for a day.

8. *Our school store (grades V and VI.)*—There is one period in our fifth and sixth grade work which the children welcome with delight. This is the time when we open our school store. In the fifth grade this usually happens when they have finished their work in fractions and easy decimals and begin work in bills. In the sixth grade it comes at the end of work in simple accounts, when bills, receipts, checks, and vouchers are studied.

When not in use the store is kept in one end of the cloak room, folded up out of the way. Just before it is to be used it is rolled out and set up. Each box is dusted and carefully price-marked by the children. We try to have these prices the same as the local prices.

The boxes and cans are all empty ones which the children have brought from home, or carton boxes sent out as advertisements by some company. The children arrange the store, putting groceries in one place, drugs in another, thread boxes in another, etc.

When the morning finally comes each child in the class is given \$5 in school currency. The store is open during class period for at least one week. Because the clerkship is an envied position, we use it as a reward to those who have had the most perfect lessons before the store opens. It is friendly rivalry and adds enthusiasm to the work.

The children take turns buying and each one buys four articles. We have two clerks, so two children may buy at once. The rest continue their regular work. We have the kind of pads used in

stores, so each clerk makes out three bills at once. One he gives to his purchaser, one he keeps for himself, and one he puts into a box for the teacher. Each purchaser takes his purchases and his bill home (to his desk).

These bills must be carefully made out, as a mistake counts against the clerk. Each pupil looks over his slip carefully when he reaches his seat, and if there is any mistake in bill or returned change he must find it before the next child finishes buying and go back to the store and have it corrected, else the mistake counts against him at the end of the week, when his change must equal \$5 minus the amount of his bills for the week. The teacher verifies this amount by adding the bills which have been put in her box for him and subtracting the total from the original \$5. (Next year I think I shall have the pupils at their desks follow each transaction so as to catch any mistake as soon as made.)

The articles which were bought remain on the desks until recess, then the children place them on the counter of the store as they pass out, and the clerks for the day remain behind, putting everything in its proper place ready for the next day's business.

In the sixth grade the children are required to write a receipt for \$5 given to each. They are also allowed to write out checks in payment for any amount under \$5, the teacher being their banker. Sometimes the clerks ask for payment the second time; then the children ask the banker for their vouchers, which they present to prove that the bill has been paid.

*NOTE*.—This school "store" is well planned.

9. *Storekeeper (grades 2 and 3)*.—One of the devices I use with good results is "Playing storekeeper." A pupil, supplied with a box of toy money, takes the part of storekeeper; each of the other pupils is given a coin, 10, 25, or 50 cents, and coming to the store in turn asks for the articles he wants and gives his coin to the storekeeper, who counts out the change. The pupil on receiving the change counts it and decides whether it is correct or not. This game has proved quite a help in rapid addition and subtraction.

10. *Keeping a store (grade 3)*.—The desire to play store arose from the fact that many children are sent to the store by their mothers, and they confess not knowing whether they receive correct change or not.

Empty boxes, cans, bottles, etc., are brought from home; the children are requested to bring only articles of which they know the correct prices. Cardboard money is made and a handful of it distributed to each child. The store is then arranged, everything put neatly upon shelves and in a special place; for instance, the cereals are in one section, spices in another, and beverages in another.

We then choose clerks, and the children go with their money to purchase their supplies. In the early stages of the game they are allowed to buy only two articles; later more are allowed. After returning to their seats each child is required to tell what he purchased, the price, what he paid the clerk, and the change received. He states whether he received the correct change or not, and the class checks to see if he is right.

11. *The model store (grade 3).*—The most helpful game used in the third grade is the "Model store." A teacher may get a model store for her room or school by obtaining empty cartons from different manufacturers. This model store can be used very nicely in connection with the arithmetic lessons. The child learns to add, subtract, multiply, divide, and make change.

After the cartons arrive, a counter and two or three shelves may be put up in one corner of the room. The cartons are arranged on these shelves. Money for the children to use may be made of paste-board. The children trace around the penny, nickel, dime, and quarter. These are used for the first few lessons. Later on they may make the half dollar and dollar. Each child has his own money.

In playing the game a grocer and delivery boy are chosen. The aisles may be called streets, as First, Second, Third, Fourth, and Fifth Street. If the room has single seats each one is numbered as a home; if double seats, each child is numbered. If you happen to be teaching the table of eights, have pupils buy eight of each article for that day. The child takes to the store whatever amount of money he wishes and buys whatever he wants. As each child makes his purchases he turns to the class and names each article purchased, tells its price, the amount of his bill, the money he gives the grocer, and the amount of change he receives. If a child wishes his groceries delivered, he tells the grocer his name, what aisle and seat to send them to, as Helen Smith, 4 Sixth Street. During the last two or three weeks of school the children are able to make out simple grocery bills. Prices should check with local prices.

12. *Playing store (grade 1).*—Have pictures on cards and place in a store. One child is mother. Mother sends the children to the store to buy for her. For instance, the mother says "Go to the store and buy six oranges." Child must find card with six oranges and bring it to mother. Game may be varied by having different amounts and more than one price for an article. For example, there may be rice at 8 cents a pound and a better grade at 10 cents a pound. The child must execute the order as given.

*NOTE.*—Correlate with industrial arts work. Let children model oranges and apples in clay and then color them. Boxes of "rice" will be better than pictures of rice. Experience and recognition of numbers is the aim in this grade rather than number drill.



13. *Playing store (grade 3).*—The following game is used to teach addition, subtraction, and multiplication of United States money. The children bring in pictures of things that are bought in a grocery store (cut from magazines). The pictures are pasted on cards and the children find the correct price of each article to put under the picture. Appoint one pupil as storekeeper, one as cashier, others as customers.

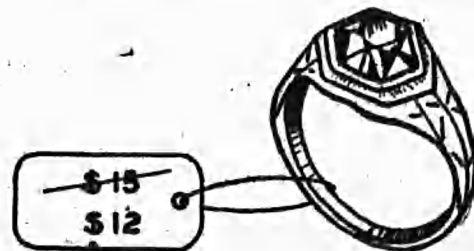
Place the pictures around the room. A customer comes in and says "Good morning" to the storekeeper. She then selects the things she wants to buy. As she picks up the pictures of the things she wishes the storekeeper calls out the prices and the cashier puts them down. At the same time all children put the price on a piece of paper (all pupils work at their seats).

When customer has finished buying she asks for her bill. The storekeeper calls on some child at his seat to tell what the customer owes. The cashier then decides whether the amount is correct. The customer gives the storekeeper the money. She does not really give him make-believe money, but she says "Here is \$2. How much change do I get?" The storekeeper then subtracts and tells her what change she gets. Playing store in this way gives everyone a chance to work—cashier, customer, storekeeper, and the children at their seats.

14. *Paying by check (grade 8).*—One member of the class keeps a store. The other girls purchase such articles as the store contains. Payments are made in cash, checks, or notes payable in one, two, or three months. Each member of the class makes a check book to be used as needed. When the checks have been cancelled at the bank, they are returned to the girls who made them. Each one compares the returned checks with her stubs. When a note reaches maturity, the girl who gave it makes the payment and destroys it after it is compared with the stub. This gives each a practical knowledge of the use of checks and notes.

15. *Price reduction sale (grade 6).*—A display sign, as illustrated, was hung over the front of the store of a jeweler who was going out

SELLING OUT  
EVERY THING  
REDUCED  
20%



of business. The ring with the label was in the show window. Find out if the reduction in the price of the ring from \$15 to \$12 is correct.

Make similar labels for other articles, showing the original price and the reduced price.

16. *Christmas toys (grade 4)*.—The Christmas idea is used. Pictures of toys are brought by the children. These are cut from magazine and newspaper advertisements, and a variety are posted on large sheets of cardboard with the prices attached. Various things may be done; the child may be given 50 cents or \$1 to spend. He may decide what toys he would like to receive and find their cost. He may decide what toys he wants to give and the cost of these. In carrying out this idea, frequently it is better to view the individual's work without public recitation, because children frequently differ as to their means of giving.

17. *The cost of the dress (special B grade)*.—The arithmetic work is correlated with the work in sewing. Each girl determines what materials are needed for a dress and the amounts of each. She does this through study of style and colors appropriate in consideration of her hair, eyes, complexion, height, and weight. At this point the arithmetic class takes over the work and has the children get prices from advertisements or direct from stores and find the total cost of materials, including trimmings, buttons, and thread. The work has a personal appeal and is of interest to every member of the group.

18. *Furnishing a dining room (Grade VI)*.—In our drawing class we have been studying how to furnish a dining room artistically. To get some idea of the expense, and to make the arithmetic more interesting and valuable, we decided to ascertain the cost of the furnishings. From the stores in this vicinity the pupils found the prices of the furniture and other articles.

The amount to be spent is limited to from \$100 to \$150. The making of bills, payment of bills, and commercial discounts, are emphasized. If cash payment is made checks are used, but if not promissory notes are given. This gives practice not only in making out checks and promissory notes but also in solving interest problems by finding the amount of the notes at maturity. Innumerable problems may be devised.

*Bills:* Example 1. Curtains are made with  $1\frac{1}{4}$ -inch headings and  $2\frac{1}{2}$ -inch hems. Allowing two widths for each window, what will be the cost per window of cloth at 50 cents per yard, curtains to be 2 yards long?

Example 2. Make out bill showing total cost of all furnishings.

*Commercial discount:* Example 3. On a bill of \$135, discounts of 10 per cent and 5 per cent are allowed. What is the net price?

19. *Furnishing a dining room (grade 6A)*.—Find the cost of papering and furnishing a dining room 12 feet wide, 15 feet long, and 9 feet high; the room is to have two windows, each  $3\frac{1}{2}$  by 6 feet, and two built-in closets, each  $4\frac{1}{3}$  by  $4\frac{1}{2}$  feet.

Window draperies are to be made from material 40 or 42 inches wide, at a cost not to exceed 75 cents per yard; wall paper is to cost from 35 cents to 50 cents per single bolt, and allowance of 40 cents per single bolt is to be made for hanging the paper.

Furnishings are to consist of window shades, rug (9 by 12 feet), serving table, dining table, buffet, five side or plain chairs, one arm-chair, pictures, and mantel ornaments, which are to be bought at current prices. Dishes are to be bought from open stock at current prices, the number of pieces to be decided by the class.

By contracting with one firm for the entire furnishings a discount of 5 per cent will be allowed on draperies, wall paper, pictures, and mantel ornaments, and 10 per cent on furniture and rug. No discount will be allowed on window shades, dishes, or cost of paper hanging.

20. *The family food supply (grade 4).*—Problem: Learning how to buy in order to have a better quality of food or the same quality at less cost.

A. General discussion to create interest.

- (a) Food used in the home.
- (b) Errands done by pupils.
- (c) Where and how food is obtained (correlate with geography).

B. Individual work concerning food used in own home:

- (a) A list of kinds and amounts used for a specified time.
- (b) Quality, prices, and amounts to be bought at one time.
  - (1) Visiting or telephoning to different stores in near-by cities.
  - (2) Consulting newspapers to find advertisements of special bargains.
  - (3) Advantages of trading at a "cash-and-carry" store or buying a large quantity in a city.
  - (4) Price lists: Sugar, — cents per pound; soap, — cents per cake; 6 cakes, — cents, etc.

