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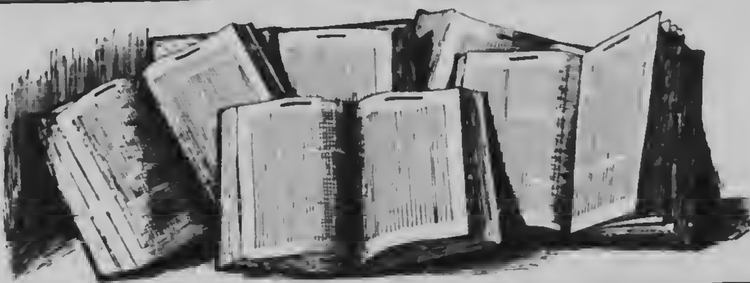

PUBLIC SCHOOL METHODS

BY THE FOLLOWING AUTHORS AND EDITORS

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British Colonies

CONTENTS

CHAPTER ONE

Arithmetic

INTRODUCTORY

CHAPTER THREE

Geography

CHAPTER FOUR

Construction Work

REED MATS AND BASKETS

EXERCISES IN KNOTTING

PAPER AND CARDBOARD

ILLUSTRATIONS

COLOR PLATES IN CHAPTER ON DRAWING

CHAPTER ONE

ARITHMETIC

INTRODUCTORY

1. Aims. There is a double value in the teaching of common school branches, and instruction in arithmetic is no exception to the rule. Like the others, arithmetic is taught because it has some practical utility in everyday life and because it is a valuable instrument for developing certain forms of mind activity.

The usefulness of arithmetic to any individual depends largely upon his business in life, but for the great majority of persons the amount of arithmetic actually needed is surprisingly small. There is certainly not enough to justify teaching the subject daily for seven years or more.

The cultural value of the study, then, must be considered, for in most schools we are teaching arithmetic much longer than is justifiable for its usefulness alone. Arithmetic calls for the use of the reasoning powers and gives the childish mind the best training he can have in logic. Through it he learns that some things are certain and unequivocally true. This is no small gain, especially in the years when the mind is full of doubts and inquiries and finds little upon which it can fasten and say, "This is absolutely so, and I know it." The thinking required in arithmetic is close, logical and accurate, and the processes are both deductive and inductive. Memory is stimulated, for all recollection must be accurate in every detail, but the things which must be remembered in arithmetic are not so numerous or difficult. It is as an intellectual exercise that arithmetic shows its greatest cultural value.

2. Methods. Some inferences may be drawn from this knowledge of the purposes for which arithmetic should be taught. To make arithmetic useful, pupils must become ready and accurate in all their computations, and this means much drill and continuous practice with problems relating to daily life. To secure logical training, pupils must be led to reason upon processes and through these led to see the underlying rules and principles. The reasoning of the first years in arithmetic is inductive, but through the years of which these books treat it becomes more abstract, more deductive. (See Volume 3, pages 82-86, Sections 13-17.) If a method in any topic in arithmetic does not secure for the pupil some practical, usable knowledge or perfect his skill in handling numbers or train his logical faculties, it is not a good method. Tried by such tests, both the methods and the subject-matter of many text-books are found faulty, and much of the instruction given in the schools is of doubtful value.

3. Primary Methods. In primary schools good methods of teaching arithmetic are more generally and effectively applied than in intermediate and higher grades, owing to the fact that there is comparatively little to teach, that the methods, which must be largely inductive, have been long known and established and that nearly everything is taught from the standpoint of utility. In these chapters, however, we do not concern ourselves with the primary grades, but assume at the beginning that the pupils can at least read and write numbers in thousands, can add, subtract, multiply, and divide in short division; that they know the common units of Canadian money and can make change in small amounts; that they can measure in simple units of length and capacity; that they know the simple common and decimal fractions, can read them and find fractional parts of whole numbers.

We are aware that these requirements are somewhat ideal, and that many fourth year teachers, and some even in the fifth and sixth years, find pupils who do not know these simple processes. Whenever these conditions are met, let the teacher drill the class until they become proficient in the desired processes. When the foundation is well laid, children seldom dislike arithmetic.

4. Independent Teaching. The object of this chapter is to help the teacher to good methods of teaching different topics and to offer a means whereby interest may be increased among the pupils; then arithmetic becomes a more valuable study and at the same time less of an ogre to teachers and pupils.

There are many good text-books now on the market, but unfortunately many still remaining in the schools are crowded with unnecessary matter that an unwise tradition holds in place. Others still give fixed rules and principles so much prominence that they practically destroy the real fundamental value of the study. The teacher who has once satisfied herself that her text-books are of the antiquated kind should not hesitate to omit obsolete topics nor to present the subject in a logical manner, no matter what the book calls for. Where the teacher is hampered by fixed courses of study or formal examinations, and will not be permitted to omit topics that are recognized as unnecessary, then she must teach the subjects, but should do it in such a way as to make them yield the greatest value in intellectual development. In this way the time is not wasted.

5. Topics to Omit. D. E. Smith writes as follows:[1]

For the ordinary purposes of non-technical daily life we need little of pure arithmetic beyond (1) counting, the knowledge of numbers and their representation to billions (the English thousand millions), (2) addition and multiplication of integers, of decimal fractions with not more than three decimal places, and of simple common fractions, (3) subtraction of integers and decimal fractions, and (4) a little of division. Of applied arithmetic we need to know (1) a few tables of denominate numbers, (2) the simpler problems in reduction of such numbers, as from pounds to ounces, (3) a slight amount concerning addition and multiplication of such numbers, (4) some simple numerical geometry, including the mensuration of rectangles and parallelopipeds, and (5) enough of percentage to compute a commercial discount and the simple interest on a note.

A conservative view will justify for one reason or another the omission of the following topics, while several other favorite subjects in the old-school arithmetic are under fire from the reformers:

(1) Apothecaries' Weight. (Used only by druggists and physicians.)

[1] David Eugene Smith: *The Teaching of Elementary Mathematics.*

(2) Troy Weight. (Of value only to goldsmiths.)

(3) Units of measure not in common use.

(4) Longitude and Time, beyond computations in Standard time.

(5) The long method in Greatest Common Divisor, except for intellectual drill in eighth or ninth year.

(6) Alligation. (Not found in new arithmetics.)

(7) Compound Proportion.

(8) Profit and Loss as a separate topic.

(9) Commission and Brokerage, and Stocks, except in simplest types of examples.

(10) Insurance, except in the form its problems affect the insurer.

(11) Exchange, except the simplest methods in actual use.

(12) True Discount.

(13) Annual Interest.

(14) Compound Interest, beyond the mere art of finding it.

(15) Partial Payments, beyond the rule in use in the place where the pupil lives.

(16) Cube Root. (Leave this subject for algebra.)

6. Objective Material. It is safe to say that every time a new subject is introduced enough objective material to make everything intelligible and as real as possible should be used. Then by concrete examples the new matter should be associated with what has preceded, with the experiences of the pupil in his daily life at home or with the business or life of his parents. In this way the pupil finds interest sufficient to make his mind go willingly into the new abstractions. Valuable as this concrete and objective work is, however, we must not lose sight of the ultimate purpose of teaching arithmetic, namely, that a boy or girl shall become able to work quickly, intelligently and accurately with figures, and to do this without objects. The danger in objective work lies in the tendency to continue it longer than is necessary.

7. Oral Arithmetic. The wise teacher avoids extremes. She does not neglect to provide abundant oral exercises for securing quickness and expertness in the use of small numbers, especially in such little problems as are constantly recurring in everybody's life, nor does she forget that the easiest way to present most new subjects is orally, with small numbers, for in such the student may concentrate his attention upon processes without being hindered by difficulties of computation.

On the other hand, the teacher will remember that paper and pencil have their place, and that it is impossible to push oral work into the domain of large numbers. The teacher of gymnastics will say that more grace, ease and strength come from much light exercise than from violent work. In the same way, skill and ease in the solution of problems come from incessant practice with small numbers. This practice may be oral. There are times, however, when heavy work with larger numbers must be done. This is the time for written work.

8. Form of Written Work. Neatness and good form are aids to accuracy in written work. Pupils must be taught to arrange all work in compact and logical form and not to disfigure it with errors of haste that bring frequent erasures. When a mistake is to be rectified, the work should be crossed out and done again in another place or clearly erased and solved again. To correct an error by making the right figure over the wrong one is simply to invite another mistake. All long problems should be so arranged that pupils can go back at any time to any part of them and find any step that is wanted. This means that enough written explanation should be given to make everything clear. Much of written arithmetical work is the expression of simple sentences, and all should be as carefully punctuated as though a part of the language lesson. (See Volume 3, page 258, Section 2.) The examples that are solved in these chapters are intended to be models of good form.

Uniformity, neatness and despatch can be secured by having the pupils arrange their papers according to the following plan:

I	Solution of Problem.	Answer. C
II.	Solution of Problem.	Answer. √

The teacher can then glance at the work, placing a "C" for "correct," in the space where the answer appears; or she may check, as indicated above, where the answer is incorrect. Then at a glance at the space in which the problem is worked, the error can be quickly discovered. There is nothing of more importance than giving attention to form; it is a time-saving device for both teacher and pupils, and establishes in the mind of the latter a most valuable lesson. The teacher should have the pupils prepare the paper by ruling the vertical lines, and they should do it quickly; then as soon as a problem is finished, and the answer placed in its proper space, the horizontal line may be drawn below.

9. Solving Problems. The first step in the solution of a problem is to read it understandingly. Careless reading is the source of more mistakes, perhaps, than any other one thing, and the time is not wasted which is spent in convincing pupils that they must study a problem till they understand thoroughly its demands.

Every problem gives certain facts and conditions and asks for a certain other fact or condition. When a pupil has read the problem and understands the phraseology, he must ask himself three general questions: (1) What facts and figures does the problem give? (2) What does the problem ask? (3) How shall I find what is asked from what is given?

Having answered these questions, another should follow: What relation does the answer bear to the corresponding fact in the problem? This last question is less definite and cannot be answered exactly but the result of reflection upon it will be to give the pupil an intimation of the size or kind of an answer, and may prevent absurdities in his results.

As an illustration, consider the following problem:

Mr. Turner earns $85 a month; his salary for the year is 68% of his brother's salary for 8 months. How much does his brother receive a month?

(1) We have given:

(a) Mr. Turner's salary for a month.

(b) The fact that this is 68% of some amount.

(c) The fact that the latter amount is the brother's salary for 8 months.

(2) We want to find:

(a) The brother's salary for 1 month.

(3) To find what we want we must know:

(a) Mr. Turner's salary for 1 year. (That is 12 × $85.)

(b) His brother's salary for 8 months. (Mr. Turner's salary for a year is 68% of the brother's for 8 months.)

(c) His brother's salary for 1 month. (⅛ of his salary for 8 months.)

(4) We see that the brother must have a larger salary than Mr. Turner.

Whenever a new subject is taken up, teachers will find it helpful to require the pupils to think through many of the problems without actually solving them. Sometimes it is a good way to anticipate difficulties in an advance lesson, at other times to show how mistakes came about in the current lesson; again, to furnish reviews of past lessons, and as drill for the purpose of making pupils think before they begin to figure. The illustration given above is an example of "thinking through."

Often it is well to require pupils to indicate the operations after the preliminary analysis has been made. Thus, in the problem above,

$12 \times \$85 =$ Mr. T's salary for 1 year.

$\frac{12 \times 85 \times 100}{68} =$ His brother's salary for 8 months.

$\frac{12 \times 85 \times 100}{68 \times 8} =$ His brother's salary for 1 month.

In such cases the teacher must beware, in indicating successive operations, that no mistakes are made in the values of the signs. To illustrate, take a simple problem like the following:

Arthur has 15 marbles, John has 20, Thomas has 3 less than John, and Henry has twice as many as the other three boys together. How many has Henry?

A pupil might indicate the operations thus: $15 + 20 + 20 - 3 \times 2$, and claim the result to be 104, the right answer. As a matter of fact, the result from the operations as indicated is 49. The operations should be indicated thus: $(15 + 20 + 20 - 3) \times 2$. The practice of giving to children problems like the following, $2 + 6 - 3 \times 4 \div 2$, and teaching them to perform successively the operations indicated to the last result, so that, in this instance, they would obtain the answer 10, when the actual result is 2, leads the pupils into continual trouble later in the course. Things should be right from the start; it is unfortunate to be obliged to unlearn anything.

10. Tests for Accuracy. From the beginning, pupils should be taught to test the accuracy of their own work—to rely upon themselves. In a good arithmetic the answers are at the back of the book and are consulted only after the question has been solved and proved. If the pupil's answer appears wrong, he should again verify his figures throughout, proving every step. If he finds no error in his work then he may assume he has erred in his reasoning, and he must go back to the problem and study that, as indicated in the preceding section, until every step seems clear and logical. If he sees no reason for changing his mind, he must conclude that the answer in the book is wrong. The habit of trying different ways to solve problems in the hope of stumbling upon a correct result is the worst into which a pupil in arithmetic can fall. He must be taught that no example is ever solved for him till every step is luminous and clear. The pupil who persists in reiterating his statement that he doesn't understand it may be better prepared on his lesson than the one who got all the answers.

11. Drill. In no subject is there greater necessity for drill, and in no subject is drill more greatly abused than in arithmetic. The necessity of making the fundamental operations purely automatic and of so fixing the facts and principles of all subjects that they will never be forgotten drives the teacher almost unwittingly into a continuous repetition that may accomplish none of the real purposes of drill. (See Volume 3, pages 122-123, Section 17.)

Drill work in order to be spirited must often be changed —perhaps not the thing drilled upon as much as the manner of presenting it. This may be illustrated by an exercise on decimal equivalents. The most commonly used equivalents, because of the frequency with which they are employed, should be learned so thoroughly that the mention of one form may suggest the other.

Cut about 20 cards, 5×3 inches, from stiff cardboard. On one side write the fraction and on the other the decimal equivalent, sometimes putting % after it, and sometimes using the decimal point. Write with charcoal or coarse pen, so it may be seen at any point in the room. Show either side to the class, and let the pupils tell the equivalent, one child reciting for several cards, or perhaps until he misses or hesitates.