21. *Gas (grade 8).*—An interesting eighth-grade topic is gas. How is it manufactured? How is the meter read? How are gas bills computed? When we study this topic we visit the gas plant in our city, where the superintendent explains to us in detail and shows us the complete process of manufacturing gas for our use. Aside from its value for working arithmetic, this experience furnishes material for a talk at our assembly exercises by one of the pupils and for an article for our school magazine.

Slips left at the homes by gas-meter readers aid us in learning how to read gas meters. By using a series of these, which have been left at a home each month during the year, we learn how to compute gas bills.

22. *Checks and receipts (grade 6).*—When taking up the work of writing checks and receipts it is interesting to have the pupils start a bank and pay rent by check. Several pupils are appointed to positions in the bank, and several are appointed landlords. The rest of the class make out checks payable to the different landlords. They, in turn, give receipts in exchange for the checks. Then the landlords take the checks to the bank, where they are examined to see if they are made out correctly, and money is given in exchange for them. In this way the pupils become familiar with writing checks and with receipts.

23. *Banking and interest (grade 7).*—Before the subject of interest is introduced have the children become as familiar as possible with banks. Much material—such as old check books, samples of notes, and deposit slips—can be obtained from parents for use in the schoolroom. Arrange the front of the room as nearly like a bank as possible and have certain children take the parts of bank officials, the remainder of the class acting as the public. Start work with deposit slips, checks, and indorsements. Children should visit a bank either individually, with parents, or in small groups. Then drop the bank for several days and work out interest. This same idea has been used successfully with notes and the working of bank discount.

24. *Banking (grade 8B).*—The class is formed into groups, each group choosing a banker. Each pupil has made a bank book and also a ruled sheet similar to those used at the bank. The sheets are given to the bank and used as each child makes his deposit. Blank checks having been obtained from the bank, each pupil is given an equal number of checks, generally three or four. All depositors start with equal balances. The checks are written carefully and given to the persons to whom they are made out. After all checks are presented each depositor goes to the bank and deposits money, having it recorded in his bank book and on the sheet that has been previously made. The checks then go through the clearing house, one pupil from each group acting as messenger. Balances are made at the bank for each depositor, canceled checks and statements corresponding. Each depositor compares his check stubs with the individual statement given him by the bank.

25. *The stock market (grades 7 and 8).*—Each member of the class selects certain stock and calculates gain or loss on 50 shares if the stock is bought on Monday and sold on Saturday of the same week. Use daily newspaper stock quotations.

26. *Insurance and taxation (grade 8B).*—If the pupil's father owns the house in which he lives, we assume the father has asked him to take charge of it for a year. If not, we assume that the pupil is owner for one year. First a committee of three is appointed to

visit a local insurance agent and find out upon what the insured value depends, the rate, etc., also to get one blank policy form. We spend a period studying this form and each pupil makes out a similar blank form. These are corrected and turned in to the chairman of the committee, who acts as the agent; and as each pupil has his house insured and pays his premium he receives a policy.

In studying taxation we appoint a committee to visit the collector. The chairman of the committee reports. We then appoint five assessors who make out the tax list. Each pupil, acting upon this information, makes out his own tax bill. They now go to the pupil who has been appointed tax collector and pay their taxes.

27. *Taxes (grade 8B).*—Tax bills are being distributed in our city. The interest of the pupils is aroused by an informal discussion of the need for taxes. Clippings from newspapers are used showing how the city is spending money on roads, schools, etc.

Pupils are asked to observe the new tax bills which their parents receive. Several pupils bring last year's tax bills to the class. We observe from these that there are two classes of property for taxation—real estate and personal. Real estate is assessed by men called "assessors," who are elected to estimate the value of the property to be taxed. The total tax to be raised is ascertained. We learn that from the total valuation and the tax to be raised the tax rate for the following year is determined. In this city it is \$3.08 per \$100. We observe that one-half of the total tax is due on a given date, together with the poll tax. The balance is due six months later.

On some bills we observe that interest has been added because those taxed failed to pay promptly. This leads to review of interest.

Pupils assess property and find the tax to be paid for the year. Other problems relating to taxes are given.

28. *Taxes (grade 8A).*—As we have now discovered the purpose for which taxes are paid, we discuss the question of equal taxation, and in the course of the discussion the terms "valuation," "assessed valuation," and "rate of taxation" are introduced.

I then call for two volunteers to go to the tax collector's office for several blank tax bills and to ask the collector for information as to method of assessing, percentage of property value assessed, etc. Next I call for volunteers from among those whose parents are property owners to bring, if possible, the tax bills for the past two years. Perhaps a half dozen or more bring in tax bills. Thus we have material to work out a good many problems of vital interest to the children. The topic of discount and interest is brought into discussion here. With the information from the tax collector's office the pupils make up original problems.

With my present class this work in taxes was done early in February, and at that time the tax collector told my pupils that the new tax bills would be sent out in May. On May 6, during the arithmetic lesson, the pupils told me that the new tax bills were out and that the rate had been reduced but that the valuation had been increased. This led to a lively discussion as to the probable cause of this reduction and increase and to the working of some more original problems.

29. *Building a home (grade 4A<sup>1</sup>).*—This project gives a knowledge of terms used in construction and of current prices; it gives also a good chance to show knowledge of fundamental processes.

Find the cost of excavating the cellar and of building the cellar wall; find the cost of materials used.

Find the cost of lumber, flooring, joists, etc., used in building the house.

Find the cost for labor of carpenters, painters, etc.

The house furnishing may also be made a subject of study.

30. *The Irving Real Estate and Development Co. (grade 7).*—The Irving Real Estate and Development Co. is planned and worked out by a seventh-grade class. The company is organized for the purpose of developing a new subdivision.

The first work, that of organizing the company, is done by the class as a whole. After a short study is made of company organization and stocks, a name is selected, the amount of capital stock determined, and stock certificates designed and made. The next step is the selling of stock. Each member of the class becomes a stock holder.

The class is then divided into four groups: (1) Engineers for laying out the subdivision; (2) office men and salesmen for the company; (3) members of an improvement association; and (4) city clerks.

The first group, the engineers, take a piece of beaver board 4 by 3 feet to represent vacant land and subdivide it into lots and streets to the scale of 25 feet to 1 inch. They number the lots, name the streets, pave the streets and sidewalks with paint and white sand, and cut paper lots the size of the lots on the beaver board. The paper lots are given to the buyers at the time of sale.

The second group, consisting of office men and salesmen, has charge of selling the lots and keeping the books of the company. A record is kept of the number and buyer of each lot, amount of money paid down, interest, cost of laying out the subdivision, and payments of dividends which have been fixed by the group.

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<sup>1</sup>Better for seventh or eighth grade.

Group three, the improvement association, has charge of fixing the following restrictions: Size of house, distance from street, cost, and type of house. Each buyer in planning to build on his lot submits plan and picture of house (obtained from magazine) to association for approval.

The fourth group, or local department, takes charge of titles, recording of deeds, making out notes, and figuring taxes. Blank warranty deeds are obtained from a real-estate company.

Each child in the class buys a lot, and when he obtains his paper lot draws upon it a plan of the house, garage, and garden. The buyer then finds the cost of sodding the lawn, fencing the lot, digging the cellar, and paving the walks. After the plans are finished the paper lots are pasted to the beaver board; when the pasting is completed there is a lot for each member of the class.

Individual books are made by the children. In these are placed a stock certificate, a copy of the building restrictions, a picture of the house, a copy of the paper lot with the plans drawn upon it, the warranty deed, checks, notes, and the individual problems.

This work motivates drawing to a scale; finding perimeter, area, volume, percentage, and interest; study of stocks; and the writing of checks and notes.

31. *An auto trip (grade 6).*—Several children are appointed to find the distance from Baltimore to Boston, according to the Automobile Blue Book. After finding the distance, 418 miles, the following examples are given the class to work out:

Find the distance, or number of miles, to be traveled from Baltimore to Boston and return, if Boston is 418 miles from Baltimore.

At an average rate of 20 miles per hour, how many hours will it take to go 836 miles?

If it takes  $41\frac{1}{2}$  hours to drive from Baltimore to Boston and return, at the rate of 7 hours' driving a day, how many days will it take?

If it takes 1 gallon of gasoline to go 8 miles, how many gallons will it take to go 836 miles? At 29 cents per gallon, how much will the gasoline cost?

The following provisions will be needed for the trip, costs as indicated:

3 cans of beans, at 15 cents per can.

5 cans of soup, at 10 cents per can.

2 cans of salmon, at 15 cents per can.

1 peck potatoes, at \$1 per peck.

$\frac{1}{4}$  peck apples, at \$1.20 per peck.

Find the cost of these provisions.

Allowing \$50 for incidental expenses, such as fresh fruit, vegetables, milk, and sight-seeing, how much will the trip cost?

32. *Taking care of pets (grade 5A).*—Children bring in the dimensions of dog kennels, pens for rabbits, and sheds for goats. The dimensions usually are either in fractions or mixed numbers. The cost per foot and per yard of building material used in the construction is ascertained and recorded. The amounts of grain and other feed used per day are also recorded, together with their cost per quart and per pint. The children then proceed to find the cost of shelter and food for their pets.

33. *Measuring height (grade 3).*—Children measure with a yardstick each other's height and reduce this to feet and inches. Have a chart showing each child's height. This may be used in various ways. Comparison of heights gives opportunity for subtraction, and finding average height gives drill on addition and division. Guessing height before measuring adds interest. This same idea may be used with the children's weight chart.

34. *Government expenses (grade 8).*—In order to make real the topics "What the Government does for us" and "How it is supported," groups of pupils visit the following departments of our city for information as to actual expenses of the current year: Fire department, police department, public library, electric-light company, secretary of board of education, street-paving department, commissioners, and hospital. The information thus secured is used in making a series of real problems which are used in our sixth grade.

Taxation is studied at the time the city budget is being made, and the local papers are eagerly scanned each night for material to be used in the arithmetic class. We secure from the assessors the assessed valuation and the amount of the budget and actually work out the city's tax rate. We find the tax on various properties, with increases or decreases since the previous year. This makes a very vital problem.

35. *The school situation (grade 8).*—In studying percentage a very interesting and practical application of the work may be made by securing from each teacher in the building, or from the principal, the number of "days present" and "days absent" for the boys and girls of each room. From these may be reckoned the percentage of attendance for each room and for the building. This gives an opportunity for a review of the principle once each month.

Further interest may be aroused by recording these results in graphic form.

36. *Collecting bus fares (grade 2).*—Select a child to be the driver. Designate two rows for a bus. The driver takes the teacher's chair.



Supply change to the children, giving them coins made from heavy paper or cardboard. Interest the children by telling them we are going for a bus ride to the park. On this trip so-and-so (naming children) may go. Vary the number. Then when the driver has collected his fares allow him to tell you how much he has received. After the children are able to do this give them coins of 10 cents, 25 cents, etc., and allow the driver to give them the change. As each individual approaches the driver ask him how much he is giving the driver, allow the change to be made, and ask for the result.

37. *Helping mother with shopping (grade 3).*—Children in the third grade like very much to go to the store for mother. They see that they must have an accurate knowledge of adding and subtracting in order to pay for the articles purchased and to bring home the correct change.

38. *Business usage as a basis of work in fractions.*—The class was divided into groups of two. Each group was given a definite place of business to visit. They ascertained the fractions most commonly used by the person in charge of the business. Each group tabulated the results found.