Use the following fractions: $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{5}$, $\frac{1}{6}$, $\frac{5}{6}$, $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{16}$, $\frac{1}{20}$, $\frac{1}{25}$, $\frac{1}{50}$. Do not use the set of cards every day, but sometimes mix them, placing on the board some in percent, some in fractional form; now use the pointer and have the class instantly state the equivalent as you pass from one to the other. Innumerable exercises of the same kind can also be given from the following table:

	I	II	III	IV	V	VI	VII	VIII
	3	7	13	9	5	21	19	17
A	$\frac{1}{2}$	.50	$\frac{1}{5}$	.20	$\frac{5}{6}$	.83$\frac{1}{3}$	$\frac{1}{12}$	.08$\frac{1}{3}$
B	$\frac{1}{3}$	.33$\frac{1}{3}$	$\frac{2}{5}$	.40	$\frac{1}{8}$	.12$\frac{1}{2}$	$\frac{5}{12}$	.41$\frac{2}{3}$
C	$\frac{2}{3}$	.66$\frac{2}{3}$	$\frac{3}{5}$	.60	$\frac{3}{8}$	.37$\frac{1}{2}$	$\frac{1}{16}$	.06$\frac{1}{4}$
D	$\frac{1}{4}$	.25	$\frac{4}{5}$	.80	$\frac{5}{8}$	.62$\frac{1}{2}$	$\frac{3}{16}$	.18$\frac{3}{4}$
E	$\frac{3}{4}$	.75	$\frac{1}{6}$	.16$\frac{2}{3}$	$\frac{7}{8}$	.87$\frac{1}{2}$	$\frac{5}{16}$	.31$\frac{1}{4}$
	.15	.06	.7	.125	.12	.00$\frac{1}{3}$	.14	.00$\frac{7}{8}$
	IX	X	XI	XII	XIII	XIV	XV	XVI

This table is susceptible of almost any number of combinations, and you should give it sufficient attention to enable you to change any number which it contains into its equivalent in the other form as readily as you can give the product of two times six. The numbers outside the double horizontal lines are to be used as multipliers and divisors. The numbers within the double horizontal lines afford numerous exercises in addition, since they can be added in any direction desired. The multipliers and divisors can be used as follows: Multiply A—III means that each number in line A is to be multiplied by 13. Divide D—X means that each number in line D is to be divided by .06. A little study will reveal to you an infinite number of combinations of this nature.

12. Attention. In no class in the school is there greater necessity for close attention. If a pupil loses a single step of an analysis or if his mind wanders for an instant while another pupil is solving a problem, he loses in effect the most valuable part of the exercise. Good reasoning demands that a person should follow a solution step by step from the beginning to the end or he can never be certain that the demonstration is correct. To secure this absolute attention the teacher may resort to those methods and devices which are suggested in Volume 3, pages 91-93, Sections 25-27. In arithmetic, however, the exactness of the work almost demands a half-military method. The teacher gives orders which are promptly executed. In oral exercises pupils stand at attention, think rapidly, answer promptly. In written work they are required to put their work down neatly, avoid erasing, and make figures that are absolutely legible. In solving their problems they work rapidly, but not hastily, and in giving their explanations speak quickly and firmly. Unconsciously the pupils will imitate the teacher's manner; if she is clear-cut, decisive in her statements, the pupils will respond in the same manner. Ten minutes of quick, sharp, intense class work in arithmetic is much better than a half-hour of loose, careless, inattentive recitation. The teacher must exercise her rights and demand absolute attention from everybody in the class when any pupil is reciting.

13. Type Lessons. There are certain subjects in arithmetic that are of great importance, which appear to be bugbears to many teachers, and, in consequence, to most pupils. Some of these subjects are really difficult for pupils when they are first met, and for that reason they give trouble; others are dependent upon principles that have not been in use immediately before, and, consequently, from forgetfulness, the pupils are at sea; a third class of subjects are made hard by the way they are usually presented.

It is felt that the teacher will be assisted here most by a series of type lessons which take up one after another the subjects that seem to have given the greatest difficulty. All the subjects are essential to progress in mathematics, and it often happens that pupils in advanced grades are hampered from a lack in matters that belonged properly to the instruction of earlier years. For this reason, the type lessons are presented without especial regard to gradation. The teacher will find the proper time for presenting these subjects discussed in the chapter beginning on page 40, under the title *Work by Grades*.

LONG DIVISION

14. Preparation. Before a pupil can be considered ready to understand the somewhat complicated process of long division, he must know not only addition, subtraction and the multiplication table, but also how to multiply a three-place number by a two-place multiplier, and must have thoroughly mastered short division. Much confusion is avoided if the two kinds of division are taught as early as the class can understand the difference between them. These are known by different names: *measuring* and *separating*, *division proper* and *part-taking*, and *division by the multiplier* and *division by the multiplicand*. To illustrate: 3 groups of 6 inches = 18 inches (multiplication). 3 groups of —inches = 18 inches (division proper, measuring, or division by the multiplier). — groups of 6 inches = 18 inches (separating, part-taking, or division by the multiplicand).

In preparation for the new subject, the pupil must be led to feel that what is coming is not difficult, but that it is merely writing out with large numbers what he has previously been doing in his mind. Accordingly, the first examples in long division may properly be those in which the divisor consists of one integer; such examples, in fact, as he has previously been performing by short division. Thus, he can answer the question, How many \$2 = \$832? If he writes this problem out, he does it in the following way: $2\overline{)\$832}$ / 416.

He knows that he divides these integers consecutively, that remainders are carried on to the next integer, and that the divisions are not always exact, for sometimes there is an indivisible remainder. We should not have the pupil think that he is dividing figures, but the concrete, for which the figures are symbols.

In the new work the teacher realizes that she has two things to teach: first, a new form; second, the use of a trial divisor and a trial dividend. She will select her divisors carefully, so as to avoid presenting too many difficulties at any one time. The best divisor to use in the first illustration is 21. After that, the following sequence of divisors is recommended: (a) 31, 41, 51, 61, 71, 81, 91; (b) 22, 32, 42, 52, 62, 72, 82, 92; (c) 23, 33, 43, 53, 63, 73, 83, 93; (d) 27, 37, 47, 57, 67, 77, 87, 97; (e) 28, 38, 48, 58, 68, 78, 88, 98; (f) 29, 39, 49, 59, 69, 79, 89, 99; (g) 24, 34, 44, 54, 64, 74, 84, 94; (h) 25, 35, 45, 55, 65, 75, 85, 95; (i) 26, 36, 46, 56, 66, 76, 86, 96[1].

15. Form. Two forms are in general use, as follows:

(Form 1)

```
21)1323(63
   126
   ---
    63
    63
    --
```

(Form 2)

```
      63
    ----
21)1323
   126
   ---
    63
    63
    --
```

The second form has some advantage, in that it suggests a very easy method for keeping the decimal point in the right position in the later division of decimal fractions.

16. Method. We may begin with the example quoted in Section 14, 832 ÷ 2, or 2 groups of —— = 832, and write it in this form:

```
  416
 ----
2)832
  8
  -
   3
   2
   -
   12
   12
   --
```

explaining in this way: ½ of 8 hundreds is 4 hundreds; 2 times 4 hundreds are 8 hundreds. ½ of 3 tens is 1 ten; 2 times 1 ten are 2 tens; 2 tens from 3 tens leave 1 ten, or 10 units. 10 units and 2 units are 12 units; ½ of 12 units is 6 units; twice 6 units are 12 units. Continue the explanation to show that in effect we try to divide the integer in

[1] Mrs. Mary D. Bradford. *The Teaching of Arithmetic.*

each place in the dividend by the divisor, that we multi that divisor by the quotient; that we subtract and bring down the figure in the next place, and thus continue our divisions to the end.

Use examples of this kind until the pupil perfectly comprehends the meaning of every step and the significance of the form in which the example is written. If the number 12 has been taught as a divisor in short division, this will be found a very helpful number to fix the form in long division.

When the form is thoroughly understood, take such an example as that given in the preceding section, or 21 groups of —— = 1323. Write it thus:

$$\begin{array}{r} 63 \\ 21\overline{)1323} \\ \underline{126} \\ 63 \\ 63 \end{array}$$

Call attention to the facts as you write them.

We see that $1323 \div 21 =$ no thousands, and that $1323 \div 21 =$ no hundreds, but that $1323 \div 21 = 2$ tens, with 63 still to be divided; we find that $63 \div 21 = 3$; therefore, the quotient is 63. We determine these conclusions by using 2, the first figure of the divisor, as a *trial divisor*, and noting how many times it is contained in 13. When we multiply 6 tens by 21, our result is 126 tens, which leaves 6 tens still undivided. The 6 tens, or 60 units, plus the 3 remaining units are 63 units. $\frac{1}{21}$ of 63 units is 3 units. 21 times 3 units are 63 units. The reason for retaining the names of the orders in the division and for proceeding in this manner is that the pupils may learn to think of the denomination of their quotient so that they will find little difficulty in retaining the proper denomination in the division of decimals. Patience in slow progress and the use of a great many problems will bring skill and ease.

It will be noticed that the divisors grouped in (d), (e) and (f) in Section 14, end in 7, 8 and 9. In such cases, the trial divisor should be considered 3 instead of 2, to avoid making the quotient figure too large.

FACTORING

17. Prime Numbers. A ready command of prime factors, especially of small numbers, is of such great value everywhere in mathematical computations that the teacher should feel justified in giving considerable time to the subject of factoring. The first step in this direction after the distinction between prime and composite numbers has been made clear, is to determine what numbers under 100 are prime, and then to commit those numbers to memory so thoroughly that one will never be in doubt about them. There are but twenty-six of them, namely, 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

A variety of drill exercises may be conceived to fix these in the mind. First, pupils may be required to read them consecutively in short space of time—twenty seconds, perhaps, is enough. They may be asked to write the prime numbers under 10, between 10 and 20, between 50 and 60, between 80 and 90, and so on, approaching the numbers in various ways, so that whenever seen they are recognized as being numbers that cannot be evenly divided.

18. Divisibility Rules. At least three of the divisibility rules given ordinarily in the arithmetics are of great practical value. They are those governing divisibility by 2, 3 and 5. These rules are:

(1) Any number is divisible by 2 if its last digit is 2 or another even number.

(2) Any number is divisible by 3 if the sum of its digits is divisible by 3.

(3) Any number is divisible by 5 if its last digit is 0 or 5.

It may not be worth while to learn others, but these three should be fixed thoroughly in mind by frequent drills, so pupils may recognize instantly a composite number if it is divisible by any one of the three numbers just given.

19. Numbers Under 100. It is not asking too much that every pupil should be able instantly to factor by inspection all the numbers under 100; in fact, the labors of arithmetic and other branches of mathematics will be much lessened if pupils are not only made facile in factoring these numbers, but if they learn in all computations to think of each number as composed of its prime factors. For instance, when a child sees 36 he should have no difficulty in seeing the two 6's, or the two 2's and two 3's in the number.

20. Cancellation. One of the most practical applications of factoring is found in the process which is commonly called cancellation, and which frequently is taught as a single independent subject and then abandoned. As a matter of fact, pupils should be taught to be constantly looking for opportunities to employ cancellation. Wherever a pupil observes in a problem consecutive multiplications and divisions, he should not permit himself to perform these as indicated until he has at least tried to reduce the labor by cancellation. For instance, if by the conditions of a problem it becomes necessary to multiply 48, 27 and 11, and to divide the product by 18 times 88, he should be taught to write the problem in this form: $\frac{48 \times 27 \times 11}{18 \times 88}$. Then with his knowledge of factoring he will readily see that 11 appears also in 88; that 8 appears in 48; that 6 appears also in 18, and that 3 is contained in 27 9 times. Thus he solves his problem without a single multiplication:

$$\frac{\overset{\cancel{6}}{\cancel{48}} \times \overset{9}{\cancel{27}} \times \cancel{11}}{\underset{\cancel{3}}{\cancel{18}} \times \underset{\cancel{8}}{\cancel{88}}}.$$

The teacher will be led into no difficulties in explanations if pupils are taught that in the course of the solution of an example numbers may be regarded as abstract, and the proper denomination assigned to the result at the end. While this method of shortening operations may sometimes be carried too far, it is much more frequently relegated too much into obscurity.

Concerning the relative amounts of concrete and abstract work which pupils should do in the intermediate grades, opinions differ. We have already called attention to the danger attending work with objects (Section 6). Perhaps the danger in abstract work is similar. If too great reliance is placed upon it, children drift too rapidly into thinking numbers in the abstract, and so lose the power to think them in their relation to problems. For this reason some of the best teachers of arithmetic do not think it advisable for pupils below the seventh year to indicate operations in the form of abstract numbers and then to cancel. They prefer that each number bear the proper label, and that each separate process in the solution be written in the form of an equation.

GREATEST COMMON DIVISOR

21. Use. The chief use of the greatest common divisor for the pupils we are considering is in reducing fractions to their lowest terms; and if problems are rightly graded, there will be no necessity for using more than the simple method by factoring. If it is necessary for any reason to teach in the intermediate grades the method by continued division, it should be presented as a process to be *learned*, not one for which *reasons* are necessary. In the eighth year a logical analysis of the process and a demonstration of it may be worth while, as an intellectual exercise.

22. Method. Since the greatest common divisor is the greatest common measure, pupils grasp the principle most readily when it is presented in concrete form. Draw upon the blackboard lines 24 inches, 18 inches and 12 inches in length. What is the longest rule that will exactly measure each of these lines? This rule will be the greatest common measure. Use the same plan with surfaces, gallons, quarts and pints, giving a sufficient number of exercises to fix the idea of a common measure firmly in the minds of the pupils.

The method by factoring is simple, if it is approached properly. Pupils know divisors and factors. Teach them to see what common divisors are, and then what the greatest common divisor is. Use examples like this explaining as you write.

2	12, 24, 36
2	6, 12, 18
3	3, 6, 9
	1, 2, 3

What prime factors do you see in 12? In 24? In 36? $2 \times 2 \times 3 = 12$, the g. c. d. What factor will divide 12, 24, and 36? What are the quotients? What factor will divide 6, 12 and 18? What are the quotients? What factor will divide 3, 6 and 9? What are the quotients? When a factor will divide two or more numbers, it is said to be common to them. What factor is common to 3, 6 and 9? A common factor is a common divisor. There may be many common divisors of two or more numbers. What common divisors have we written for 12, 24 and 36? (Ans. 2, 2 and 3.) If 2 and 2 will both divide all the numbers, will 4 divide them? If 2 and 2 and 3 will divide them, will 12 divide them? Can you find a number larger than 12 to divide 12, 24 and 36? Why? Then 12 is the *greatest* common divisor of 12, 24 and 36, and we found it by multiplying together all the prime factors of the three numbers.