When the survey of the town was completed we found that the results included the most commonly used fractions employed by tailors, hardware men, shopmen, grocers, schoolmen, dressmakers, etc. This device stimulated the pupils to greater effort throughout the whole study of fractions.

39. *The home-problem notebook (grades 6 and 8).*—The children are encouraged to make note of the arithmetic problems with which they meet outside the school or in the home. Each day we place the figures 1-4 in a column on the board in some inconspicuous place. The first child who comes in with what she considers a good problem places her initials beside figure 1 and then goes to the side board and copies her problem in the space assigned for the purpose. The second child places her initial after figure 2, and when the first child has finished copying her problem the second child copies hers. The third child and the fourth child put their problems on the board in a similar way. Thus we have four problems on the board by 9 o'clock. If we desire, we may increase this number. In order that each child may have an opportunity to contribute a problem, the same child may not put a problem on two days in succession or for several days unless one of the four places has not been taken by 5 minutes of 9. During the arithmetic period the problems are discussed and solved. Sometimes the class decides a problem is impractical. In that case it is erased. The others are copied into the home-problem notebook some time during the day. At the end of

each problem is put the answer and name of the child who contributed the problem. Four new problems a day give us 16 for the first four days of the week. On Friday we usually have a written review, including such problems as may have given some difficulty. At the end of each month the child who has given the largest number of problems for our notebook receives some special recognition. In the sixth grade I do not encourage the children to bring in problems which they themselves can not solve, but in the seventh and eighth grades this may be helpful.

Though this work is recognized as less vital than work involving larger life situations, it does, however, offer the opportunity for a wide spread of interest and encourages an interest in the practical affairs of the home.

## GAMES

It is evident that teachers apply the term "game" very loosely. Most commonly it is applied to a mere device. This bulletin has endeavored to distinguish between real games and devices. Games are worth while in themselves. They stand on their own feet. They are enjoyed because of the game, not because of the teaching. The teaching is incidental in a real game. On the other hand, the game devices, which are very numerous, are subordinate to a drill process, so that the process is the important thing.

To be sure, it is conceded that the very word "game" carries some attraction. This survey shows that the term is applied to all grades of excellence, from real games to the most formal devices or exercises.

The following are the best illustrations of real games reported:

*Hull gull (grade 2B).*—Six to 10 players are arranged in a circle and given 10 beans apiece. Each player takes some or all of these in one hand. Any player may begin. He holds out his closed hand to his left neighbor and says, "Hull gull."

The neighbor replies, "Hands full."

The first one then asks "How many?" and the second one guesses. If he guesses correctly he gets all the beans in the first player's hand. If not, he must give him as many as the difference between his guess and the right number. For instance, if he guesses 7 and the right number is 5, he must give 2; if he guesses 3 and the right number is 5, he must give 2.

Each in turn asks his left-hand neighbor until one player has all the beans; he is then declared the winner. When a player has no more beans he drops out of the game.

*Tenpins (grade 1 or 2).*—1. Child knocks down as many pins as he can. Count number knocked down.

2. Same as 1. Keep score on the board.

3. Same as 1. Write figure to represent number of pins knocked down.

4. Same as 1. Let each pin count for 5 or 10. Count by 5 or 10 at end of game to find score.

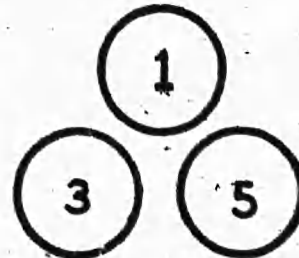
*Basket ball (lower grades).*—Have something to represent basket. Each child gets a turn to throw balls into the basket. Count number in the basket.

Let each count for 5 or 10 (or some other number). Count score at the end.

Play in teams to see which team gets the highest score.

• *Bouncing ball (grade 1B).*—Draw three circles on a low black-board about 15 inches in diameter; arrange in this form. Place Nos.

1, 3, and 5 in the circles (other numbers may also be used). Draw a line on the floor several feet from the board. Each child in turn stands on the line and bounces a large rubber ball on the floor in front of the circles. The ball will bounce forward and hit the black-board as it comes up. The child tries to make it bounce within the lines of one of the circles.



Each child may have three trials, thus giving a possible score of the three numbers. The child having the highest combination wins. In case of a tie, those having the same score may have one extra "bounce," the numbers received being added to the scores.

*Bean bag.*—Mark a little circle, a triangle, a square, and a big circle on the floor—like diagram. Each child throws four bean

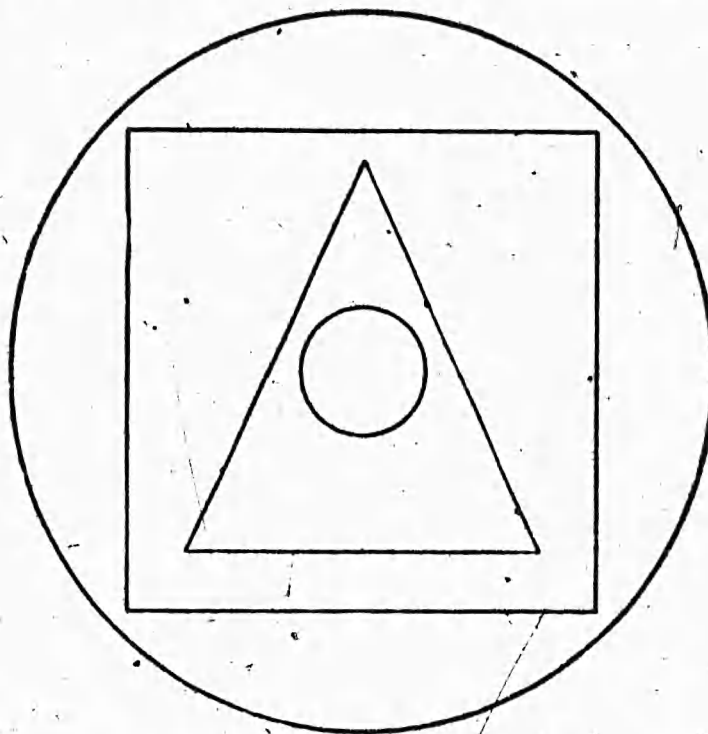


FIGURE 1.—Diagram for bean-bag game

bags. A bag in the large circle outside the square counts 0; a bag in the square outside the triangle counts 1; a bag in the triangle outside circle counts 5; a bag in the small circle counts 10. The children add the four numbers to get the total score.

*Hoop-la, or pitch rings.*—This game is helpful in teaching addition.

Materials: A board 18 inches square and from  $\frac{1}{4}$  to  $\frac{3}{4}$  inch thick; 21 curtain hooks (straight —); 24 rubber fruit-jar rings.

Screw hooks into points over scores after dividing board into 3-inch squares.

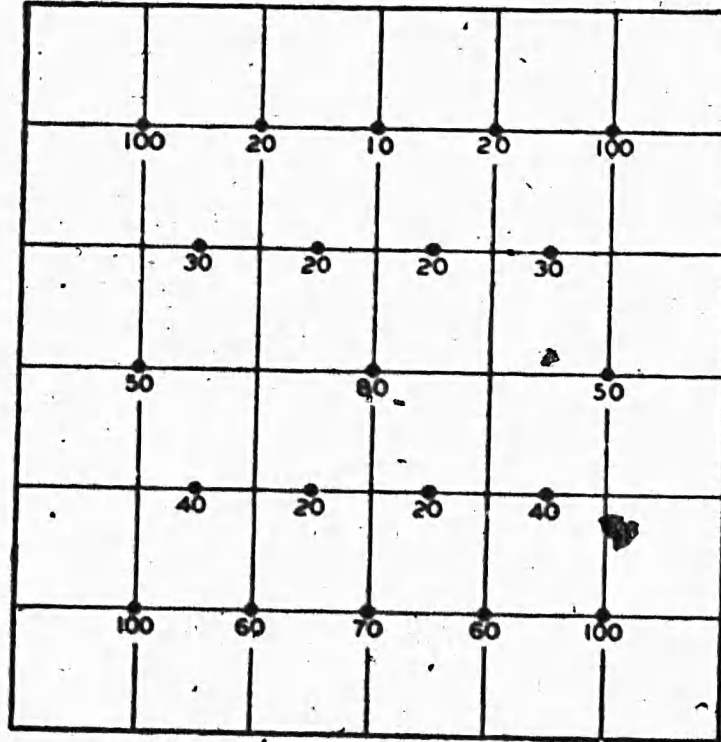


FIG. 2.—“Pitch rings” involves frequent additions

Hang board on wall or door, level with most of the players' eyes. Players stand 6 feet away and toss rings. One string consists of 24 rings (or less, as agreed). One game consists of five strings (or less, as agreed). Add scores.

Each pupil must add own score in taking rings off of hooks. The ring must hang on the hook; otherwise it is not counted. Groups of two or three can play. If more play, use 10 rings instead of 24. For lower grades use smaller numbers.

## GAME DEVICES

The following devices were reported by teachers as "games." Each one does contain an element of play and may for a short time hold children just as a game does. In the first grade, and largely in the second grade, the emphasis should be on the game. But the teacher chooses the game with educative value. The teacher capitalizes the child's interest in games, and so arranges that number knowledge will contribute to success in playing the game. Play is the child's world, and the numbers used must serve him where his interests are.

Gradually, in higher grades, games are replaced by drill devices or drill exercises, as practical uses have become apparent to the child. The illustrations in this and the four following sections are borderline cases, and are labeled "game devices."

### COUNTING AND READING NUMBERS

*Bull's-eye (counting, grade 1).*—Place a bull's-eye in front of room and throw a rubber ball at it. Count the times it is hit and have the children count the times it is missed.

*Ring toss (counting, grade 1 or higher).*—Place a standard (or if unable to get one, a chair will do) and make rings of rope. Toss the rings over the standard and keep score of number of successes and number of failures.

*Circle party (counting, grade 1).*—Place the children in a circle, have a child go around the circle and touch each child on the head and put him to sleep, and count the children as they are touched. Wake them up in the same way.

To count by fives have the children place hands on knees, and have one child touch the hands and count the fingers.

*Postman (grade 1).*—Children make about eight post cards out of bogus for seat work. Children arrange chairs as streets. Postman (one of the children) gives a few post cards (not more than six) to each child. Then he goes on second trip and gives each child a few more; six or less. Each child in turn tells how many post cards he received on each trip and how many he received on both combined.

*Number party (grade 1).*—Give each child a number. His number is his name. Let him come to the party and tap out his number on the door. He then asks, "Who am I?" Others listen and count and say, "Come in, ———," telling his name.

Vary with figures on calling cards. He presents his card and children read the figure to find out his name.

*Mailman (grade 1).*—Have figures written on the board to represent house numbers. Let children play they are delivering mail.

Give them cards with figures on them to deliver to corresponding figures on board. See which one is best mailman—one who delivers mail most quickly by matching numbers correctly.

*Number parade (grade 1).*—Give half the class cards with figures and half cards with pictures. Have them get partners by matching figures and pictures. Have children arrange themselves in serial order and parade.

*Skip and tell (grade 1).*—Form circle. Choose a given number to play. Mark numbers on the floor, having one more child than numbers. At a given signal from bell or triangle, children skip. When a second signal is given children stop and each finds a number. The one who did not find any number goes back to his seat. Players tell numbers they are standing on. One number is erased and at the signal children again skip. The game continues until only two are left in the circle. These two try to find the last number. The last one wins the game.

*Number game (for quick recognition, grade 1).*—Form two parallel rows of children. First child of each row is the captain. Captains' names are written on board.

Give each couple the same number until all have numbers. When their number is written or flashed before class the pair of children run forward, touch the blackboard, and return to their places. The child who reaches his seat first wins a score for his side. At the end of the game the scores are added and one of the captains tells which side wins and how much ahead it is.

This game may be used in teaching counting by 2's, 5's, and 10's when marking scores.

*Number ball (grade 1).*—Have cards with numbers printed or pasted on them and provide a ball. Each card has a cord attached so that the number cards may be suspended from the children's necks. Children stand in circle; each one has a card.

One child goes to center of circle and tosses the ball into the air; at the same time he calls some number. The child whose number is called runs to the center and catches the ball as it rebounds. He, in turn, tosses the ball, calls a number, and so continues the game.

*Hunt the apple (grade 2).*—One child closes his eyes while another hides an apple somewhere in the room. At the word "Ready" the child who is "It" opens his eyes and tries to find the apple. All the other children count until the apple is found. If the counters reach 100 before the apple is found, the one who hid it shows the hiding place.

The children may count by 1's, 2's, 5's, or 10's, as seems best suited to the needs of the class. Individual counting may be substituted for concert counting.

*Telephone game (grade 2 or 3).*—Each child will have a toy telephone. Teacher will have a list of names and numbers as: Mary, 1643; Jack, 7924.

Each child will have a slip with a corresponding number.

Teacher: "What is your number, Mary?"

Mary: "My number is one-six-four-three."<sup>1</sup>

This teaches children to read numbers.

Teacher may call numbers, and each child will recognize his or her own number.

This is a good game with which to correlate arithmetic and language.




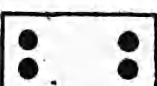
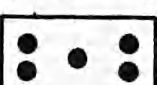
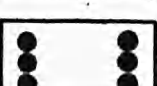
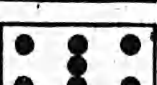

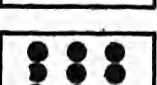
	I	ONE	1
	II	TWO	2
	III	THREE	3
	IV	FOUR	4
	V	FIVE	5
	VI	SIX	6
	VII	SEVEN	7
	VIII	EIGHT	8
	IX	NINE	9

FIG. 8.2—Cards for "Matching game"

*Matching game (grade 2).*—From tagboard or heavy paper make 36 cards like those shown in diagram. Give a card to each player. The child runs quickly forward and stands before the class. He holds up his card. All those having same number in other forms stand beside him.

Each child should state what he has on his card, as "I have number 7," and "I have the word seven."

<sup>1</sup> Use regular telephone style of reading numbers. See Terry, Paul W., "The Reading of Numbers," Chicago University Press.



*The automobile show (grade 2 or 3).*—Models of various cars are cut and mounted so that they stand up. They are then classified and the prices put on. After they are marked the class may come and buy the desired model. Practice in reading and writing numbers of hundreds and thousands is secured.

*Buzz (grade 4 or 5).*—Pupils are lined up around the room. Starting at the head and proceeding down the line the pupils count, thus—1, 2, 3, 4, 5, etc., as in numbering. Every pupil to whom falls a number containing the figure 7 (for instance), or any multiple of 7, must say "Buzz" instead of the number. If he calls out the number instead, he must sit down.

Then proceed until all have had to take their seats.

#### ADDITION

*Domino game (grade 2 or 3).*—The children make out of cardboard or paper rather large dominoes which contain the known number combinations.

Each child may flash a domino before the class, calling on some one to give the combination. If the answer is correct, the child giving it may flash one of his dominoes. If not, the first domino is flashed again.

*A variation:* The teacher or any appointed child may say any number, and the child who first holds up the domino making that combination may give the next number, and so on through the class.

*Hippety-hop-1 (grade 2).*—This game may be played out of doors. The children form a circle. Each child holds a card bearing a number of colored dots. Numbers from 1 to 7 are used, also the following rhyme:

Hippety-hop, a skip I take.  
Tell me what our numbers make.

One child is chosen to be "It." He skips around inside of circle, stopping at the termination of the rhyme which the children are reciting. He faces the child by whom he stops. It becomes this child's duty to repeat the combination of the two cards (his own and that of the skipper) and state their sum. If correct, the other children repeat, and the two children exchange places and go on with the game as before. When several have had a turn at being "It" they are requested to stoop, thus allowing every child an opportunity to skip. Those stooping, however, are requested to take part in the concert recitation of the combinations and rhyme. This holds the attention of all pupils throughout the game.

*Hippety-hop-2 (grade 2).*—The children form a circle. Each child holds a card bearing a number of colored squares. Numbers from 1 to 7 are used, also the following rhyme:

Hippety-hop, away we go;  
Tell us the sum, if you know.

The one who is to be "It" announces "Here comes Three!" He skips around inside of circle, stopping at termination of rhyme which the children are reciting. He faces the child by whom he stops. Both children strive to be first in giving the correct sum of the two cards. The successful one is the one to skip. When one makes an error he forfeits his card and stands in the center until he can give the sum of the two numbers before either child holding the cards can do so. In that case he wins a card back and the chance to skip next.

NOTE.—A very good feature of this game device is the fact that a child may return to the game after a failure.

*Hippety-hop-3.*—The children form two parallel lines about 12 feet apart, facing each other. Each child in line holds a card bearing a number from 1 to 9. Each child in line B holds a card bearing the sum of two numbers in line A. One child from line A takes his place midway between the two lines and facing line A. The following rhyme is used:

Hippety-hop, I come to your place,  
If you know the sum, I'll run you a race.

As the rhyme is being repeated by the children the child in the center skips and stands before some child in line A. This child takes the hand of the one who approaches him, and the two skip and stand at a reasonable distance from the child in line B whose card bears the sum of their numbers. This child makes the number statement, as "Nine and three are twelve," and then chases the two digits to their own line. If he succeeds in catching one of them the child caught takes his place between the two lines ready to begin the game again, while the pursuer returns to his place in line B.

NOTE.—The children enjoy the running and excitement of this plan.

*Tick, tack, toe (grade 2 or higher).*—A large square made with colored chalk is placed on the board. Squares are marked off, and all combinations with which the children are familiar are written within the squares with white chalk. A pupil takes a pointer, closes eyes, and those at their seats say:

Tick, tack, toe, around the square we go;  
Hit or miss, stop at this.

Pupil must give answer to problem at which he has stopped.  
This may be used for drill in any process.

*The Merry-go-round (easy combinations).*—Material: None required.

Teacher: Draw circles on the blackboard. The circles on the blackboard represent the rings that hang from the bars of the merry-go-round.

Children: Let the children pretend they are riding on a merry-go-round. A ring is taken when the result of the combination in that ring has been correctly given. John has the first ride. He tries to ride fast and catch all the rings he can. When he misses a ring another player takes a ride. Applaud every rider who takes all the rings.

*Pussy wants a corner.*—Give two children each the same number until all the numbers from 2 to 10 are taken. This allows 18 children to play the game. The numbers are pinned on the children in plain sight. All but one form a large ring around "Pussy," who is in the center. Pussy goes to any one in the ring saying, "Pussy wants a corner." The child to whom it is said, asks "What corner?" Then Pussy gives any combination that will make some sum from 2 to 10. If she says "2 and 7" the two 9's exchange places, and Pussy tries to get one of the places while the exchange is being made.

This is a good device; children like it.

*Pussy in the corner.*—The children form a circle. Each child is given a card upon which is printed a combination. As each child receives his card he gives the answer orally. If the child gives an incorrect answer, or says he does not know, another child tells him the answer.

Now the children are ready to play. One pussy or more than one may be chosen. A pussy runs and stands in front of another child in the circle and shows his card. The child in the circle says the answer and they change places. The child who is now pussy runs to another child in the circle, etc.

If the child in the circle can not give the correct answer to the pussy's combination they change cards instead of places, each telling the other the answer of the new card. In that case the pussy has another turn.

This makes a good outdoor game. When it is played indoors where there is not sufficient space for a circle the children may remain in their seats.

*The helper game (grade 3).*—The children form a circle. Each child holds a card bearing a number from 1 to 9.

The child chosen to be "It" stands in the center of the circle and says "I am 7" (or whatever his number happens to be). "Who will help me make 15?" He may choose any sum to 18. In answer to this question all children holding cards bearing the number 8 quickly

step to the center. The first to reach the side of the interrogator becomes "It," the others taking their places in the circle. Alertness of mind and body is the watchword.

*NOTE.*—A teacher's comment follows: "I find that the children never tire of this game. It may be used in grade 4 or 5 successfully."

*Farmer (grade 4).*—The children form a circle. Each child holds a card bearing a number from 1 to 30.

One child is chosen to be the farmer and takes his place within the circle. He steps up to some child in the circle and says "Have you seen my sheep?" The other replies "No, how old is he?" The farmer says "He is — years older (or younger) than you." The child tries to locate the one holding the card which bears the sum, or difference, as the case might be. The one holding this card begins to run around the outside of the circle, pursued by the other child. If the pursuer is successful, he becomes the farmer. If not, the farmer has another turn.

*Relay race (grade 3).*—At a given signal the children in the front seats go to the board and write any number from 1 to 10. The first child in the row returns and takes the second seat. The second child goes to the board and writes his number directly under the first number, returns and takes third place, and so on down the row. The last child in the row adds the column of figures and takes his place in the front seat. The row finishing correctly wins one point. One child is scorekeeper. The race is finished when pupils reach their own seats. Final honors are given to the row obtaining the greatest number of points.

*Number race.*—Race to see who will get over the fence first.

Divide the class into teams—boys against girls or row against row. Draw a vertical line for the fence. Put about 10 addition problems on each side. A child from each team starts at either end and tries to get over the fence first. Class watches to see that no one goes over the fence until every answer on his side is correct. Keep score.

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

*Number game (for combination drill, grade 3).*—Cards with numbers are passed to pupils. Then one pupil is chosen to be "It." He bounces his ball and calls out any number combination, such as 4 and 3. Then the pupil holding the 7 card runs to the front of the room and gives the combination as he catches the ball.

The game may be changed by having the combination cards passed to the pupils and having the pupil who is "It" call out the answers. Then every pupil who knows his combination runs up

with his card; the first one who catches the ball is "It." The cards are held for the class to see.

The teacher will add new combinations after they have been presented in class for mastery. The cards are used for review drill and must not contain unknown combinations.

This device keeps the attention of the entire class.

It may be varied by having the first pupil in the group write the first answer, the second pupil the second answer, etc. This plan uses more pupils and keeps all alert.

*A number contest.*—This game is used to teach the number combinations, which are written on the blackboard without answers.

Divide the class into two sections, calling one "Reds" and the other "Blues." Choose a child from each side as a contestant and a third for score keeper. Each contestant is given a pointer, and as a sum is called for, each of the two contestants tries to be the first one to touch the right number with his pointer. The two contestants continue to race until every child in one row of seats has had a chance to ask for a sum, after which one point is counted on the score for the side of the child winning the greatest number of answers; then two new contestants are chosen.

This game is quite a favorite with the pupils.