LEAST COMMON MULTIPLE

23. Uses. The least common denominator of two or more fractions is the least common multiple of their denominators. In addition and subtraction of fractions, then, it will be necessary to know how to find the least common multiple of numbers, and not infrequently such knowledge is helpful elsewhere. One simple method is all that is necessary for our pupils to know and that method they can understand perfectly.

24. Method. Introduce the subject by fixing attention upon *multiple*, *common*, and then *least* common multiple. Use an example, and question after the manner indicated in Section 22, above. When you are thorough your pupils will understand that to find the least common multiple of two or more numbers you take all the prime factors of the smallest number, all the prime factors of the second number not found in the first, all the prime factors of the third number not found in the first, and so on. In form, your example may appear like this:

$$8 = 2 \times 2 \times 2.$$
$$10 = 2 \times 5.$$
$$12 = 2 \times 2 \times 3.$$
$$2 \times 2 \times 2 \times 5 \times 3 = 120. \text{ the l. c. m.}$$

MAKING CHANGE

25. A Practical Method. The clerk in a store ordinarily uses the method of addition in making change. If a customer buys goods amounting to $1.15 and gives the clerk a two-dollar bill, the clerk begins his computations with $1.15; and tries to add to it coins that will make the amount one that he can handle easily. In this case two 2 five-cents or a ten will make a dollar and a quarter; three "quarters" or a "half" and a "quarter" will make the sum $2.00. He does not count the customer's change. In larger amounts the method is the same: Thus, if a debt of $6.34 is paid with a ten-dollar bill, the clerk will say, "Six thirty-four; thirty-five, (one cent passed); forty, (five cents passed); fifty (ten cents passed); seven (a half-dollar passed); eight (a dollar bill passed); ten (a two-dollar bill passed)." Often the customer, unaccustomed to quick dealing, laboriously subtracts $6.34 from $10.00, finds the remainder to be $3.66, and counts the change to see that he has the right amount.

26. As a School Exercise. Every pupil should be taught early to make change rapidly and accurately. To do this the pupil must know which pieces of money are best to use and then must combine them properly. Imitation money is necessary in the lower grades. If there is none in the school, it may be made from pieces of paper, and the pupils should buy and sell among themselves in a great number of imaginary transactions. In the upper grades more complex examples may be given, and pupils should be required to write out the process in form like this:

Bill given, $20.00	Amount of purchase,	$17.23
	Change	.02
		.25
		.50
		2.00

If the sum of the purchase and the change equals the amount of the bill, the change is correct. The work should then be scrutinized to see if the change was given in the best way, and to detect the use of coins or pieces of money not in circulation.

COMMON FRACTIONS

27. General Suggestions. (a) KEEP THE DENOMINATORS SMALL. In elementary teaching of fractions let the denominators be kept small in all problems and in higher grades in a very large part of the problems. In life, we rarely use fractions with large denominators. The greater part of the computations we must make do not involve denominators larger than 20.

(b) MAKE THE METHOD CLEAR BEFORE GIVING DIFFICULT EXAMPLES. Remember the chief object is to train pupils to work rapidly, accurately and understandingly. Keep their minds clear, and while subjects are new keep their work so easy that they will like to do it.

(c) APPLY EVERYTHING. Make the work thoroughly practical. Do not keep the numbers concrete longer than is necessary. Make every pupil conscious of the fact that some knowledge of fractions is demanded every day of every man. The utility of fractions will create interest and make study pleasing.

(d) KEEP YOUR WORK UNIFIED. Do not emphasize too much the idea of new things to do; let the work glide naturally from one "case" to another; raise no imaginary difficulties.

(e) BE SYSTEMATIC. While you do not wish to magnify the difference in processes, you must yourself have a clear idea of them and of their logical arrangement. What you must teach in fractions, and the order in which those operations should appear, is shown in the following list:

(1) Multiplication.

(2) Reduction of mixed numbers to improper fractions.

(3) Division (part-taking) (Section 14).

(4) Reduction of improper fractions to whole or mixed numbers.

(5) Division (division proper) (Section 14).

(6) Reduction to higher and lower terms.

(7) Reduction to a common denominator.

(8) Addition.

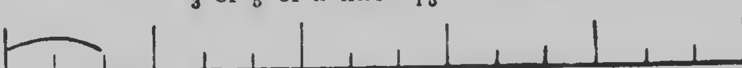
(9) Subtraction.

28. Multiplication. The only place in multiplication where any trouble may be anticipated is in teaching multiplication by a fraction.

Pupils have long known how to take fractional parts of units; this is now shown to be multiplying by a fraction. To take $\frac{1}{2}$ of 6 is to multiply by $\frac{1}{2}$. By an objective method, the process of multiplying a fraction by a fraction follows very naturally, in this manner:

A line of such length that it can easily be divided into equal parts affords the best illustration for operations in fractions. Use simple problems, as the following:

$\frac{1}{3}$ of $\frac{1}{6}$ of a line $= \frac{1}{18}$ of a line.



$\frac{2}{3}$ of $\frac{1}{6}$ of a line $= \frac{2}{18}$ of a line.

$\frac{2}{3}$ of $\frac{2}{6}$ of a line $= \frac{4}{18}$ of a line.

$\frac{4}{5}$ of $\frac{7}{8}$ of a line $= \frac{28}{40}$ of a line.

Take other examples, like $\frac{3}{4}$ of $\frac{2}{3}$, objectively, until the pupils see that the rule invariably holds. Then dismiss objective tactics and keep the pupils at work till the process is automatic. Require results to be in the lowest terms. Use factoring, having small numbers for the denominator. Pupils must be possessed by the idea that they should not multiply till they have tried to cancel.

29. Division. Pupils learn that a fraction may be divided by a whole number in two ways; first, by dividing the numerator; second, by multiplying the denominator. No difficulty is experienced in the acquisition of these two facts. If trouble comes at all, it is in teaching the division of one fraction by another. The simplest method is that used in addition and subtraction, thus:

Divide $\frac{2}{3}$ by $\frac{3}{4}$. $\frac{2}{3}=\frac{8}{12}$. $\frac{3}{4}=\frac{9}{12}$. $\frac{8}{12}\div\frac{9}{12}$ (considering the denominator the *name* of the fraction) is the same as $8 \div 9$. So $\frac{2}{3}$ divided by $\frac{3}{4}$ are $\frac{8}{9}$. In form, the example should appear thus:

$$\tfrac{2}{3}\div\tfrac{3}{4};\ \tfrac{8}{12}\div\tfrac{9}{12};\ 8\div 9=\tfrac{8}{9}.$$

The process just given is at best, however, but an introductory one. From it pupils learn the various facts of division, including the one that in arithmetical operations division by a proper fraction always makes the quotient larger than the dividend. For practical work in division, pupils should be taught to invert the divisor, cancel if possible, and multiply. When this method is first presented it is not necessary to teach the reasons. The pupils should learn to do it, and should practice it until they can do it quickly and accurately. It is a first-rate short process. Later, in a higher grade, the reasons may be taught. From the following demonstration the teacher can learn how to proceed:

I. We know that $1 \div \frac{1}{2} = 2$, $1 \div \frac{1}{3} = 3$, $1 \div \frac{1}{4} = 4$, $1 \div \frac{1}{5} = 5$, etc.

II. We know that $1 \div 2 = \frac{1}{2}$ as much as $1 \div 1$. $1 \div \frac{1}{3} = 3$; therefore, $1 \div \frac{2}{3} = \frac{1}{2}$ of 3, or $\frac{3}{2}$. $1 \div \frac{3}{5} = \frac{1}{3}$ as much as $1 \div \frac{1}{5}$. $1 \div \frac{1}{5} = 5$; therefore, $1 \div \frac{3}{5} = \frac{1}{3}$ of $5 = \frac{5}{3}$. From many examples of this sort we may conclude that when 1 is divided by any fraction, the quotient is the fraction inverted.

III. We know that $2 \div \frac{2}{3}$ = twice as much as $1 \div \frac{2}{3}$; if $1 \div \frac{2}{3} = \frac{3}{2}$, then $2 \div \frac{2}{3} = 2 \times \frac{3}{2}$, or $\frac{6}{2}$. $1 \div \frac{4}{5} = \frac{5}{4}$. 3 divided by $\frac{4}{5}$ = 3 times as much as $1 \div \frac{4}{5}$. $1 \div \frac{4}{5} = \frac{5}{4}$; therefore, $3 \div \frac{4}{5} = 3 \times \frac{5}{4}$, or $\frac{15}{4}$. From these and similar examples we conclude that the quotient of any whole number divided by a fraction may be found by inverting the divisor and multiplying.

IV. If $1 \div \frac{4}{5} = 1 \times \frac{5}{4}$, $\frac{1}{3} \div \frac{4}{5}$ will equal $\frac{1}{3}$ of $1 \times \frac{5}{4}$, which equals $\frac{1}{3} \times \frac{5}{4}$; $\frac{2}{3} \div \frac{4}{5}$ will equal $\frac{2}{3} \times \frac{5}{4}$, etc. So the principle holds in dividing one fraction by another.

30. The Three Problems. There are three classes of questions, compounding multiplication and the two kinds of division (Section 14), that keep appearing in common fractions, in decimal fractions and in percentage and its applications. These three cases, or problems, as they are called, are so important that at some time, perhaps in the sixth grade, the attention of the pupils should be directed specifically to them, and they should be taught understandingly and thoroughly. The following are the problems:

A. To find a fractional part of a number. *Type:* What are $\frac{3}{4}$ of 16?

B. To find what fractional part one number is of another. *Type:* What part of 16 is 12?

C. To find a number when a fractional part of it is known. *Type:* 12 is $\frac{3}{4}$ of what number?

In each of those problems three things are considered: (1) a number which may be called a standard, or base, of operations; (2) another number which is usually a part of the standard; (3) a fractional expression. When any two of the things are given, the third may easily be found by analysis, thus:

A. What are $\frac{3}{4}$ of 16?

$\frac{1}{4}$ of 16 is 4.

$\frac{3}{4}$ of 16 are 3×4, or 12. This problem is solved by multiplying the basal number by the fractional part.

B. What part of 16 is 12?

12 is less than 16, that is, it is $\frac{12}{16}$ of 16. $\frac{12}{16}$ in

its lowest terms is $\frac{3}{4}$. This problem is solved by dividing the second number by the basal number.

C. 12 is $\frac{3}{4}$ of what number?

If 12 is $\frac{3}{4}$ of a number, $\frac{1}{4}$ of the number is $\frac{1}{3}$ of 12, or 4; $\frac{4}{4}$, or the whole number, is 4×4 or 16.

These problems can be stated in general terms as follows:

A. To find the second number, when the standard number and the fractional part are given.

Standard number $\times$ fractional number $=$ second number. Illustration: $16 \times \frac{3}{4} = 12$.

B. To find the fractional part, when the standard number and second number are given.

The second number $\div$ the first number $=$ fractional part. Illustration: $12 \div 16 = \frac{3}{4}$

C. To find the standard number, when the second number and fractional part are given.

The second number $\div$ fractional part $=$ standard number. Illustration: $12 \div \frac{3}{4} = 16$.

Older pupils will understand the following formulas: Let us represent the standard number always by "B," the second number by "P" and the fractional part by "R." Then the problems read thus:

A. Find P when B and R are given. Formula: $B \times R = P$. Illustration: $16 \times \frac{3}{4} = 12$.

B. Find R when B and P are given. Formula: $P \div B = R$ Illustration: $12 \div 16 = \frac{3}{4}$.

C. Find B when P and R are given. Formula: $P \div R = B$. Illustration: $12 \div \frac{3}{4} = 16$.

As the three important problems, or "cases," in percentage are identical with these, such work as is given above forms an excellent introduction. It seems unnecessary to say that all phases of the problems should not be presented at one time. What is given above is knowledge classified after repeatedly meeting it, after long practice in questions of varied phraseology to perfect skill in handling the problems.

31. A Different Plan. The general plan for teaching fractions given in the preceding sections conforms to the plans in the arithmetics in most general use. There is, however, a growing tendency still further to simplify the work, and to do away with the processes of finding the greatest common divisor, least common multiple, and the old method of finding the least common denominator.

When we reduce $\frac{1}{3}$ and $\frac{1}{4}$ to twelfths, one-twelfth is not the least common multiple of $\frac{1}{3}$ and $\frac{1}{4}$, since it is smaller than either of them. It is, in fact, the greatest common measure of $\frac{1}{3}$ and $\frac{1}{4}$. $\frac{1}{12}$ is contained 4 times in $\frac{1}{3}$, therefore we may say $\frac{1}{3}=\frac{4}{12}$.

This greatest common measure may be found by factoring the fractional units, taking all of the factors of the smaller fractional unit and such factors of the other fractional unit as are not used in obtaining the first fractional unit, e.g.,

$\frac{1}{8}=\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$.
$\frac{1}{6}=\frac{1}{3}$ of $\frac{1}{2}$.
$\frac{1}{3}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}=\frac{1}{24}$.

If the pupils have been taught to obtain fractional units in their early work in fractions by dividing from the whole always to the next smaller divisions, instead of commencing at one end of the line and guessing the size of the required part, they will really be telling in the above work how they would obtain the fractional unit given; and this is really resolving the fractional units into their prime factors. A pupil, for instance, should first cut into halves when he wants to get $\frac{1}{8}$; then each $\frac{1}{2}$ into halves, and each of these $\frac{1}{4}$'s into halves. He then always thinks of $\frac{1}{8}$ as $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$.

DECIMAL FRACTIONS

32. General Suggestions. (a) RELATE EACH PROCESS TO PREVIOUS KNOWLEDGE. This general suggestion is peculiarly applicable in the teaching of decimal fractions. The previous knowledge which the pupil has in this instance is his understanding of Canadian money and its use, and of common fractions, especially those whose denominators are tenths, hundredths, etc. Guard against the idea that decimals is a new and difficult subject. Proceed slowly and see that each step is thoroughly mastered and understood in its relations to the preceding one.

(b) TEACH THE PUPILS TO READ DECIMALS CORRECTLY. Pupils very commonly mispronounce the names of the decimal orders. Secure from the very start clear and distinct articulation of them, as, ten*ths*, hundred*ths*, thousand*ths*, ten-thousand*ths*, hundred-thousand*ths*, million*ths*, etc. Do not allow the use of the word *and* in the naming of the orders. In this connection it might be well to call attention to the fact that *and* should be omitted from the reading of whole numbers and used only between the members of mixed decimals. If the teacher observes this principle from the beginning in teaching numbers, she will save herself and her pupils a great amount of confusion. To illustrate this principle, observe the following numbers and the proper reading thereof:

.375	(Three hundred seventy-five thousandths.)
.3745	(Three thousand seven hundred forty-five ten-thousandths.)
682.	(Six hundred eighty-two.)
42398.	(Forty-two thousand three hundred ninety-eight.)
31008.	(Thirty-one thousand eight.)
3.78	(Three *and* seventy-eight hundredths.)
91.075	(Ninety-one *and* seventy-five thousandths.)
300.075	(Three hundred *and* seventy-five thousandths.)

(c) TEACH THE PUPILS EXACTLY HOW THEY SHOULD WRITE DECIMALS. It is highly important that pupils should not be allowed to set down the significant part of the decimal and then put in the ciphers where they seem necessary and fix the decimal point last. What they should do is to think from the decimal point, deciding first how many places will be required and then writing the decimal in consecutive figures from left to right. As an illustration, study the following exercise:

Teacher (reading): One and twenty-five hundredths.

Pupil (thinking): One unit place and two decimal places; (writing) *one, decimal point, two, five.*

Teacher (reading): Three hundred and seventy-five thousandths.

Pupil (writing): *Three hundred;* (thinking) seventy-five thousandths requires three decimal places; (writing) *decimal point, naught, seven, five.*

Teacher (reading): Ninety-one and eight thousand three hundred-thousandths.

Pupil (writing): *Ninety-one;* (thinking) hundred thousandths requires five decimal places; eight thousand three has four places, therefore: (writing) *decimal point, naught, eight, naught, naught, three.*

(d) Grade the Examples Carefully. Here, as elsewhere, remember that the examples given in these lessons are intended for the teacher's information. No one would think of presenting, in introductory lessons, such fractions as those given in the two subsections above. Such writing and reading as is given in the preceding two subsections would come only after the pupils had had considerable practice in both operations.

(e) Be Systematic. As in common fractions, it is not necessary that the pupils should recognize as such all the different cases of operations in decimals, but it is necessary that the teacher should know exactly what things are to be taught and the order in which they should be presented, namely:

(1) Reduction
   1. Of decimals to common fractions.
   2. Of common fractions to decimals.

(2) Addition and subtraction
   Of pure and mixed decimals.

(3) Multiplication
   1. Of pure and mixed decimals by integers.
   2. Of pure and mixed decimals by decimal multipliers.

(4) Division
   1. Of pure and mixed decimals by integers.
   2. Of pure and mixed decimals by decimal divisors.

(f) Give Numerous Practical Problems. No one arithmetic will furnish all the problems that any class should solve, and almost every arithmetic contains problems which in some localities are not the best for the pupils. Every effort should be made to relate the problems closely and clearly to the daily life of the pupils or to those things which they are studying in other lessons. In this way the arithmetic becomes real, and the practical utility of decimals interests the pupils.

(g) Review Frequently. Every day some problems should be given which relate to the lessons of preceding days, so that the pupils may have no opportunity of forgetting the principles which they have learned or losing the skill which they have acquired. As a matter of fact, however, advance problems call for the use of principles already learned, and reviews may be effected often by calling attention to these principles. Reviews should be given frequently in other subjects as well as in decimals, but attention is here called to the practice because it so frequently happens that when a class is studying decimal fractions little or no attention is paid to common fractions, and in graded schools it not infrequently happens that the knowledge pupils gain of the one subject is permitted to lapse when the other subject is taken up in a different grade.

33. Preliminary Work. As has been said, the approach to decimals is made through Canadian money and common fractions whose denominators are ten or some power of ten. The pupil learns that decimals are merely a labor-saving device; that it is a much simpler matter to use a decimal point than it is to draw a line, write a denominator and carry on the somewhat complicated operations of common fractions. Then he learns that he has already been using decimal fractions in Canadian money, in which ten cents occupy the position of tenths and cents the positions of hundredths. It is important that the pupil should understand that the value of a figure rests entirely upon its relation to the decimal point, in decimals as well as in whole numbers. Put upon the blackboard a diagram like the following:

Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Units	Tenths	Hundredths	Thousandths	Ten thousandths	Hundred thousandths	Millionths
7	6	5	4	3	2	1	1	2	3	4	5	6

See that the pupils understand the fact that the first place to the left of the decimal point is units; the first place to the right is tenths; the second place to the left, tens; the second place to the right, hundredths. Call attention to the spelling and the pronunciation of the names of the orders and then drill upon them until the pupils are able to answer without hesitation and with perfect accuracy such questions as these: What is the first order to the right of the decimal point? What is the third order to the left of the decimal point? What is the second order to the right of the decimal point? What is the first order to the left of the decimal point? What is the first order to the right of the decimal point? What is the third order to the right of the decimal point? What is the fourth order to the right of the decimal point?

34. Addition and Subtraction. Pupils will have no difficulty in solving problems in addition and subtraction if they are related back to the operations that have been performed in Canadian money. Addition and subtraction should be taught together, and problems in one or the other operation should be given indiscriminately. It may be wise to pass to examples and problems in addition and subtraction before the pupils are fully versed in reading and writing decimals, if the teacher remembers to make every example in addition and subtraction a test of the pupil's ability to read and write.

35. Multiplication. Before multiplication of decimals appears as a separate topic, the pupils will understand at least one phase of it, namely, that of multiplying a decimal by an integer, because they will have had many problems involving that operation in their transactions with Canadian money. When this phase of multiplication of decimals is clear to them, they should be taught the short methods of multiplying by the powers of ten and the multiples of ten. When using a power or multiple of ten as a multiplier, pupils should always perform the operation by moving the decimal point and by multiplying by the significant figure only, thus:

$$98.4 \times 10 = 984.$$
$$29.407 \times 100 = 2940.7$$
$$6.73 \times 40 = 67.3 \times 4 = 259.2$$
$$65.42 \times 800 = 6542. \times 8 = 52336$$

In all work in multiplication the pupil should understand that the multiplicand and product always agree in unit value. If we multiply dollars, we have dollars for a product; likewise, if we multiply tenths, we have tenths for a product. This principle is of great value in pointing off in the multiplication of decimals.

(1) $4.2 \times 6 = 252$ tenths, which, reduced to a whole or mixed number, equals 25.2.

(2) $.6 \times 4.2 = \frac{1}{10}$ of 252 tenths.
252 tenths $= 25.2$
$\frac{1}{10}$ of $25.2 = 2.52$.

Numerous exercises of this character will soon enable the pupils to place the decimal point correctly.

Another plan of presentation is to begin with common fractions, as follows:

$$\tfrac{1}{10} \times \tfrac{1}{10} = \tfrac{1}{100}$$
$$\tfrac{1}{10} \times \tfrac{1}{100} = \tfrac{1}{1000}$$
$$\tfrac{1}{100} \times \tfrac{1}{100} = \tfrac{1}{10000}$$

These facts we know from multiplication of common fractions. The results must be the same if we write the fractions as decimals; accordingly,

$$.1 \times .1 = .01$$
$$.1 \times .01 = .001$$
$$.01 \times .01 = .0001$$

An examination of these three simple problems shows you that in every decimal product there are just as many decimal places as there are decimal places in the multiplier and the multiplicand taken together. Again:

$$\tfrac{3}{10} \times \tfrac{7}{10} = \tfrac{21}{100}$$
$$\tfrac{3}{1000} \times \tfrac{7}{10} = \tfrac{21}{10000}$$

4 and $\frac{7}{10} \times 2$ and $\frac{3}{10}$ is the same as $\frac{47}{10} \times \frac{23}{10}$, which equals $\frac{1081}{100}$, or 10 and $\frac{81}{100}$.

Written as decimals the results must be the same, namely:

$$.3 \times .7 = .21$$
$$.003 \times .7 = .0021$$
$$4.7 \times 2.3 = 10.81$$

In this last case, as before, the number of decimal places in the product is the same as the number of decimal places in the multiplier and multiplicand together, hence the rule: *Multiply the decimals as though they were integers, and point off in the product as many decimal places as there are in the factors.*

36. Division. Division of decimals in an elementary form has been made by the pupils in their problems in Canadian money; they should next learn the short method of dividing by integral powers and multiples of ten. When these facts are mastered and have been practiced until the pupil is not only familiar with the process but understands the reasons therefor, he will be ready to take up the only thing that is ever troublesome, namely, the division of one decimal by another. Here, as in multiplication, the difficulty lies in locating the decimal point after the operations have been performed. There are several ways in which this may be done without difficulty, but probably the most certain and easily remembered is that method in which the divisor is made an integer before dividing. It may be taught in the following manner:

(a) Review the division of mixed decimals by an integer.

(b) Show that any decimal may be made an integer by multiplying it by the right power of ten.

(c) Pupils know that to multiply both divisor and dividend by the same number does not change the value of the quotient; therefore, we may divide easily by a pure or mixed decimal if we multiply it and the dividend by such a power of ten as will make the divisor an integer.

If pupils are taught to keep their division examples always in perfect form, the liability to make mistakes in the position of the decimal point will be very materially decreased. The form suggested in Section 16 of this chapter is an excellent one to follow, and if the pupil is taught always to place the first figure of his quotient exactly above the last figure in his first partial dividend, the decimal point in the quotient must appear over the decimal point in the dividend. The four following examples will illustrate this:

(1)

$$62.9 \div 3.7 = 629. \div 37.$$

(a)
$$\begin{array}{r} 17. \\ 37.\overline{)629.} \\ \underline{37} \\ 259 \\ \underline{259} \end{array}$$

(b)
$$\begin{array}{r} 17 \\ 3.7\overline{)62.9} \\ \underline{37} \\ 259 \\ \underline{259} \end{array}$$

(c)
$$\begin{array}{r} 1700 \\ .037\overline{)62.900} \\ \underline{37} \\ 259 \\ \underline{259} \\ 00 \end{array}$$

(2)

$$4.62 \div 2.2 = 46.2 \div 22.$$

$$\begin{array}{r} 2.1 \\ 22\overline{)46.2} \\ \underline{44} \\ 2.2 \\ \underline{2.2} \end{array}$$

(3)

$$30.5 \div 61 = 305 \div 610.$$

$$\begin{array}{r} .5 \\ 610\overline{)305.0} \\ \underline{305.0} \end{array}$$

(4)

$$7.466 \div 7.1 = 174.66 \div 71.$$

```
      2.46
71)174.66
   142
    32.6
    28.4
     4.26
     4.26
```

37. The Three Problems Again. The three problems which are discussed in Section 30 of this chapter appear in decimal fractions as frequently as in common fractions. The three should at some time be taught together and in conjunction with the same three problems in common fractions, to show the unity of idea and practice and to prepare the way for the same three problems when they appear in percentage. If this plan is carried out and the pupils are made thoroughly conversant with these problems in both simple and decimal fractions, the subject of percentage will be robbed of half its terrors. The reader of this chapter should go back to Section 30, read it carefully throughout and apply it in numerous problems to decimal fractions. Everything that is printed in that section applies as well to decimals as to common fractions, excepting the type examples. The decimal types are as follows:

Problem A. What are .75 of 16?
Problem B. What decimal part of 16 is 12?
Problem C. 12 is .75 of what number?

PERCENTAGE

38. Preliminary Work. When the pupil has mastered decimals, percentage in the abstract should give him no trouble whatever, for the principles and operations of the two are identical. *Decimals* is a broad and general term;

percentage, a specific term. All examples in percentage are examples in decimals, but not all examples in decimals are in percentage. Again, percentage may be considered as a special form of common fractions, and all that can be done in percentage is embraced in the three problems which are discussed in Section 30. All examples in common and decimal fractions in which the denominator is 100 are in a measure examples in percentage. It is upon this fact that the teacher must persistently dwell in all preliminary work. There is nothing new in principle or operation—merely a difference in name.

As the denominator in percentage is invariably 100, there is no necessity for writing it. The sign % indicates a denominator of 100.

39. The Three Problems Once More. To find any percent of a number is merely to find so many hundredths of it, and this is Problem A, Section 30. We do, however, in percentage, give different names to the elements that appear in the three general problems. Thus, that which is described as the basal or standard number in Section 30 is in percentage called the *base*; that which is known as the second number is in percentage called the *percentage*, while that which in fractions, both common and decimal, is called a fractional part, is here known as the *rate of percentage*, or merely the *per cent*.

Accordingly, the three problems, when stated in percentage, appear as follows:

Problem A: To find the percentage of a number. Type: What is 75% of 16?

Here the percentage is to be found, the base is 16 and the rate, or per cent, $\frac{3}{4}$. If we represent base by B, percentage by P, and rate, or per cent, by R, we have: Find P when B and R are given; a form identical with the one given in Section 30, for problem A.

Problem B: To find what per cent one number is of another; that is, to find R when B and P are given. Type: What per cent of 16 is 12?

Problem C: To find the number of which 12 is 75%; that is, find B when P and R are given. Type: 12 is 75% of what number?

Naturally some difficulty may be experienced in applying the percentage names to the different elements and understanding them at sight. but if the teacher is guarded in presenting the names slowly and working with Problem A until the names are well understood, she will have no great trouble in leading the pupils to see clearly the other problems. It is taken for granted, too, that these terms will not be entirely new to the pupil when the formal presentation of percentage is made. The skilful teacher will have used the words a great many times much earlier in the course, and pupils will have learned to find simple percentages of numbers and to find what part one number is of another in examples involving small figures. What we are outlining here is rather the advance work, the systematic arrangement of knowledge which should precede every serious study in the applications of percentage.

40. Form in the Three Problems. In the solution of examples some people regard the per cent as a decimal, write it as hundredths and perform all the operations exactly like decimals. Others treat the rate of percentage as an integer and do not attempt to place the decimal point until the problem has been solved. The difference in treatment is shown clearly in examples involving the third problem; thus the question, 88 is 8% of what number? may be solved in the following two ways:

(1)	(2)
$88 \div .08 = 8800 \div 8.$	$88 \div 8 = 11.$
$8)\underline{8800}$	$11 \times 100 = 1100.$
1100	

It is immaterial which method is used, but after one has been selected it ought to be followed in all the work by the class, in order to avoid confusion.