*A railroad journey.*—Along the top of the blackboard write the names of familiar towns. Between each two write a figure which represents the mileage between towns or one which represents the fare. The child starts on his journey by adding the miles he has gone or the fare he has paid. The game is to see who can go the farthest without stopping. Thus: Akron, 6; Cuya Falls, 9; Stow Kent, 4; Ravenna, 12; Warren, 7; Niles, etc. The child points to each one, saying 6 - 15 - 19 - 31 - 38, etc. When he can do no more with reasonable speed he must get off.

There is possibility of correlation with the work in geography in intermediate grades.

*Baseball device (grades 3, 4, and 5).*—Children start, each time, with the number in the center; this is added first to the numbers inside the diamond, as,  $8+4$ ,  $8+5$ , etc. The numbers on the outside are outfielders. As many troublesome ones as desired may be placed there. A complete circuit of the diamond counts one score. If a wrong answer is given, the player is marked out (0). The children will keep their own scores and not lose interest for a long time.

The numbers and sign may be changed as often as desired.

*Eraser game (grade 3).*—Material: Combinations on board, cards with answer to combinations, and two erasers.

Game: Two children, one from each team, are given erasers. The teacher or a pupil displays an answer card. Children race to

to erase combination corresponding to answer. The child who wins this race scores a point for his team. The next two on team are given erasers, etc. Add the points; the team having highest score wins. An exceptional child may be score keeper.

*Baseball game.*—Place 12 combination cards in the following order:

Home			First			Second			Third		
8	10	6	8	8	5	7	9	10	9	7	9
<u>9</u>	<u>9</u>	<u>7</u>	<u>9</u>	<u>5</u>	<u>6</u>	<u>8</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>7</u>	<u>9</u>

Divide the class into two groups. Groups are named, as Eveleth-Virginia; Giants-Cubs; etc. The first batter on the visiting team

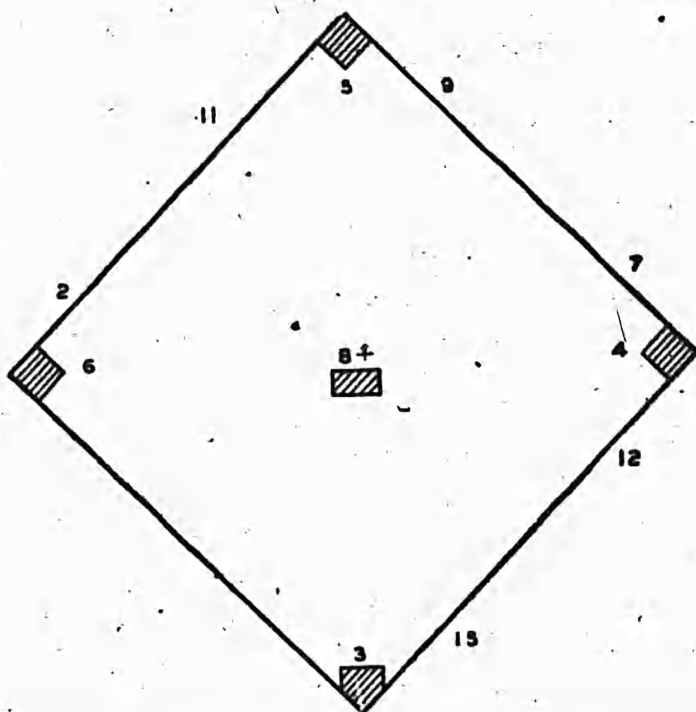


FIG. 4.—Baseball diamond for teaching addition

begins with  $\frac{8}{9}$ , giving answers as rapidly as possible. Should he miss  $\frac{10}{6}$  his side gets 8 points. If he gets 12 points he makes a home run. The first batter on the other team now tries, etc. The winning team has the highest score, which is added by the class or the score keeper. The cards should be changed often.

*Traffic signals.*—Flash cards of addition and subtraction combinations are distributed among the pupils. The teacher or a pupil may act as a traffic officer, standing in front of class and calling any number the combinations of which have been studied. As the number is called all children having cards bearing combinations requiring the number called as an answer pass quickly to front, face class,

and show their cards. Any mistakes are corrected by children at seats. The class then show their cards, and those standing call those who should have passed to front but failed to do so. All go to seats and another number is called by traffic officer. The children pretend to be cars and their cards are the license tags called for by officer.

*Ninepins.*—The teacher chooses one child to be "It." He selects nine children from the class and these stand in a straight line facing him. The teacher then gives combinations rapidly, as "7 and 8," "17 and 9." If the child who is "It" gives the answer before the first child in the line, he has knocked down a ninepin, and this child takes his seat. If any child in the line answers first he remains in the line until all have had their turn. Each ninepin knocked down counts two. Score may be kept by one of the pupils at the blackboard.

This may be varied by flashing cards instead of giving the combinations.

*Drop the handkerchief.*—The children form a circle. Each one has a number (from 1 to 18) pinned on his back. Each pupil knows his own number. One pupil goes around the outside of the circle. He taps some one and says "4." The one tapped, whose number is 8, says the sum, "12," and immediately runs around the circle to catch the other child before he gets back to his own place in the circle. If he does not catch him, then he is the next to be "It." If he does catch him, then the one caught must be "It."

#### SUBTRACTION

*Circle "It."*—The children form a circle. Each child holds a card bearing a number from 4 to 18.

Directions: The child chosen to be "It" is blindfolded and stands within the circle. He touches some child who tells him the difference between the two numbers, his own and that of the one blindfolded. The latter, knowing his own number and having been told the difference between them, must tell the number of the other child. If correct, his blindfold is slipped off by the teacher and he chases the other child once around the circle in an effort to catch him. If he succeeds in doing so he remains "It." If he fails, the one pursued becomes "It."

*Hippety hop-4.*—The children form a circle. Each child holds a card bearing a number of colored dots. Numbers from 1 to 9 are used, also the following rhyme:

Hippety hop, we all say,  
How many left when you take me away?

Directions: One child is chosen to be "It." His number is announced by the entire circle. He skips around inside of circle, stop-

ping at the termination of the rhyme which the children are reciting. He faces the child by whom he stops. It becomes this child's duty to give the answer, as, "4 from 12 leaves 8." These two children exchange places and proceed with the game as before.

*Game of brothers (grade 3).*—The number to be learned is the family name. Any two numbers that combine to form it are the brothers.

For instance, "13" is the family name. One brother is "4," and he always calls for "9." The brother "6" calls for "7," etc., for all combinations of "13."

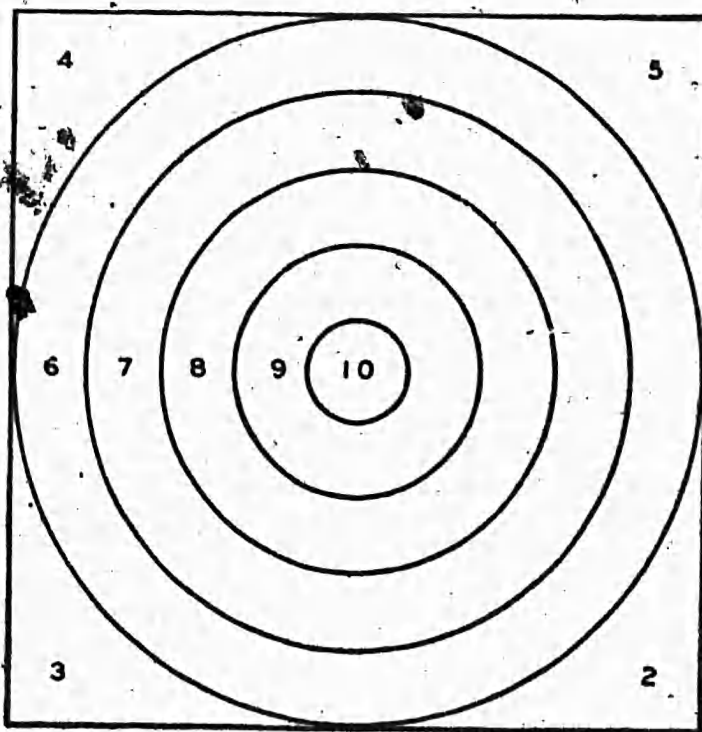


FIG. 5.—Chart for target game

This drill is a help to subtraction later, as it trains the mind to supply the complementary part in any combination when one part is given. As, when "4" from "11" is given, it becomes automatic to think "4 and 7 make 11" and to answer "7."

*Target game.*—Pupil shuts his eyes and, with chalk, turns around and points quickly to the chart. If he points his chalk on the circle marked "6," his score is  $10-6$ , which makes 4. If on 5,  $10-5=5$ , etc. Pupils try to get the highest score.

Played by sides, each pupil giving his score and writing it for his side, this device becomes a good game.

*Fox and chickens.*—Have children place a given number of objects on desk. Call them chickens. While the children's eyes are closed, one child, the fox, takes a different number from several desks. The children report the number of chickens stolen.

*Note.*—This is slow, often too slow, but some may find it helpful.



*Additional subtraction devices.*—Grouping of children is a device which may be effectively used. Call 10 children to arise; 2 be seated; the remainder standing is 8. Show that in every subtraction involving 10 and 2 the remainder is always 8. Notice the following:  $20-2=18$ ;  $30-2=28$ ;  $40-2=38$ ;  $50-2=48$ ;  $100-2=98$ ;  $800-2=798$ ;  $5,000-2=4,998$ ; etc.

Use the grouping device with various combinations:  $8-2$ , always 6;  $9-2$ , always 7;  $4-3$ , always 1; and  $9-3$ , always 6.

Many of the schemes noted in the preceding section on "Addition" are applicable also to this section on "Subtraction."

#### MULTIPLICATION

##### *Happy times.*—

1. Any even number of players, preferably six or more.
2. Played at a table or on the schoolroom floor.
3. Two sets of cards, one bearing the combination (as  $5 \times 8$ ); and one bearing the result (as 40).
4. Cards dealt, as in any card game.
5. Each player must have same number of cards. If number is uneven, cards that match may be removed to make an even number.
6. All players match the cards held in the hand after cards are dealt. (Example: If player holds  $7 \times 9$  and 63, then discard the matched cards.)
7. First player lays down any card which he holds in his hand. Either product or combinations.
8. Any player who can match it and make a correct combination gets both cards, which he places in his "guard pile." He then puts down another card, and the game proceeds as before.
9. Any player making a wrong combination takes back the card he played, loses his turn, and forfeits all the cards in his "guard pile" to the player who does make the correct combination.
10. If no player can make the correct combination, all players must place cards in plain sight. The player who first discovers the correct card is privileged to take it and match the card on the table making the combination correct. He adds these to his "guard pile," gets another turn, and the game proceeds as before.
11. The player who is first rid of all cards and has the largest "guard pile" is the winner.
12. The game may be begun with one table, and as other tables are taken up they may be added. It also makes a game complicated enough for upper-grade pupils who are weak in multiplication. It is a game which may be taken home and played by the whole family in the evening. It will make weak ones work when nothing else will. An unusually strong member of the class who is

letter perfect may be given the oversight of the game while the teacher is otherwise occupied.

*Note.*—Good for home or rainy-day drill. Its chief value is in linking home and school.