Using the same figures in Problem A, the two methods appear:

$$\begin{array}{r} 1100 \\ \underline{8} \\ 8800 \end{array}$$ (1100 was multiplied by 8 and then two places were pointed off in the product.)

$$\begin{array}{r} 1100 \\ \underline{.08} \\ 88.00 \end{array}$$ A third method is to take 1% first by pointing off two places and then to multiply by 8, thus: $$\begin{array}{r} 11.00 \\ \underline{8} \\ 88. \end{array}$$

In the formal solution of concrete examples, the teacher should insist that so much explanatory matter be written in connection with the work that the denomination of the members will be perfectly clear at every step. The unit value should always be kept clearly in mind. By writing in this manner, the pupil will not reach the end of his problem and be ignorant of what he has found. Here follows a good form for the solution of a concrete example in Problem C:

To illustrate: A sold his house for $4900, and lost 30%. What did the house cost?

Solution: 100% of the cost = the cost.
30% of the cost = the loss.
70% of the cost = $4900.
1% of the cost = $70.
100% of the cost = $7000.

Another form:

100% of the cost = cost.
30% of the cost = loss.
70% of the cost = selling price, $4900.
1% of the cost = $70.
100% of the cost = $7000, cost of the house.

41. Analysis. Whatever form is finally decided upon as the appropriate one for written examples in which the percentage is not easily seen, it is evident that the solution of such examples should be preceded by a great deal of analysis in which the method of fractions is pursued. Thus, the analysis of the type example in Problem A is as follows:

What is 75% of 16?

1% of 16 is $\frac{1}{100}$ of 16, or .16.

75% are 75×.16, or 12.

Therefore, 75% of 16 is 12.

The analysis in Problem B is as follows:

What per cent of 16 is 12?

12 is $\frac{12}{16}$ or $\frac{3}{4}$ of 16.

$\frac{3}{4}=\frac{75}{100}$; therefore, 12 is 75% of 16.

Problem C may be analyzed as follows:

12 is 75% of what number?

If 12 is 75% of a number, 1% of that number is $\frac{1}{75}$ of 12, or $\frac{12}{75}$, which equals $\frac{4}{25}$.

If $\frac{4}{25}$ is 1%, 100% of the number is 100×$\frac{4}{25}$ or $\frac{400}{25}$, which equals 16.

42. Complex Examples. It often happens in business that questions arise which involve more than one of the three problems, and our arithmetics abound in similar examples. Pupils must be taught to watch for these complex examples and to analyze them carefully (see Section 9) to detect which problems are involved. Another complexity arises in examples in percentage when for any reason the percentage is added to or subtracted from the base. To find either the *amount* or *difference* does not bring in a new problem in fractions or percentage, but adds a new step which should be carefully explained when it is first met. It is not necessary to trouble pupils with this in the early stages of teaching the subject, but before they enter very fully into the practical applications of percentage they must understand finding difference and amount.

43. Use of Common Fractions. Teachers should not leave in the minds of pupils the idea that all examples in percentage must be solved by the regular methods of percentage. As a matter of fact, most of the percentages required to be found in a man's daily life are better handled if the percent is regarded as a fractional part of 100, in the form of a common fraction. When the percentage is one of the so-called aliquot parts of 100, it is better to consider it as a fractional part. The following list gives those most common per cents which may profitably be used in this way.

50 % = $\frac{1}{2}$	75% = $\frac{3}{4}$	$16\frac{2}{3}$% = $\frac{1}{6}$
$33\frac{1}{3}$% = $\frac{1}{3}$	20% = $\frac{1}{5}$	$12\frac{1}{2}$% = $\frac{1}{8}$
$66\frac{2}{3}$% = $\frac{2}{3}$	40% = $\frac{2}{5}$	$8\frac{1}{3}$% = $\frac{1}{12}$
25% = $\frac{1}{4}$	60% = $\frac{3}{5}$	$6\frac{1}{4}$% = $\frac{1}{16}$
	80% = $\frac{4}{5}$	

(See Table, Section 11.)

After the teacher is certain that the pupils thoroughly understand the principles of percentage, she should insist that all examples, either oral or written, which involve the per cents given above, should be solved by the methods of common fractions.

TEST QUESTIONS

1. Write three good examples, each involving one of the three general problems in percentage.

2. Solve the three examples you wrote in answer to the first question.

3. Re-state each of the examples given by you in answer to the first question so that they will illustrate (a) the three general problems in decimal fractions and (b) the three general problems in common fractions.

4. Explain the process of making change when purchases amounting to $13.21 are paid for with a twenty-dollar bill.

5. Prove that in the multiplication of one fraction by another we may multiply the numerators together for the new numerator and the denominators together for the new denominator.

6. Prove that division of fractions is accomplished by inverting the divisor and proceeding as in multiplication of fractions.

7. What are the two great aims in teaching arithmetic? Which do you consider of the greater importance? Give reasons for your answer.

8. (a) Why is a knowledge of factoring of importance to pupils in arithmetic? (b) Of what value is it to intermediate pupils to understand the process of finding the least common multiple? (c) Of what value is a knowledge of the process of finding the greatest common divisor?

9. (a) Write in words the following decimals:

53.674
.8592
21.0106
918.0006
.0487

(b) Write the following decimals in figures:
Seventy-five and twenty-eight thousandths
Five thousand nine hundred forty-two ten-thousandths.
Two hundred and two hundredths.
Two thousand and two thousandths.
Thirty-six and two thousand sixteen ten-thousandths.

(10) Solve the following problems, putting your solutions into what you consider the best possible form for pupils who are working such questions for the first time:

(a) The cattle on a certain stock farm increase at the rate of 18½% per annum. If there were 4896 cattle in 1899, how many were there in 1901?

(b) Divide 2450.90 by .998.

(c) A man willed one-third of his property to his wife, two-thirds of the remainder to his daughter, and the rest to his son. The difference between the wife's and the daughter's shares was $2500. Find the value of his property.

CHAPTER TWO

ARITHMETIC (Continued) AND ALGEBRA

BUSINESS APPLICATIONS OF PERCENTAGE

1. General Suggestions. (a) Take One Step at a Time. Impress upon your pupils that long problems are really composed of several short ones; that in the preliminary analysis they must try to discern the short problems; and that the conclusion of the brief course of reasoning in one of the latter becomes the basis of another.

(b) Show the Identity of Operations. There is not a single new process in all the applications. Relate the operations closely to those of percentage, and thereby to common and decimal fractions.

(c) Teach Objectively. Whenever possible, show the actual business papers described in the application that is made of percentage. Require the pupils to copy and to learn business forms, notes, checks, drafts, bills, etc., from good models.

(d) Make the Knowledge Real. Do not content yourself with the forms mentioned above. Give real examples and obtain real examples from the pupils. Let them get interest data from notes their fathers have and compute the amount due thereon, and in this way show them the utility of their knowledge.

(e) Review Frequently. Try to call up every day something that has been passed over. Compare the old knowledge with the new. In this way the familiar processes will not grow strange under new names.

(f) Cling to One Method of Solution. When pupils are learning new facts, new terms and new business rules, do not confuse them by introducing new methods in computation. In interest, for instance, teach at first but one good method of computation, and stick to it. Later, in review in the eighth or ninth years, you can show the different methods, if you have time.

(g) Omit Antiquated and Unbusiness-like Problems. Much depends on the book you have, but it is probable that you will find some things not adapted to your class. Have no hesitation in omitting what is unimportant, unless you have ample time to use it for practice. (See page 3, Section 5.)

2. Classification. The business applications that must be considered may be classified for the purposes of solution into two groups. The subjects in the first group involve the three general problems of percentage (See page 33, Section 38), in the identical forms given there. There are absolutely no differences except in the names of the three quantities that enter into the problems. Profit and Loss, Commercial or Trade Discount, Commission, Insurance (in most instances) and Taxes are in this group.

The applications in the second group are slightly complicated by the fact that the results are affected by *time*. Mathematically, that means that the number obtained in solving the general problem must be multiplied by a fraction or an integer to obtain the final result. Notice this question: What is the interest on $300 for 6 months at 6 per cent? In the first place, this is problem A in a new dress. It means, what is 6% of $300? We solve the problem to find 6% of $300 to be $18. Normally, interest is reckoned at a certain per cent for a year. For a less time, the interest is less. Thus, time is a factor in this problem, and we must multiply $18 by ½ to obtain our final result.

In this second group of subjects are included Interest, Compound Interest, Bank Discount, Partial Payments, Stocks and Exchange.

3. Comparison of Names. The table following may assist the teacher in remembering the names used in the various business applications and in avoiding confusion in their relation to the three general problems of percentage. A table similar to this should be built up by the pupils as they progress in their work:

1. DECIMALS (a) Problem A (b) Problem B (c) Problem C	BASAL NUMBER (Given) (Given) (?)	DECIMAL (Given) (?) (Given)	SECOND NO. (?)* (Given) (Given)†	SUM (?)* (Given)†	DIFFERENCE (?)* (Given)
2. PERCENTAGE	Base..........	Rate per cent...	Percentage	Sum	Difference
3. PROFIT & LOSS.....	Cost Price......	Rate.....	Loss or Gain.....	Selling Price...	Selling Price
4. TRADE DISCOUNT....	List Price......	Rate.....	Discount...	....	Sel'ing Price
5. COMMISSION	Cost Price (in buying)... Selling Price (in selling)	Rate.	Commission	....	Amount Remitted
BROKERAGE	Par Value......	Rate....	Brokerage..	....	....
6. INSURANCE..	Sum Insured...	Rate.....	Premium...	....	....
7. TAXES......	Assessed Value.	Rate.....	Tax.......	....	....
8. INTEREST...	Principal.......	Rate....	Interest....	Amount..	....
9. BANK DISCOUNT....	Amount Due on Note.........	Rate.....	Discount...	....	Proceeds
10. EXCHANGE	Face of Draft..	Rate.....	Premium Discount.	Cost.....	Cost

*Any one of these terms may be required.
†Any one of these terms may be known.

4. Profit and Loss. There is no necessity for treating examples in profit and loss as though they were in a new subject. Nearly every boy and girl knows enough of buying and selling at a loss or gain, so that problems in this topic may be given in connection with others in percentage, without even explanatory comment. When the topic Profit and Loss is reached in the arithmetic, it becomes a review lesson merely.

5. Trade Discount. Wholesale dealers publish catalogues of their goods and usually quote retail prices which, however, are subject to change. To their customers wholesalers are in the habit of giving a discount reckoned at a certain per cent "off" those list prices. The computation of that discount is simply an instance of Problem A in percentage. But two or more of these trade or commercial discounts are sometimes quoted on the same article, and when this is done a new application of the problem arises. Here is an illustration:

What is the net amount of a bill of goods, the list price of which is \$540, discounted 25% and 15% off for cash?

Solution: $25\% = \frac{1}{4}$. $\$540 - \frac{1}{4}$ of $\$540 = \$405$, the amount of the bill after the first discount, and the base upon which the second discount is computed. Then: \$405 − 15% of \$405 = \$344.25, the net amount of the bill.

Observe that this is not the same as 25% + 15% = 40% on the list price. The latter would be the better terms, for \$540 − 40% of \$540 = \$324. \$344.25 − \$324 = \$20.25, balance in favor of the second method.

The only point, then, upon which the teacher will need to dwell is that the *difference* after one discount becomes the base upon which the next is reckoned.

6. Commission. Oftentimes when one person transacts business for another he receives as his pay a certain per cent of the amount of money used in the transaction; if he buys, he receives his commission on the cost price; if he sells, his commission is reckoned on the selling price. This changing base is what breeds most of the confusion that arises, for pupils are inclined to associate *base* with cost price exclusively. Keep foremost the idea that the agent should be paid for what he does, and that the measure of what he does is the money he pays out when he buys for his employer, and the money he receives when he sells for his employer.

The conditions that give most trouble are typified in the following problem, an impractical one, not often arising in business:

If I sent an agent \$512.50 with which to buy goods and pay his commission of 2½%, how much does the agent invest in goods?

The key to the example is again the fact that the commission is charged on the cost price of the goods; that is, the cost price of the goods is the base, or 100%. Accordingly, the money I send is 100% + 2½% = 102½% of the amount to be expended. Therefore, we have an example of Problem C:

102½% of the amount to be invested by the agent = \$512.50.
1 % " " " " " " = \$5.
100 % = \$500, the amount expended for goods.

7. Insurance, Taxes and Duties. Pupils who understand the percentage problems will have no difficulty in solving the questions in these subjects. The burden on the teacher now is to make the subjects real to the pupil. All are practical, and everyone should know about them. To find out how property is assessed in your locality and what the rates of taxation are, and to compute taxes on local property holdings are methods of securing the interest of your pupils. You can get an insurance policy blank from an agent, and read it with your class; you can find the local rates and the pupils can make questions in local insurance. *Duties* may be related to lessons in history and geography.

8. Interest. Unless the subject is complicated by artificial difficulties, interest never gives the pupils any great amount of difficulty. It is the simplest kind of an application of percentage, and the introduction of time as a factor need cause no trouble (Section 2).

Call attention to the fact that in business transactions involving interest a year consists of twelve months of thirty days each. This is the *legal* year, but pupils will see that it is not an exact year. After the pupils have learned to compute interest by ordinary methods they can solve for themselves problems in *exact interest* when their attention is called to the fact that the term applies to interest in which the year is considered as three hundred sixty-five days, that is, its *exact* length. There is no need of making a new topic of this subject, and no more time need be spent upon it than is necessary to show what constitutes exact interest and how it differs from legal interest.

But one problem need be raised in compound interest, and that is the simple one of finding the interest. But one new fact is it necessary for the pupil to learn, namely, that compound interest means adding interest to principal. If it is required to find the compound interest for a considerable length of time, pupils may easily be led to see that this compound interest is the difference between the original principal and the final amount. Some of the old arithmetics gave many complicated examples in this subject which were impractical and unnecessary and which have been omitted from most of the later books.

At first the teacher will content herself with giving but one method of finding interest, but later the pupils shouid learn one or two other methods and be shown in what type of examples each method is most advantageous. It is safe to repeat here a principle that we have often alluded to, namely, that when a pupil is engaged in learning new terms and new processes, the examples to be solved must be exceedingly simple; but that after the facts and principles become familiar, attention may be concentrated on short processes and harder problems.

9. Partial Payments. This subject has many times proved troublesome, but principally owing to the fact that the problems are necessarily long and that pupils are deficient in skill in carrying out the ordinary computations. Sometimes pupils have been confused by having two or three different methods introduced to their attention. It is necessary to learn one method and learn it well, and that method is the one which is legal in the place where the pupil lives. In the great majority of cases this will prove to be what is known as the Canadian Rule. This is one of the rules which must be learned because it is a rule in a legal sense; that is, the courts have decided that when partial payments are made on notes, the payments shall be applied in a certain definite manner.

After pupils have learned the legal rule they should be given a great many simple problems, so graded that they do not present more than one difficulty at a time. Most arithmetics contain too few problems and go too quickly from simple ones of two or three steps to long and complex ones. It really happens in business that examples of partial payments are exceedingly long and tedious, but such should not be presented until the pupil has thoroughly mastered every step of the process, and this he can do best through examples in which the numbers have been so chosen that there will be no complications in figures. As soon, however, as a process is familiar, this topic should be one of those made most real and vital to the pupils. Pupils can bring the data of notes in the possession of their parents, and these data can be made the basis for interesting problems. At the same time a large amount of drill should be given in the writing of legal promissory notes, so no pupil can possibly leave the subject until he knows what are the essentials of a valid note and what is the legal phraseology. It is an instance of poor teaching for a pupil to leave the public school and not be able to write a legal note or to detect the flaws in notes that are not valid.

After the student has become very familiar with the legal method, he should be given one of the others for comparison. As the legal process is almost invariably the Canadian Rule, the other one should be that which is usually known as the Merchants' Rule. By this rule interest is computed on the face of the note till the time it is paid and the sum is added to the face of the note. Interest is then computed on each of the payments from the time it is made until the note is paid, and the sum of all the amounts of these payments is taken from the sum of the principal and interest, the difference being the amount due. Several examples should be given in which the comparison is made between the two methods, and pupils should be asked to determine which is the more equitable to both parties interested. The Merchants' Rule is frequently used for small notes due in less than a year.

10. Banking. The treatment which is given to the subject of banking will depend largely upon the character of the arithmetic used, but in any case that phase of banking which is most important for the pupil is the one which he is almost certain to meet in his everyday life. More and more, banks are becoming places of deposit in which people keep their funds and from which they pay their bills by means of checks. Accordingly, every child should be instructed in methods of depositing money, in forms of checks, in the commercial value of checks and in the responsibility of the parties whose names appear thereon. It is quite possible that the arithmetics contain very little on this subject. If so, the teacher should go to the nearest banks and obtain from them deposit slips, passbooks, blank checks and the other forms which are in common use. The banker will be glad to give the teacher a small supply and will doubtless take pains to explain the use of them.

As a problem in arithmetic it is but a brief step from paying by a check, locally, to paying at a distance by bank draft, and from this to foreign bills of exchange is another single step. The teacher will find what the local custom is in regard to the charge for drafts and for exchange and then ask the pupils to solve problems accordingly. As a matter of fact, banks are sometimes very liberal with their regular customers in the matter of drafts, while in other cases they hold strictly to their rates and charge a fixed amount for drafts of certain size, or a regular percentage on the face of the draft.

The only other phase of banking which need be considered in the public schools is that of borrowing money from a bank. Here, by careful explanation, a teacher can avoid confusion, if she lays stress upon the fact that ordinary bank discount is interest on the amount which is to be collected at the maturity of the note and that this interest is collected in advance under the name of bank discount. Naturally, if the note which is discounted does not bear interest, the face of the note is the base upon which the discount is reckoned. If the note bears interest, the basis upon which the discount is reckoned is the amount of the note at maturity. Another phase of this subject brings in Problem C of percentage. This is the case when a person wishes to borrow a certain sum from a bank. He must then make out his note for a larger sum, to be determined by the methods of Problem C. Suppose a man wishes to borrow $1,000 for three months from a bank. The amount of the note which the borrower signs will be $1,000 plus the interest on that sum for three months and three days. If the note is not paid at the end of three months the bank may accept a part payment and then renew the balance. If the borrower does not come to the bank on or before the day on which the note is due, the bank may protest the note and collect it by legal process.

11. Paying Money at a Distance. While the class is studying the subject of exchange, or rather, in advance of that time, instruction should be given in other common methods by which money may be sent to a distance. Besides the methods by check and bank draft, referred to above, money may be sent safely through the postoffice and through express companies. The teacher should go to the postoffice or send some one of her pupils to obtain the blanks which are necessary, to learn how and at what expense letters may be registered and how money may be sent by postoffice money-order. Postmasters are so much troubled by the ignorance of people who wish to send money that they are usually very glad to give out the information and will supply all the blanks that are necessary to make classes understand the processes. It is very important that boys and girls should receive practical training in such matters as sending money by postoffice orders. The business that may form a part of everyday life will always be interesting both to children and parents.

Currency may be sent through an express company in much the same manner that it is sent in a registered letter, and the large express companies also have express money-orders which they sell at a fixed charge proportionate to the amount. From the nearest express office the teacher may obtain the blanks and the instruction which is necessary to make this subject clear to her pupils, if she does not already understand it. Time cannot be more profitably spent than in learning these common business customs.

12. Stocks and Bonds. The subject of stocks and bonds is one of increasing importance, and before pupils leave the public school they ought to understand what corporations are, how they are formed, how stock is issued and how handled in the market. If people understood these matters a little more thoroughly there would be fewer cases in which money is thrown away by foolish investment; but the subject is too great to be treated satisfactorily in the public schools. However, much can be done that is worth while, if the teacher presents the subject concretely and gives the greater portion of the time to making the pupils understand the different terms which are always before the newspaper reader.

Bonds differ from stocks in that the holders of stocks are the owners of the property, while the holders of bonds are the creditors of the property. In other words, stocks are certificates showing that the holder owns a certain part of a business enterprise; bonds are certificates showing that a certain enterprise owes money to the holder. The interest on bonds is a fixed per cent of their par value. The interest on stocks (dividends) fluctuates with the success of the enterprise, but is reckoned as a per cent of the par value. The solution of problems is a matter of comparative unimportance.

The complicating feature in arithmetical stock-buying problems is the brokerage, for pupils are frequently confused by the fact that the brokerage is computed on the par value of the stocks, in both buying and selling transactions, and not upon the market value; consequently, the actual cash in the transaction is not always the base. This does not seem unreasonable when one stops to think of the fluctuations in value that any stock may undergo even in the course of a single day.

Out of these conditions come numerous problems which always confuse young students more or less, but which will be rendered comparatively simple if the teacher will insist that the pupils take one step at a time and remember the facts we have stated above.

To illustrate the most troublesome complications, we explain three simple problems:

1. If a one-hundred-dollar 4% bond was purchased at par, what per cent would it yield on investment?

The 4% interest which the bond bears is reckoned on the par value. As the bond was purchased at par and the interest is reckoned at par, an interest of 4% is yielded on the investment.

2. If a 4% bond was purchased at 150, what per cent would it yield on the investment?

This bond yields 4% on its par value, that is $4 on the hundred, but the bond was purchased for $150. Accordingly, the interest yielded is $4 on $150. This is an application of Problem B, which shows the interest to be $2\frac{2}{3}$%.

3. If a 4% bond was purchased at 50, what per cent would it yield on the investment?

As in the two preceding examples, the 4% interest is on the par value, consequently the interest on the bond is $4. As the bond was purchased at $50, it cost the purchaser but $50. $4 interest on $50 is 8% on the investment.

LONGITUDE AND TIME

13. The Comparison. If in the geography classes the pupils are taught what longitude is and then understand the changes of day and night that are brought about by the rotation of the earth upon its axis, there will be no difficulty in giving the arithmetical knowledge necessary in order to compare longitude and time. In some of the older arithmetics much is included under this head that may profitably be omitted, yet some few facts are important. The pupils must know that at any given moment places lying to the east of a given point show time later in the day, and places west of that given point show time earlier in the day. For every fifteen degrees of difference in longitude a difference of one hour of time is made. Knowing the difference of longitude, the difference of time may easily be ascertained. When pupils understand this thoroughly and can find the difference in time, they have all the arithmetical knowledge necessary; but there are two other subjects that are so intimately connected with this that the facts concerning them should be made known. As these are not given in all arithmetics, they are discussed briefly in the next two sections.

14. Standard Time. In so large a country as the Dominion the difference in time occasioned by difference in longitude naturally bred much confusion among the railroads; so in 1883 a standard time system was introduced by them and adopted very generally by the people. Certain meridians fifteen degrees apart, beginning at sixty degrees west of Greenwich, have been established as standard meridians, and places seven and one-half degrees east or seven and one-half degrees west of the standard meridian are said to have the same time as that on the standard meridian. Trains traveling east or west change the time one hour at a point near to this standard meridian.

Standard time is exact time only on the standard meridians; at places seven and one-half degrees east or west of the standard meridian it varies a half hour from actual time. Convenient as standard time may be to the railways, it is in places midway between standard meridians rather inconvenient. Towns located in such longitude frequently keep two times, known as sun time and standard time. Nearly all Canadian cities and towns, even the smaller and more remote, use standard time exclusively.

15. International Date Line. If a person were to travel completely around the earth from west to east he would appear to gain a day; if he should travel completely around from east to west he would appear to lose a day. This fact would bring about a great deal of confusion, especially among sailors, were it not for the fact that nations have agreed to call the meridian 180° W. from Greenwich the *international date line*, or the place from which the days start. Vessels going east will count the day on which they reach the meridian 180° W. twice, and vessels going west will skip one day as they cross this international date line. For instance, if a ship sailing west crosses the line on a Monday, the next day is Wednesday; if sailing east it crosses the line on Monday, it counts the next day Monday also.[1]

POWERS AND ROOTS

16. Roots and Powers. Square root and cube root are recognized as two rather difficult subjects in the upper

[1] While theoretically the date should change on the 180th meridian, for practical purposes the line is extended eastward about 20° on the 52d parallel in north latitude, so as to include the entire group of the Aleutian Islands in the same date; and it extends eastward about the same distance on the 43rd parallel, south latitude, to include the New Zealand group of islands.

grammar grades, but so much of the two as is really necessary may be taught with considerable ease. When the time arrives for introducing the subjects, the pupils should be given enough general exercises to fix the idea of powers and roots thoroughly in mind. This may best be done by showing that a power is a number composed of equal factors, and that the root is one of the equal factors of a number. When the number contains two equal factors it is a *square*, and one of its factors is its *square root*; if the number contains three equal factors it is a *cube*, and one of its factors is its *cube root*; if the number contains four equal factors it is a *fourth power*, and one of its factors is a *fourth root*.

Abundant examples may be given in which roots are to be found merely by the application of the following principles of factoring:

1. Find the square root of 441.

$$\begin{aligned}\sqrt{441} &= \sqrt{3\times3\times7\times7}\\ &= \sqrt{21\times21}\\ &= 21\end{aligned}$$

2. Find the cube root of 216.

$$\begin{aligned}\sqrt[3]{216} &= \sqrt[3]{2\times2\times2\times3\times3\times3}\\ &= \sqrt[3]{2\times3\times2\times3\times2\times3}\\ &= \sqrt[3]{6\times6\times6}\\ &= 6\end{aligned}$$

3. Find the fourth root of 256.

$$\begin{aligned}\sqrt[4]{256} &= \sqrt[4]{2\times2\times2\times2\times2\times2\times2\times2}\\ &= \sqrt[4]{4\times4\times4\times4}\\ &= 4\end{aligned}$$

4. Find the fifth root of 7776.

$$\begin{aligned}\sqrt[5]{7776} &= \sqrt[5]{2\times2\times2\times2\times2\times3\times3\times3\times3\times3}\\ &= \sqrt[5]{2\times3\times2\times3\times2\times3\times2\times3\times2\times3}\\ &= \sqrt[5]{6\times6\times6\times6\times6}\\ &= 6\end{aligned}$$

17. Square Root. After pupils understand the meaning of roots and are able to find any root of simple numbers easily factorable, a method may be presented for finding the square root of a number which is not easily factorable. There are two ways of introducing this subject; one is the algebraic method, and the other may be called the method by diagram. Each of the two results in the development of the same rule, and they are sufficiently explained in most arithmetics. While at the beginning it may be wise to confine the attention of the class to the development of the rule, the ultimate aim of the teacher should be the understanding of the underlying principles. Pupils should be kept at the demonstration until the rule is clearly developed, and then they should be led to learn the rule and should practice its use until it becomes thoroughly automatic. The following explanation shows how the rule should be applied and shows the best form for the work:

Extract the square root of 55225.

Pointing the number off into periods of two figures each (5′52′25), we find that there are three periods and consequently know there will be three figures in the root.

We see that in the left-hand period, 5, the largest perfect square is 4, of which the square root is 2.

Write the example thus:

5′52′25|2
4 (placing the square of the first figure of the root under the first period in the power.)
152 (subtracting, and bringing down the second period.)

Making a trial divisor by taking twice the root already found ($2 \times 2 = 4$), we find it contained in 15 about 3 times, the second figure in the root. Annexing this figure to the trial divisor, we have 23 for the complete divisor. Multiplying this by the second figure of the root and subtracting from the dividend, we have 23 for a remainder, to which we annex the last period in the root, making 2325 for the new dividend. Keep the example in this form:

$$
\begin{array}{r|l}
 & 5'52'25\,|\,\underline{23} \\
 & 4 \\ \cline{2-2}
2\times 2=4 & 152 \\
\underline{3} & \\
43 & \underline{129} \\
 & 2325
\end{array}
$$

Making a second trial divisor by taking twice the root already found ($2\times 23=46$), we find it contained in 2325 about 5 times, which we may place temporarily as the third figure in the root. Completing the second trial divisor by

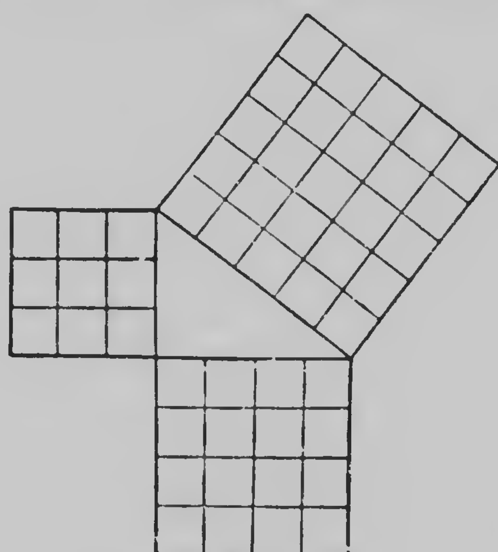


Fig. 1.

annexing this third figure of the root, we have 465 as the complete second divisor. Multiplying this by the third figure in the root and subtracting, we find no remainder. Thus, we know that 55225 is a perfect square, and that 235 is its square root.