*Old witch (grade 3 or 4).*—Have an old witch, a mother, and children. If working on the 9 table, give the children such numbers as 27-36-45-54-63, etc. The old witch comes to the door. Each is to think very hard of the combination that makes his number. The old witch knocks and says "I want a child." The mother asks "Is it  $9 \times 5$ ?" "No, it is not 45," quickly replies the witch. Such a conversation goes on for some time. Finally the mother may say "Is it  $9 \times 7$ ?" "Yes," replies the witch, "it is \_\_\_\_\_." The pupil having the 63 must know instantly that  $9 \times 7$  equals 63 and that the old witch wants him. He runs, saying as he does so, "Well, if  $9 \times 7$  are 63, you must catch me."

This game may be applied to each of the fundamental processes.

*Note.*—This is time-consuming for the amount of drill.

*Number relay.*—The class is divided into two teams equal in number. For the purpose of example, I shall call one team the "North side" and the other team the "South side."

The blackboard immediately in front of the "North side" is allotted to that team. The blackboard immediately in front of the "South side" is allotted to that team.

The teacher writes a number combination on each board. (As I teach multiplication, I use combinations such as  $6 \times 3$ ,  $6 \times 9$ , etc. However, addition and subtraction facts are equally good.)

At a given signal, the first person on each side runs up to the board, writes the answer to the combination already there, writes a new combination, and returns to his seat. The next person then does likewise. This continues until everyone has run.

In deciding which side wins the game, accuracy, speed, and the number of fouls should be taken into consideration.

*Number match.*—The number match is a multiplication table drill. Have a captain for each side, as in a spelling match. Let them choose pupils for their sides. As a pupil fails to answer correctly he sits down. The pupil who gives most correct answers wins.

*Multiplication drill.*—Large squares, with a number in each, are drawn on the blackboard. One child chooses a number to be used as a multiplier. This child tosses the ball to one of the squares and another child must give the product before the ball has been caught after bouncing on the floor. If the child answers all correctly, he may throw the ball.

This can also be used for other processes. It is too time-consuming for frequent use.

*Baseball (grade 4 or higher).*—After the pupils know their multiplication facts fairly well this game can be played. The teacher

throws a soft indoor baseball to a child, at the same time calling out  $3 \times 4$ . The child is supposed to catch the ball and give the answer at the same time. He then throws the ball back to the teacher.

This is excellent for inspiring the pupils to learn something otherwise dry and also for drill work. They all want to play "arithmetic baseball," and they soon learn that in order to get any fun out of it they must know the tables so well that the answer comes automatically.

*Bean bag.*—The entire class forms a circle in front of the room. One child stands in the center of the circle with a bean bag. He gives a combination, as  $6 \times 7$ , and tosses the bean bag to one child on the circle. The child gives the answer and at the same time catches the bean bag. If he answers correctly, he takes his place in the center and gives a combination. If he misses, however, the child in the center has another chance. This is done for 5 or 10 minutes, and then if a child misses he takes his seat and studies his combinations. The last one remaining on the circle wins the game. This is too time-consuming for regular use in a fourth grade, and little or no formal drill in multiplication should be given below the fourth grade.

*poor*  
DIVISION

*A relay race in short division (grade 4 or 5).*—Divide blackboard into as many spaces as there are rows of seats. Seat children in rows of equal number. Give crayon to child in last seat of each row. At signal each child in a last seat goes to the board and writes five figures, no two being alike, and divides by a given number, say, 3. Each then returns to his seat and gives his crayon to the child in front of him; this child in turn divides the first quotient by 3, and so on till all have divided. Any remainder at the end of each division is crossed off. The row finishing correctly first wins. Example:

$$\begin{array}{r} 3 \overline{) 24,685} \\ 3 \overline{) 8,228} \\ 3 \overline{) 2,742} \\ 3 \overline{) 914} \\ 3 \overline{) 304} \\ 3 \overline{) 101} \\ 3 \overline{) 33} \\ 3 \overline{) 11} \\ 3 \overline{) 3} \\ \quad 1 \end{array}$$

*Additional division devices.*—Many of the schemes noted in preceding sections under addition, subtraction, and multiplication may be used for division.

## OTHER DEVICES

*Cross-questions.*—This may be played between two teams or two lines. One team asks the questions and the other team answers the questions or combinations. Children may be helped by the teacher in becoming skilled in calling for combinations on which others are weak; and if so, the drill falls where most needed.

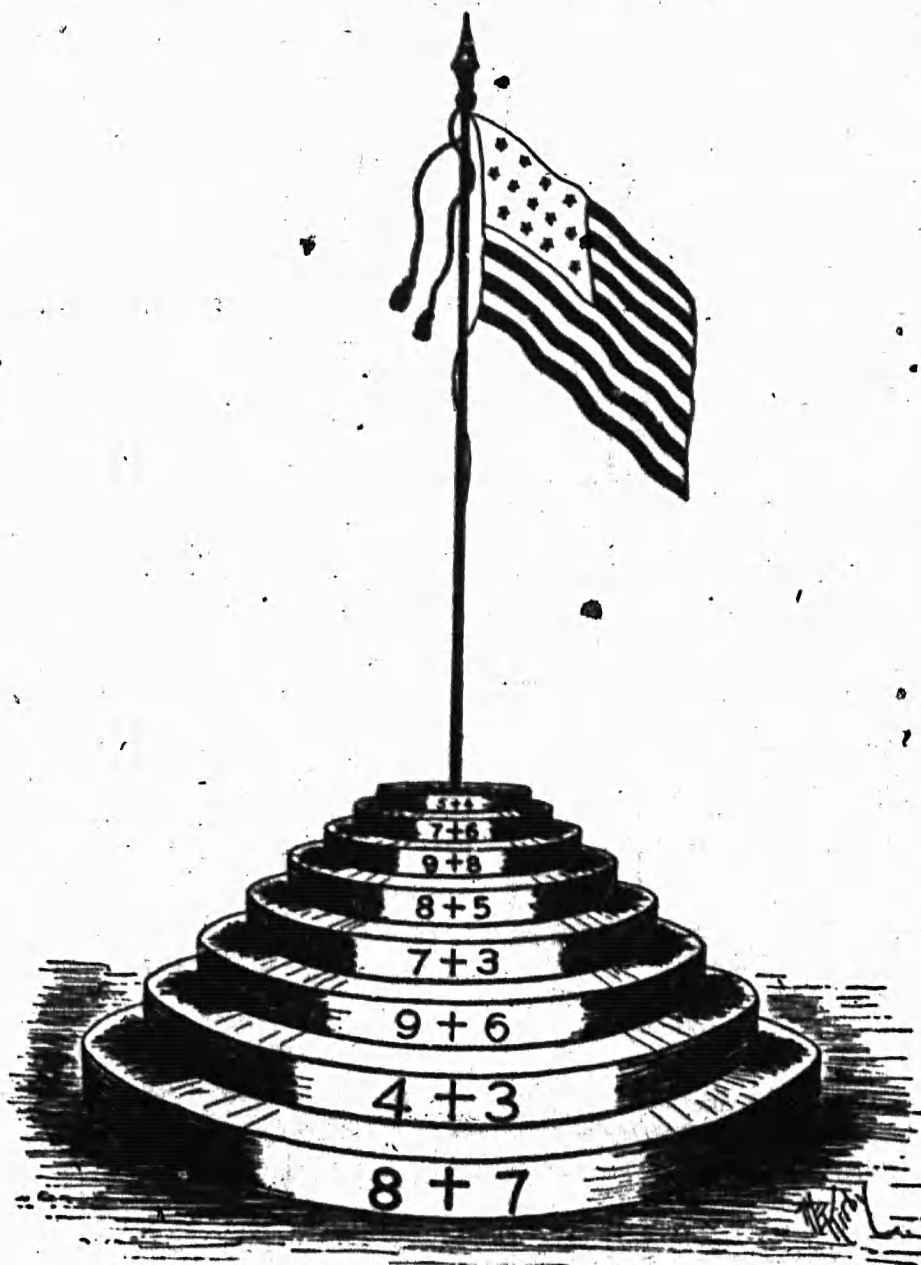


FIG. 6.—Device for drill in addition

*Climbing the stairs.*—Device used for drill on addition, subtraction, or multiplication. The child's aim is to go all the way upstairs and get the flag.

*Firemen's ladder.*—The fireman's ladder may be used for drills in addition, subtraction, and multiplication. Draw a ladder. Place on each rung any number from 1 to 9.

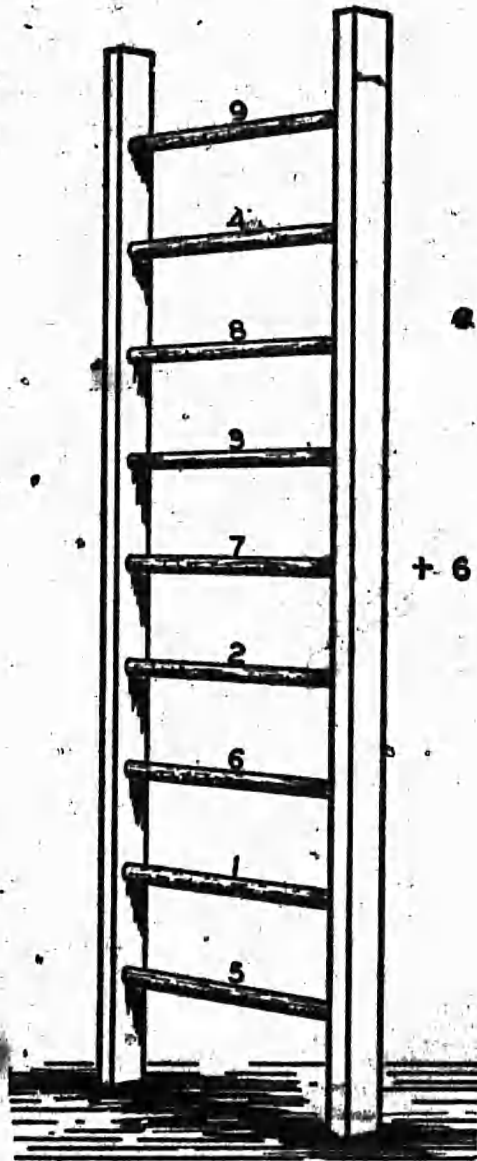


FIG. 7.—“Fireman's ladder” for addition, subtraction, and multiplication

Children, as firemen, aim to climb ladder by adding any designated number to numbers on the rungs and saying only the answers. To one side of the ladder, at top, list names of girls who reach the top, and to the other side those of the boys. At the close of the game count number of boys and girls getting to top of ladder. They are good firemen. The side having the most wins.

*Train race.*—Draw on the board a diagram of a railroad running from a point designated Chicago to one designated New York. A point marked midway between is Pittsburgh. Numbers 3 to 12 are placed between the railroad ties and  $\times 6$  (or some other combination) at Pittsburgh.

Two children play trains and race to Pittsburgh, one starting at New York and one at Chicago. They multiply the numbers between the railroad ties by the number in the center and write the answers under the railroad numbers. The child who reaches Pittsburgh first wins the race. The contest may be between boys and girls or between rows.

NOTE.—Groups of combinations should be of the same difficulty. See studies by Holloway, University of Pennsylvania, and Clapp of Wisconsin.

### A Trip by Rail.—

Dickinson

Glendive

$2 \times 7$   $2 \times 5$   $2 \times 11$   $2 \times 9$   $2 \times 8$   $2 \times 8$   $2 \times 6$   $2 \times 12$   $2 \times 4$   $2 \times 10$   $2 \times 2$

Flyer

Express

Freight

Wreck

Many of the fathers of the pupils are engaged in railroad work and the children are familiar with the different trains. If a child

can make a speedy run between the two cities he is on a "flyer." If he is not so fast he is on an express train. If a child makes a very slow trip he is said to be on a freight train. A mistake causes a child to get off the track, so he is in a wreck. The children at their seats decide on what kind of train the child at the board is riding. After each child has a turn the wrecks are helped on the track and allowed to start out again. This gives the inaccurate children the extra practice they need. This device is very popular in the second grade.

*Stepping-stones.*—Children visiting in the country like to cross streams on stepping-stones. In the illustration given a new stone is reached by dividing the number on it by 12, as  $144 \div 12 = 12$ , etc. As the child starts to cross the stream he is cautioned, "Don't fall into the water."



FIG. 8.—"Stepping stones" for practice in division

*Bar drill, or the high jump.*—Another device for drill on multiplication and division is the use of the bar. Sometimes we have a race to see who will reach the top of the bar first.

2		8	
5		20	
8		40	
6	×4	4	÷4
12		16	
10		24	
7		28	
6			

Sometimes we arrange the most difficult combinations at the top. Then we call it "the high jump," and the game is to see who can go highest or who can clear the bar.

*Ring the bell (grade 3).*—Undoubtedly, every child has visited an amusement park and has observed some sort of contrivance for testing skill and strength. The children in my class are well acquainted with the amusement park game, "Ring the bell," so I have endeavored to introduce it into the classroom. Competition is keen between boys and girls to decide who are the stronger and who are

able to ring the bell most frequently. The object of this device is to aim for speed and accuracy. The pupil begins at the bottom and tries to reach the top without error.

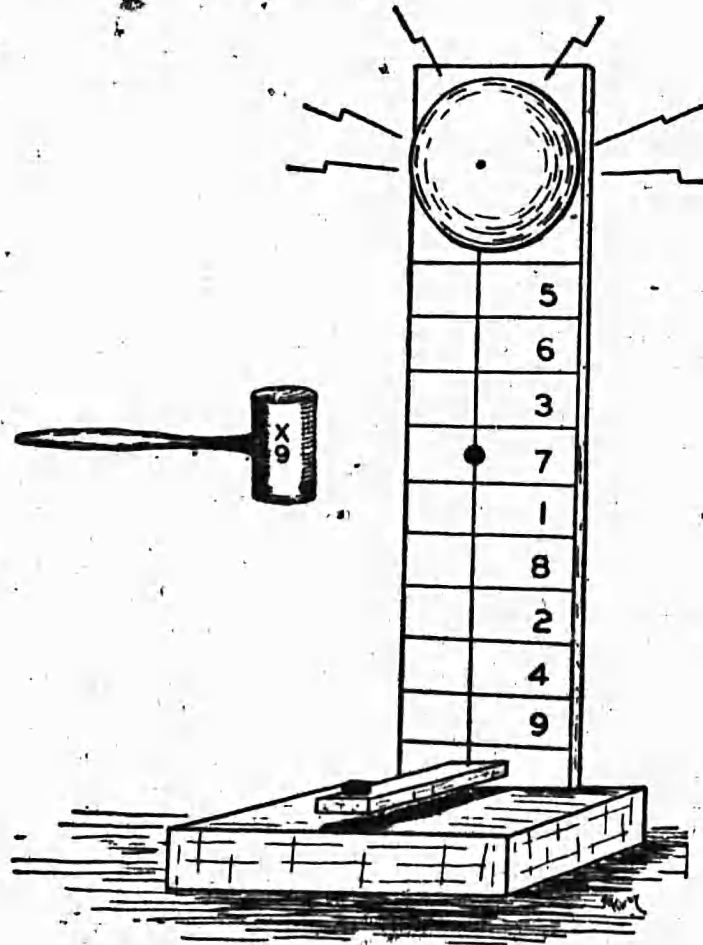


FIG. 9.—“Ring the bell” for multiplication drill

*Geometric figure devices.*—Any number arrangement will serve for addition or multiplication. By care in placing the numbers the same devices may be used in subtraction and division. The number in the center is combined in some of the fundamental relationships with those on the outside, the teacher or pupil pointing to the numbers in turn, or the pupil naming results without pointing. Above a circle may be written “Merry-go-round,” or beneath it, “Keep the wheel rolling.”

*Picking apples.*—Draw on the board an apple tree with apples on it. Each apple has on its side a number combination. The children pick apples by giving the combinations. The one who picks the most apples wins the game. Keep score.

The plan may be varied by having pupils compete in rows or by having two teams in competition. The opportunities must be evenly distributed.

*The windmill.*—A windmill either of cardboard or construction paper is used. Attach numbers to the arms or sails of the mill, these

numbers to be multiplied by a number fastened in the center—or added to that center number.

*Spinning the arrow.*—Make a circle of cardboard. Place numbers from 0 to 12 at regular intervals around the circumference.

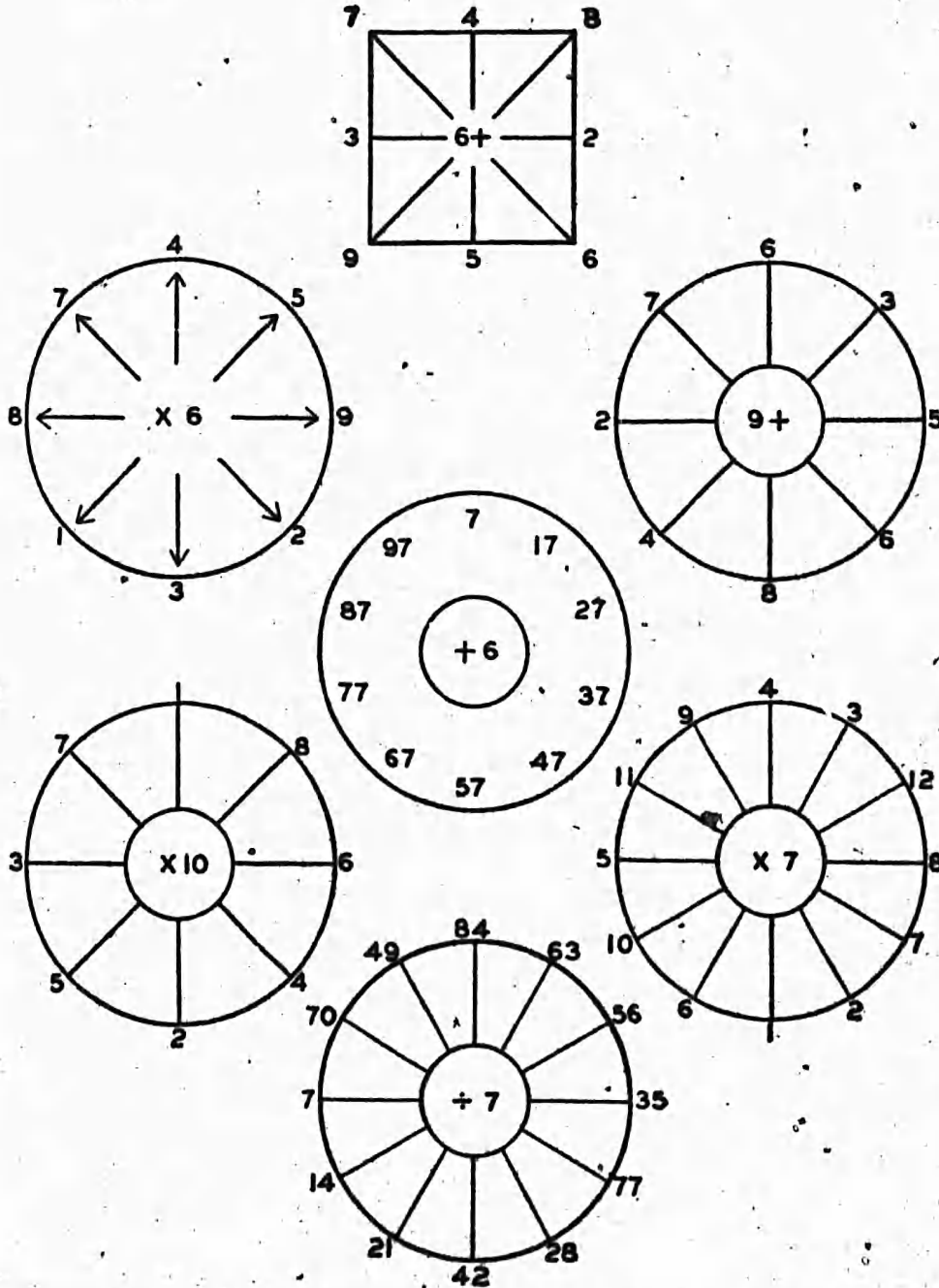


FIG. 10.—Geometric figures aid in the fundamental processes

Fasten an arrow loosely in the center. Each child spins the arrow, multiplies the number to which the arrow points by a given number, and adds a second given number. For example, one child spins, multiplies the indicated number (say 9) by 6, and adds 5. Another child spins, multiplies 8 by 6, and adds 5, etc.



*Over the wall—*

8×5	2×9	6×5	2×12
9×7	8×2	7×7	9×7
9×2	9×7	3×2	3×6
7×1	4×6	4×11	8×8

Each child has a chance to see how quickly he can give the answers and get over the wall; then he's *out* of the game. The row of children getting the largest number of children *out first* wins.

*Radio game.*—For this game a picture of a radio set is drawn on the board. This radio is just a simple box with a loud speaker. From the loud speaker are coming music, songs, and talks, for which I use numbers in circles—one-digit numbers if I wish to drill on multiplication, two-digit numbers for short-division drill. We all try to hear the news over the radio. If a child is not able to give an answer to the combination, his radio is out of order; and he tries to correct the fault before that part of the program is finished. This device is popular with a class having radio outfits in their home.

*A clock game.*—The children draw clocks on the board. The teacher then gives a time, as "a quarter after 12." The children draw the hands and underneath write the products of the numbers the hands point to.

*Combination cards.*—The teacher makes a set of cards out of white drawing paper, size 3 by 5 inches. The combinations are written on these cards with black crayon. The cards are placed in a large circle on the floor. The children sit around the circle. The day before the children have been told that each one is to bring a picture of an automobile to school. These pictures are pinned on the children just before class. An older child, or a student teacher, is chosen to act as the timekeeper who times each child as he races around the circle. The pupil who is chosen to race bounces a rubber ball on each card and gives the answer. If the card is 9 plus 7, the pupil says "16" and passes to the next card. The entire class, with the teacher, help check the pupil's answer. The student teacher, or older pupil, announces at the end of the race how long it took the pupil to go around the circle. If two children run the race in the same time, they are given a chance to run again. If two children choose Ford cars, they are allowed to race against each other to see which Ford car is the better car.

*An auto trip.*—An easily prepared device suggestive of many variations, which never fails to hold the interest of the entire class, is that of an auto trip.

At one end of the blackboard draw a few lines representing roofs of buildings, and above these write the name of the local city or

town. At the other end of the blackboard draw a garage, a hospital, and a hotel, leaving space under each for names of pupils. Above these write the name of some distant city. Between the two towns place the hard combinations. Flash cards are best to use, as they may be quickly rearranged.