The example will appear, when completed, in this form:

$$
\begin{array}{r|l}
 & 5'52'25\,|\,\underline{235} \\
 & 4 \\
\hline
2 \times 2 = 4 & 152 \\
3 & 129 \\
\hline
 & \quad 2325 \\
2 \times 23 = 46 & \\
5 & \\
465 & \underline{\quad 2325}
\end{array}
$$

18. Applications of Square Root. This principle can be demonstrated in two ways, both of which eighth year pupils can understand.

(1) Have the pupils construct a right triangle, ABC (Fig. 1), whose base is 4 inches and whose altitude is 3 inches. Construct squares upon each of the three sides so they will not overlap each other, forming the squares AB, AC and BC. Divide each square into square inches; count the square inches in each. What does this prove?

(2) Draw two equal squares, as 1 and 2 in the illustration below. From any corner of 2, going around in the same direction, lay off equal distances by dots. Connect these

1 2 3 4

Fig. 2.

dots, as in 3, and shade the triangles thus laid off. Apply these triangles to 1 so as to make 4. You will notice that 3 contains one square and four equal right triangles; 4 contains two squares and four equal right triangles. How do the right triangles in 4 compare in size with those in 3? The square in 3 is the square upon which side of the right triangle? The large square in 4 is the square upon which side of the right triangle? The small square 4 is the square upon which side of the right triangle? Prove that the area of these two squares is equal to the area of the square in 3.

Construct other triangles of different sizes. Do these, when measured, prove the same principle?

This principle may be applied in a variety of examples which will give the pupils excellent practice drill in measuring. They can find the diagonals of windows, doors, desks, books, etc., from actual measurement.

19. Cube Root. It is doubtful whether it is wise in ordinary grammar schools to teach cube root by any other method than that of factoring, as described in Section 16; but some schools may require other methods to be taught, and sometimes strong classes will find good exercise in finding roots of this degree. The ordinary rule may be used in such cases and its demonstration left entirely to algebra, or the teacher may illustrate the truth of the rule by the use of blocks. The following table shows a comparison of the rules for square and cube root and may be helpful in fixing both in mind:

	SQUARE ROOT	CUBE ROOT
Pointing Off	*Periods of 2 Figures Each*	*Periods of 3 Figures Each*
First figure in the root.	The square root of the largest perfect square in the left-hand period.	The cube root of the largest perfect cube in the left-hand period.
First Subtrahend.	The largest perfect square in the left-hand period.	The largest perfect cube in the left-hand period.
Trial Divisor	Twice the root already found.	Three times the square of the root already found, considered as tens.
Completing the Trial Divisor	Annexing the new figure of the root	Adding (a) three times the product of the root found, considered as tens, by the new figure. (b) The square of the new figure.

THE METRIC SYSTEM

20. The Units. As the metric system is in use in all countries of the world excepting Great Britain and the United States, it seems that as a matter of information pupils ought to understand what it is before they leave the public school; beyond this, time should seldom be spent upon it. If it is taught at all, it should so be taught as to be of some practical value. To accomplish this, the system should be introduced without any reference whatever to the ones now in use in this country. The teacher should be familiar with the metric system, and the pages devoted to it are especially for her benefit.

The first step is to give the historical introduction, to show how the fundamental unit, the meter, was derived, and to fix the idea of its actual length. This can be done only by a meter stick or tape. Pupils will notice that it is not far different from a yard in length, but at first no definite comparison need be made.

It is possible that a decimeter measure is given in your arithmetic, but if you have nothing of the kind, you can make a meter stick by taking a strip of wood $39\frac{3}{8}$ inches long. Divide it into ten equal parts. These parts are decimeters. Divide one decimeter into ten equal parts. These parts are centimeters. Divide one centimeter into ten equal parts These parts are millimeters.

The second step is to show how the units of capacity (liter) and weight (gram) are derived from the unit of length and to fix the idea of those units by actual measures of capacity and weight. Here, again, the pupils will note that the liter is about the same as a quart, but that fact is now merely incidental.

One of the pupils can make for you a cubical box of wood one decimeter on a side (interior measure). This can be used for measuring sand and grain, to give the idea of the liter.

The pupils may be asked to draw diagrams to illustrate a box one decimeter on each side.

As a third step, show how the units of square measure and cubic measure are derived from the unit of length.

21. The Tables. After the pupils have gained a thorough comprehension of the different units, the tables for all may be given as one by stating the fact that each unit is divided into tenths, hundredths and thousandths, and that each unit is multiplied by ten, hundred, thousand and ten thousand.

Again, these units are all named by attaching a prefix to the name of the unit. The prefixes showing fractional parts of the units are derived from the Latin, and those showing multiples of the unit are derived from the Greek. These facts may be fixed in the mind if presented in the following form:

The Units: Meter, square meter, cubic meter, liter, gram.

One-tenth of the Unit: Deci- $\begin{cases}\text{meter}\\\text{liter}\\\text{gram}\end{cases}$

One-hundredth of the Unit: Centi- $\begin{cases}\text{meter}\\\text{liter}\\\text{gram}\end{cases}$

One-thousandth of the Unit: Milli- $\begin{cases}\text{meter}\\\text{liter}\\\text{gram}\end{cases}$

To construct the table of multiples of the unit, use the Greek prefixes, deka- (ten), hecto- (one hundred), kilo- (one thousand), myria- (ten thousand).

When these facts are thoroughly understood, pupils may be told that not all these denominations are in practical use and they may be called upon finally to learn only those denominations which are common.

Linear Measure:

- Meter
- Millimeter (.001 of a meter)
- Centimeter (.01 of a meter)
- Kilometer (1000 meters)

Square Measure:

- Square meter
- Are (square dekameter; 100 square meters)
- Hectare (square hectometer; 10,000 square meters)

Cubic Measure:

- Cubic meter (called stere, in measuring wood)

Measure of Weight:
Gram
Kilogram (1000 grams)
Metric Ton (1,000,000 grams)
Measure of Capacity:
Liter

22. Comparisons and Equivalents. After the pupils have mastered all that is intimated in the two sections preceding they may be taught to compare the metric system with our system, and in doing so they may learn the following equivalents:

The meter equals 39.37 inches (a little more than a yard).
Kilometer: 3280.8 feet (nearly $\frac{5}{8}$ of a mile).
Hectare: $2\frac{1}{2}$ acres.
Liter: 1.06 liquid quarts.
Gram: 15.4 grains.
Kilogram: $2\frac{1}{5}$ pounds avoirdupois.

It will be convenient in solving examples to have for reference a table of equivalents such as the following:

1 inch	=	2.54	centimeters.
1 foot	=	30.48	centimeters.
1 mile	=	1.06	kilometers.
1 acre	=	.4	hectare.
1 gallon	=	3.785	liters.
1 bushel	=	3524.	hectometers.

The pupils should be taught to make these tables of equivalents themselves from the standard units, meter, liter and gram. In fact, it is necessary only to remember these three in order to transfer any measurement from one system to another.

The teacher should give a great variety of practical examples in the metric system. Each pupil can make for himself a decimeter measure, can divide it into centimeters and millimeters and then can find the dimensions of books, seats, windows and other surfaces and compute areas and solid contents of various spaces and objects and carry out in the metric system all the operations of mensuration which we commonly give in our own tables. As was said at the beginning, there is no use in teaching this subject unless enough practice is given in it to make it a permanent possession of the pupils.

MENSURATION

23. Concrete Work. We have many times spoken of the imperative necessity of making work in arithmetic concrete. Occasionally teachers are found who think that the mere giving of names to figures makes the expression concrete. In reality, 2 *bu.* is no more concrete as an expression than is 2, unless the abbreviation *bu.* really indicates a measure of which the reader has a distinct mental conception. From the beginning of the primary department mensuration should be concrete, in the vital sense of that term, and this can be true only when the pupils have a clear conception of facts and put into practice the principles and rules which they learn.

Work in mensuration is not difficult and rarely occasions any great amount of trouble to pupils, but it does frequently run so into abstractions that it has no vital importance to the mind of the pupil. A boy or girl learns to reduce from one denomination to another, to add, subtract, multiply and divide compound numbers of various kinds, yet throughout all the processes he may have no conception of size, quantity or real measurement. The work he does under such circumstances is merely practice which gives him facility in the handling of abstract numbers. When this is true, one of the best departments of the arithmetic has lost the greater part of its value.

24. Compound Numbers. From the beginning, the work in compound numbers must be thoroughly concrete. Every pupil must have, at the outset, a foot rule divided into inches and fractions of inches. With this rule he must be taught to measure lengths for which the foot is the customary unit. Teach him that before he measures, he should estimate the length. Ask him to draw, without measuring, lines of 1 foot, 2 feet, etc., in length, and then measure them. It is only by such constant thinking of length that *foot* really comes to have a distinctive meaning.

What is said of the foot holds with equal propriety in respect to the inch, the yard and the rod. The schoolhouse, the schoolgrounds, distances across streets, distances between trees, etc., may be measured. A rod should be laid off on the sidewalk or in the room and paced by the children until they can get the distance with reasonable accuracy in other places without measuring. Quarter-mile, half-mile and mile distances should be laid off near the schoolhouse, and pupils should pace these distances until they acquire a sense of relative lengths. Interest can be created by making these measurements take the form of contests. To illustrate, the class may be told each to start from a given point, to walk five rods and mark the place where he stops; then the class may join in measuring five rods and in determining whose estimate is nearest to the distance.

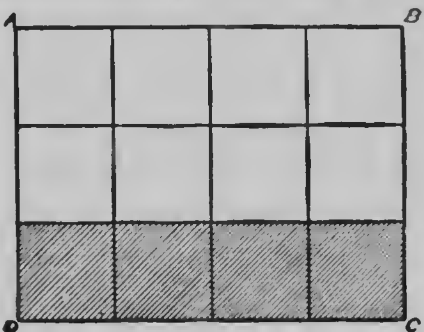
In measuring capacity one set of measures will be sufficient for the school, but at least one set should be there. Certainly the units pint, quart, peck and gallon must be seen, and many measurements of sand, corn, water or other material must be made. In these measures, as in linear measures, the teacher and pupils together must devise an infinity of practical problems involving the measurement of the capacity of utensils at home or those about the schoolhouse.

If possible, scales should be obtained and weighing done in avoirdupois. If it is not possible to bring scales to school, doubtless somewhere in the vicinity a set can be found which pupils may use or at least see in operation.

25. Plane Surfaces. In teaching the measurement of plane surfaces, it is a very simple matter to make the work concrete if pupils are taught to draw the figures on paper or on the blackboard, to measure the dimensions, and to compute the areas from their own measurements.

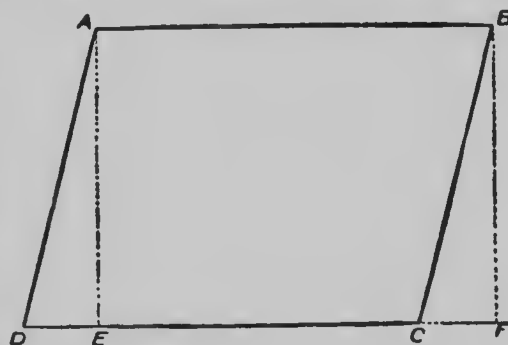
The measurement of plane surfaces is based on the measurement of the rectangle, and the principles for finding the area of different figures simply reduce these figures to equivalent rectangles.

The unit of measure in finding area is a surface unit, and is called a square unit, as a square inch, square foot, square yard, etc. The area is a certain number of times this square unit. *A square unit is not the product of linear units.* 1 foot multiplied by 2 feet does not equal 2 square feet.



(*a*) RECTANGLE. The first step in finding area is to demonstrate that the area of a rectangle is equal to the product of the number of square units in one dimension by the other dimension.

A rectangle 4 inches long and 1 inch wide will contain 4 sq. in.; if 3 inches wide, it will contain 4 sq. in. ×3 or 12 sq. in.



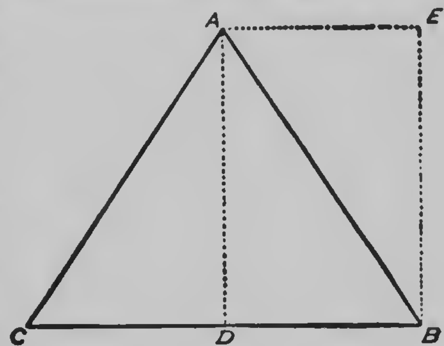
(b) RHOMBUS. A rhombus or rhomboid can be changed to an equivalent rectangle, and its area can be found in the same manner.

Find the area of the quadrilateral ABCD, whose length is 4 inches and whose vertical width is 3 inches.

Construct the vertical line AE. Cut the triangle ADE along the line AE and apply it to the opposite end of the figure so that AD shall coincide with BC. You now have the rectangle ABFE, whose area is equal to that of the first figure ABCD.

(c) Triangle. A triangle is also readily converted into an equivalent rectangle. (3)

Construct the line AD perpendicular to CB at its middle point; cut the triangle ACD along the line AD and apply it to the triangle ABD so that AC will coincide with AB. You now have the rectangle AEBD whose area is equivalent to that of the triangle ABC.



Notice that the length of the rectangle is equal to the altitude; and its breadth is equal to one-half the base of the triangle, and you derive this principle:

The area of a triangle is equal to one-half the area of a rectangle having the same base and altitude.

(d) Trapezoid. The trapezoid is a combination of a rectangle and one or two triangles, according to its form.

Find the area of the trapezoid ABCD whose parallel sides are respectively 3 and 5 inches and whose width is 3 inches.

The trapezoid is composed of the rectangle ABED and the triangle BEC. The rectangle measures 3 inches on a side and has an area of 9 sq. in. The triangle has an altitude of 3 inches and a base of 2 inches; its area is equal to the product of its altitude by one-half its base—3 sq. in.; 9 sq. in. + 3 sq. in. = 12 sq. in., area of ABCD. Construct FG perpendicular to EC at its middle point, making it equal to BE. Prolong AB to F. Cut the triangle HCG along the line GH, and apply it to HBF so that BH and HC will coincide; the point G will fall on F, and the triangle HCG is equal to the triangle HBF. Therefore, the rectangle AFGD is equal to the

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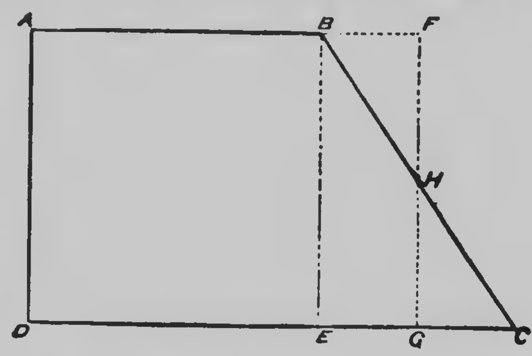
trapezoid ABCD. The length of the rectangle AFGD $= \frac{5+3}{2}$, or 4 inches. Therefore, to find the area of a trapezoid,



multiply half the sum of the parallel sides by the altitude, and express the product in square units.