A child is called on to give the answers in order as rapidly as possible. If he gets through with no mishaps, he is allowed to go to the hotel, and his name is placed in the space allotted for it. If he hesitates, or goes along in a jerky fashion, he must go to the garage. If he fails utterly, he must be sent for and taken to the hospital. The person going after him must say the combinations from the city back to the shaky place and then repeat on the way in. If he is nearer to the local town than the distant one, he may be taken back to the home town. Sometimes the failure is slight, but the player must call for help. Then he is "towed in," helped only a little.

In all cases the player who misses must repeat the combinations he misses. At intervals along the road danger signals may be put up, such as "Dangerous curve ahead," "Steep grade," and the like. At these places the hardest combinations are placed.

After all have played, the names are checked over to see how many went to the hotel, to the garage, and to the hospital. This game may be used to good advantage in drilling on the multiplication tables or the addition combinations.

*The hare and the hounds.*—The purpose of this device is to make competition the incentive for speed and accuracy.

The examples for drill are placed on the front and side blackboards. Each child in the race is supplied with a pencil and with a pad on which only the answers are to be written. Each child stands before or faces the problem he is working.

A hare is chosen and is given an early start. Let him finish about three examples. This child must try to keep ahead of the hounds that are following closely behind him. When the hare reaches safety, after the last problem, or when the hare is caught, mistakes are checked. This may change the positions, because the hounds and hare must go back to correct all mistakes. The winner of the race is chosen the hare. Time called or given must be observed by all.

A slow pupil may be chosen the first hare or encouraged by a bigger start, say five or six problems worked before the hounds begin. As the children improve in speed, competition should be made stronger. Boys versus girls also adds to the pep of the game. (Two to twelve children play at once.)

The children at the seats may work the same problems that are placed on a special board for them. These children should try to finish before the children at the board.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Begin	$1/2$	$3/4$	$2/3$	$7/8$	$5/8$	$3/5$	$5/7$	$3/10$	$1/2$	$5/6$	Safety goal
here	$1/3$	$1/2$	$1/6$	$1/4$	$1/2$	$3/10$	$3/14$	$1/5$	$3/8$	$2/3$	

*Device in square measure.*—In taking up in the fifth grade square measure as applied in figuring the number of square feet in the walls of a room, I found that the children were confused as to the meaning of the word perimeter. I had each child bring to class a box, the dimensions of which were not less than 3 by 4 by 2 inches. Most of the pupils brought shoe boxes, the dimensions being in fractions. This was just what I wanted, as it made the children see the practical application of fractions, and also gave another opportunity for drill in adding and multiplying fractions.

The children's names were placed on the board and after them the dimensions of their boxes, the measurements having been made very carefully in class and recorded. Next the perimeters were figured from the given dimensions, the class working together; and the child whose box was being figured was given the privilege of marking with a red "C" all correct answers on his classmates' papers.<sup>1</sup> The perimeters were also recorded after each respective owner's name.

The next step in the work was for each pupil to cut out the bottom of his box, then open at one corner, so that he could see that the sides of the box, when straightened out, made a rectangle, the length of which corresponded to the perimeter of his box. Then the number of square inches in the rectangle was found and recorded.

This device, though simple, fixed in the minds of the children the meaning of perimeter. It also gave many problems in square measure and a helpful review in addition and multiplication of fractions. Making each child responsible for the correct solving of his own box problem quickly and accurately, so that he might check his classmates' work, kept up the interest of the whole class and proved a most helpful and successful project, as a test later proved.

*Graphs.*—As a means of motivating review work, preparatory to the State efficiency tests, each pupil is recording his daily average on a graph. These may be either the curve or bar variety. Interest is added by drawing with red ink a line to represent the failing average (this is to be marked "Danger!") and a line of another color to represent the grade which must be made if the pupil is to be an honor student. This proves a worth-while incentive to hard work.

*Cardboard protractors.*—A lesson in making cardboard protractors will prove interesting and valuable when teaching angles or arc measure.

<sup>1</sup> If the class is large, the teacher will have to assist in checking, so as to save time.

Provide each pupil with a sheet of cardboard 5 by  $8\frac{1}{2}$  inches. Draw a line across one side of the cardboard one-half inch from the edge. In the middle of this line place a dot. Taking a compass and using this dot as a center, draw a semicircle with a 4-inch radius. Using the same center, draw a semicircle with a  $3\frac{1}{2}$ -inch radius. To find the degrees on the semicircle drawn, place over it,

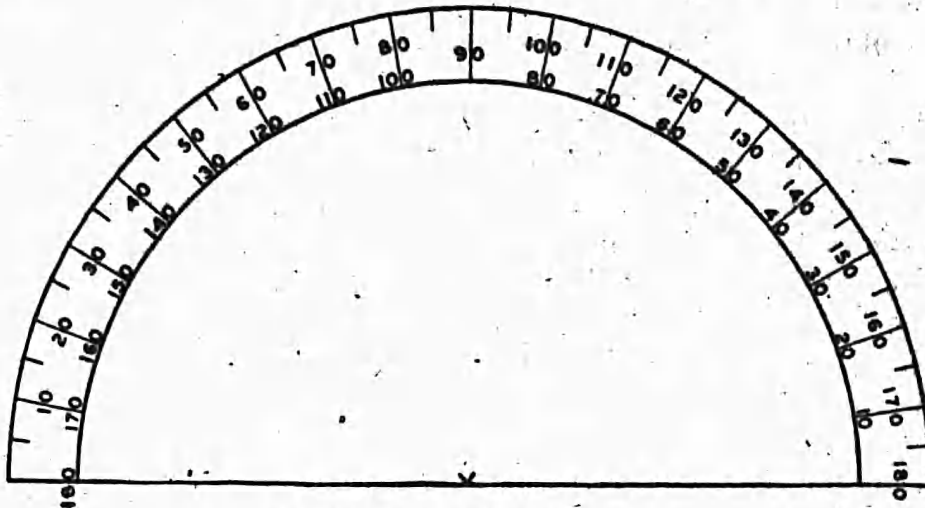


FIG. 11.—A cardboard protractor

with diameters and centers even, a metal protractor; using the center as a starting point, let a ruler extend across the metal protractor along the desired degree. The point on the rim of the semicircle along which the ruler extends will be the same degree. Write the figures to correspond.

*Addition.*—My most useful device is a chart, or a copy on the blackboard, of 45 combinations, similar to the following:

	1	2	3	4	5	6	7	8	9
A	<u>5</u> <u>1</u>	<u>6</u> <u>2</u>	<u>4</u> <u>4</u>	<u>7</u> <u>3</u>	<u>3</u> <u>7</u>	<u>9</u> <u>3</u>	<u>7</u> <u>4</u>	<u>2</u> <u>1</u>	<u>1</u> <u>8</u>
B	<u>6</u> <u>4</u>	<u>5</u> <u>7</u>	<u>1</u> <u>3</u>	<u>9</u> <u>9</u>	<u>8</u> <u>6</u>	<u>6</u> <u>5</u>	<u>4</u> <u>3</u>	<u>4</u> <u>1</u>	<u>9</u> <u>4</u>
C	<u>5</u> <u>3</u>	<u>9</u> <u>5</u>	<u>9</u> <u>7</u>	<u>9</u> <u>1</u>	<u>8</u> <u>8</u>	<u>7</u> <u>1</u>	<u>8</u> <u>2</u>	<u>1</u> <u>1</u>	<u>3</u> <u>2</u>
D	<u>3</u> <u>3</u>	<u>4</u> <u>5</u>	<u>2</u> <u>9</u>	<u>8</u> <u>4</u>	<u>9</u> <u>6</u>	<u>7</u> <u>7</u>	<u>9</u> <u>8</u>	<u>7</u> <u>6</u>	<u>7</u> <u>2</u>
E	<u>6</u> <u>6</u>	<u>5</u> <u>5</u>	<u>4</u> <u>2</u>	<u>2</u> <u>2</u>	<u>8</u> <u>5</u>	<u>3</u> <u>8</u>	<u>6</u> <u>3</u>	<u>6</u> <u>1</u>	<u>5</u> <u>2</u>

FIG. 12.—Chart with 45 number combinations

Calling a pupil to read the line A, I time him and then call upon others to beat the record he established.

The chart is used by reading horizontally, vertically, backward, forward, and then by skipping about.

Automatic responses are soon attained.

This may be extended to decade drill by adding 10, 20, etc., to the lower numbers.

Combinations should be changed frequently, according to needs of the class.

*Arithmetic battles.*—Give your class a series of short talks on the value of quick action. Conduct at different times thereafter a series of arithmetic battles between two armies headed by captains. The class must be divided into two equal armies, each having a captain, doctor, and nurse. The captains take their places in front, or as leaders of the armies facing them. The bullets we use are: Multiplication tables, mental arithmetic in the four processes, 45 combinations, measurement tables, per cent equivalents, etc.

Captain A is chosen to shoot first. He gives an example to one of Captain B's men. If he answers correctly, all right, but otherwise the doctor is sent. Then Captain B gives an example to a soldier in Captain A's army, and so on. If more than one person makes a mistake, or, as we say in battle, is wounded, either the doctor or the nurse gives him medicine, which is to learn the correct answer. This can be done either by saying it often or writing the correct answer on paper.

The doctors keep track of the number wounded. The one having the smaller number of wounded men wins, and "Captain's A's men are best" is written on the blackboard to remain until the next battle.

## MOTIVATION IN COURSES OF STUDY

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The principle of motivation is now so fully accepted by schoolmen that in planning courses of study regular provision is made for plans and schemes that will motivate the work. The Milwaukee Board of Education has a publication dealing with projects and games for the primary grades, in which a section of 12 pages is devoted to games in arithmetic. Under counting, addition, subtraction, multiplication, or combinations of these, 44 games are reported. In Detroit there is a separate publication on primary arithmetic games which consists of 31 pages and contains 49 illustrations. It should be noted, however, that most of these are devices rather than games. The Indianapolis schools have a separate publication dealing with arithmetic games for grades 1, 2, and 3. The publication contains 55 pages and is an unusually fine collection. It includes number rhymes and number songs as well as the usual games and devices. It is a very thorough piece of work. In such recent courses of study as those of Berkeley, Trenton, Denver, Rochester, Baltimore, etc., there are definite suggestions for motivation. It should be noted that the suggestions are more numerous for the lower grades, and that the most common means of motivation are the so-called "games," many of which are devices rather than games. These recent courses of study show a marked contrast with the best of arithmetic courses of just a few years ago.

No attempt has been made to analyze with completeness the recent courses of study in arithmetic. The illustrations cited show the evident tendency to provide for motivation. They also illustrate the need for a more vital motivation than is yet common. If present tendencies continue, more vital motivation is the reasonable expectation for the near future.

The recent course in arithmetic at Melrose, Mass., shows some of the newer possibilities, and the forthcoming yearbook of the department of superintendence (Fourth Yearbook) will contain valuable suggestions on the course in arithmetic. More attention is being placed upon experience as a basis for number work. The demand is greater for actual life situations. All this, together with real games,

will in time supplement in a very valuable way the much-used device. In time we may expect that the device as such will largely disappear from the first and second grades, where meaning and concept work rather than formal drill should prevail. The present demand is for courses of study in which number concepts developed through experience and life contacts shall precede any and all formal work in number. This means enough actual experience and arranged activities to develop understanding and meaning for the child. Formal work will then follow in a secondary rôle and will be based upon vital interests and felt needs.

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