(e) Circle. The rules concerning the circle are sometimes difficult of comprehension, but never if they are introduced objectively. Concerning circles, there are two important facts that the pupil must know. The first of these is the ratio which the circumference bears to the diameter. This the pupils should be taught to find for themselves by actually measuring the diameter and the circumference of perhaps a dozen different circular objects and finding the ratio of the diameters to the circumferences. If the pupils are accurate in their measurements, they will find that the average of their dozen ratios shows that the circumference is about $3\frac{1}{7}$ times the diameter. In all ordinary computations $3\frac{1}{7}$ should be used as the value of π.

In getting the diameter, teach the pupils to measure several times in several directions, being careful always that the rule crosses the center. The diameter is, of course, the largest cross-measurement that can be made.

The circumference may be taken with a tape measure or in this manner: Make a small dot on the circumference of the circle to be measured and a similar dot on a flat surface. Place the circle on the flat surface so that the dot in the circumference corresponds to that on the surface. Then roll the circle once over and mark the spot where the dot in the circumference touches the plane surface; then measure the distance between the two dots for the length of the circumference.

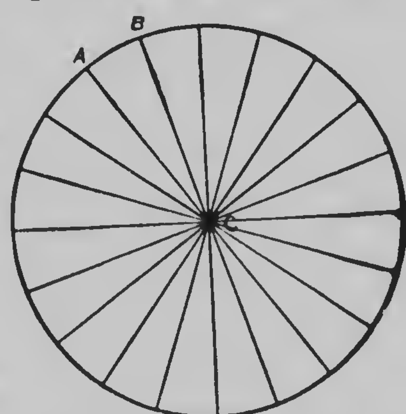
Teach the pupils to tabulate their work in this form:

Object	Diameter	Circumference	Ratio
Lead Pencil .	$\frac{9}{32}$ in.	$\frac{7}{8}$ in.	3.111
Bottle	$3\frac{7}{16}$ in.	$10\frac{15}{16}$ in.	3.181
Glass	$2\frac{19}{32}$ in.	$8\frac{3}{16}$ in.	3.156
Lid of Inkwell...	$1\frac{7}{8}$ in.	$5\frac{7}{8}$ in.	3.133

Average, 3.145

The younger pupils will succeed best with larger circles than those given in the table, such as those found in stovepipe, pails, the various sizes of plates and other utensils about the home.

Develop the rule for finding the area of a circle from the rule for finding the area of a rectangle, in the following manner:



Cut a circle from a piece of thick paper or cardboard. Draw diameters enough to separate the circle into as many triangles as can conveniently be handled. Call attention to the fact that the base of these triangles is not a straight line, but that if enough triangles are made it will be very nearly a straight line; then cut the circle into triangles along the diameters you have drawn and arrange these triangles so as to produce a parallelogram like the one shown in the accompanying figure. From one end of the parallelogram cut off the right triangle AEC and transfer it to the other parallelogram, where it will occupy the position DEC. This makes of the

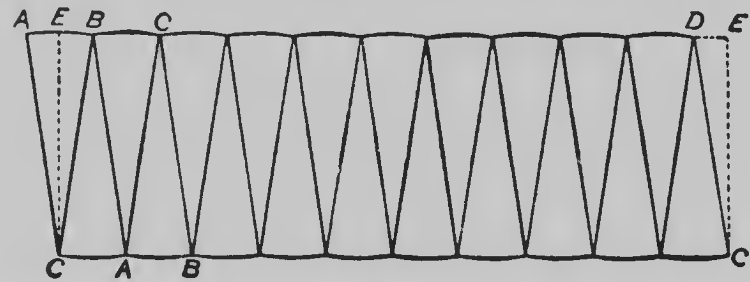


figure a rectangle EECC, whose length is one-half the circumference and whose altitude is the radius of the circle; therefore, to find the area of a circle, ***multiply one-half the circumference by the radius.***

26. Business Applications. When the pupils understand thoroughly the measurement of plane surfaces and the simple geometrical figures usually given in the arithmetic, this knowledge should be made applicable to the affairs of everyday life by problems in measuring land, in papering walls and ceilings, in plastering and painting, in the purchasing and laying of carpet, etc.

In teaching the measuring of land, pupils should know the unit *acre* and have some conception of its size, but they should also be taught the system of government land surveys, to the extent that they will understand the meaning of township, the arrangement of sections in a township, and the way in which sections are divided. In rural schools it will probably be an easy matter to find some of the posts from which lines have been run or at least to show examples of a quarter-section, a forty and eighty, or some of the other units in which farm lands are held.

The problems in papering, plastering, etc., should be applied to the schoolhouse or the homes of the pupils, who make the actual measurements themselves. It is not safe always to rely upon the methods given in your text-book for computing the expense of these various pieces of work, for local customs vary greatly. The problems in the book may be solved after the method prescribed there, but in the more numerous practical examples made by the pupils the methods of the locality should be followed. The pupils will be glad to consult the painters or plasterers and find out how they estimate the surfaces which they finish or decorate.

Ordinary carpet is a yard wide, but Brussels carpeting is usually three-quarters of a yard wide; other more expensive grades are still narrower. Attention should be called to the fact that carpeting is never cut lengthwise by the seller, and, accordingly, there will probably be some waste, owing to the dimensions of the room—a waste which may be increased considerably if figures must be matched. The arithmetics, however, usually give these facts so that pupils are not liable to forget them.

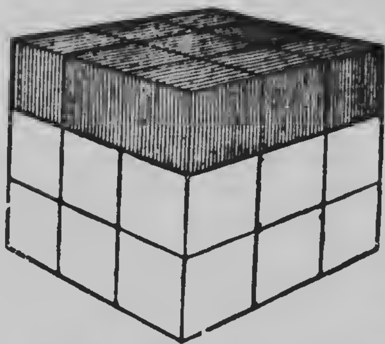
27. Solids. It seems scarcely necessary to discuss further the subject of mensuration. So far as possible, the rules should be developed objectively, in manner similar to that indicated for finding the area of surfaces, though differing, of course, for solids, because of the introduction of the third dimension. Some of the rules are difficult of explanation; it may be wise to give them as facts and leave their demonstration till the pupil is older and is studying geometry.

In the development of this division of mensuration, we should always keep in mind the following principle: *The cubic unit is not the product of square units by a linear unit.* Three square feet multiplied by two feet are not equal to six cubic feet.

THE CUBE. The measurement of solids is based upon the measurement of the cube, and the unit of measure is a cubic or solid unit, as the cubic inch, cubic foot and cubic yard.

The cube is taken as the type of rectangular solids. You should become so familiar with the cube that you can readily determine its number of faces, edges, solid angles and diagonals, without having the solid before you.

Construct a cube measuring 3 inches on a side. Count the cubic inches in the first layer. There are 3 layers in the cube; the first layer contains 3 rows of 3 cubic inches each, and the entire cube 27 cubic inches. From this we see the correctness of the following principle for finding the volume of a solid: *Multiply the area of the base by the thickness (height or depth), and express the product in solid units.*



28. Business Applications. The measuring of wood, lumber, stone and brick work are familiar types of the practical business applications of the rules which a pupil learns more abstractly in the measurement of solids. The only comment to be made on these applications is that they should be carried out with the coöperation of the pupils in very many practical examples involving the actual measurement of real things at home or at school, and that computations should be made in accordance with the local custom in all these home-made examples.

Teachers will find, too, that the value of different units of measure varies in different localities. For instance, the number of pounds in a bushel or the number of gallons in a barrel may be quite different in two adjoining states. Of course, pupils should learn and use the estimates which are legal in the place where they live.

29. Facts for Reference. The following facts not found in all arithmetics may be of considerable value to teachers in rural schools.

1 bu. struck measure contains 2150.42 cu. in.
1 bu. heaped measure contains 2747.71 cu. in.
1 gal. dry measure contains 268.8 cu. in.

1 gal. liquid measure contains 231 cu. in.
7 cu. ft. of ears make 3 bu. shelled corn.
75 lb. of new corn in the ear make 1 bu.
343 cu. ft. fine hay in stack make 1 ton.
450 cu. ft. of coarse hay in stack make 1 ton.
1 ton of hard stove coal is about 35 cu. ft.
1 cu. ft. of water weighs 1000 oz., or $62\frac{1}{2}$ lb.
1 cu. ft. of liquid contains about $7\frac{1}{2}$ gal.
A barrel containing $31\frac{1}{2}$ gal. contains about $4\frac{1}{5}$ cu. ft.

Oats, wheat, shelled corn and small grains are sold by struck measure.

Fruits, vegetables, etc., are sold by heaped measure.

A spherical vessel holds two-thirds as much as a cylinder of the same diameter and depth.

A conical vessel holds one-third as much as a cylinder of the same diameter and depth.

A vessel flaring like a coffee cup holds about one-half as much as a cylinder of the same diameter and depth.

To find the contents of a bin or a wagon box in bushels, multiply its cubic contents in feet by .8 for struck measure and by .63 for heaped measure. If the box or bin flares at the sides, take half the sum of the top and bottom measures for the average dimension.

30. Books for Teachers. Much has been written on the teaching of arithmetic, and a great deal on special devices for teaching number in primary schools. There are no works devoted exclusively to intermediate and higher grades. Two books, however, are of general interest:

The Teaching of Elementary Mathematics. David Eugene Smith. 300 pages. The Macmillan Company. This interesting book treats of the historical reasons for teaching arithmetic, algebra and geometry and contains something of methods in each. It is adapted rather to teachers in high schools than to those of intermediate and higher grades.

Special Method in Arithmetic. Charles A. McMurry. 225 pages. The Macmillan Company. A book for teachers, one of whose principal ideas is to relate the arithmetic closely to other studies. The book will help to clarify ideas in teaching and will suggest some helpful devices.

It is always a good thing for a teacher in intermediate and public schools to have several text-books besides the one which is in use in the school. Especially is this the case if the adopted text-book is old and in any way out of date. Among the newer works, any one of which would be helpful, are the following:

Public School Arithmetic. McLellan and Ames. A three-book series, based on McLellan and Dewey's *Psychology of Number*. Macmillan Company.

Southworth-Stone Arithmetic. In two parts; Part Two for higher grades. Benjamin H. Sanborn & Company.

Arithmetic, Book Two, by Young and Jackson. D. Appleton & Company. An original work, full of original illustrations and problems. The controlling method is inductive, and a strong effort has been made to give really concrete work.

Advanced Arithmetic. David Eugene Smith. Ginn and Company. A practical arithmetic with plenty of oral work introducing every topic.

Bailey-Wiemer Series. Second and third books; the third book introduces some elementary algebra. American Book Company.

ALGEBRA

31. Place in School. In many schools it is now customary to begin the study of algebra in the higher public schools, and some of the recent arithmetics introduce algebraic principles. There seems good reason for this practice; as the pupils are quite competent to understand the elements of the science, interest in school is increased by the new study and pupils get good training in certain forms of reasoning.

The algebra of the public school is naturally simpler, more concrete and practical than that of the high school, and the topics should be presented in a different order. The neatness and simplicity of algebraic methods of solving problems by the use of the equation commend themselves to the pupils and indicate the simple and interesting way by which the subject may be introduced as early as the eighth or ninth year, at least. "Algebra and arithmetic should run side by side during the eighth and ninth years."[1]

32. Text-Books. There are a number of text-books in algebra for public schools, each having some decided

[1] D. E. Smith: *The Teaching of Elementary Mathematics*.

merits of its own. Authors differ in method of treatment and in the quantity and character of the matter presented. This is the more true from the fact that it is impossible to master the subject at the age and in the time given. The teacher will be compelled to follow the text-book in use and is not liable to go far wrong if she does. It is sometimes the case in rural schools that pupils of public school age wish to take up the subject of algebra and are provided with only high school texts. If these are used, a vast amount of labor is thrown upon the teacher, as few pupils can proceed intelligently without constant assistance.

33. Definitions. There is little necessity for learning many definitions in elementary algebra; in fact, none should be given until the pupil has a clear understanding of the thing defined. If the teacher is careful in her choice of words and uses new terms sparingly and always with sufficient explanation, the pupils will gradually pick up an algebraic vocabulary large enough to enable them to carry on the fundamental processes understandingly, though they may be unable strictly to define any of the terms. A definition in mathematics must be exact, and original definitions are rarely that; not infrequently definitions that are incorrcet appear in algebras.

34. Literal Quantities. It is sufficient in the beginning to show that x is a convenient symbol for any quantity—convenient in that it is easily and quickly made and can be seen at a glance. Mathematicians have agreed to use x, y and z to represent quantities whose value we do not know and a, b and c to represent quantities about whose value there is to be no question in the problem whose solution we are considering. To the beginner there is no distinction between *quantity* and *number*, and none need be made at first. The way to introduce the use of letters is through problems. The following shows what may be done:

What is the product of 24 by 9?

The product we do not know and we may represent it by x. Then,

$$x = 24 \times 9.$$
$$x = 216.$$

By many familiar arithmetical problems increasing in difficulty the pupils become familiar with the use of letters to represent quantities and at the same time with the form of the equation.

35. Problems. Almost from the beginning pupils can solve problems by using the simple equation, and that with very little explanation, if the teacher is careful in her selection. Early in the work pupils should be taught to attack the problems systematically. There are three questions to be asked of every problem in algebra, as in arithmetic (see page 6, Section 9). They are in effect the same questions, but they differ in phraseology. In algebra they are:

1. *What is the unknown quantity?* This is in one-step problems the answer, the number to be found, the number to be represented by x.

2. *What two expressions may be found for the same number or facts?* These expressions are the unknown quantity and some known terms that represent its value. They are the members of the equation.

3. *What is the algebraic form of this expression of the equality?* When the answer to this question is written we have the equation to be solved.

As an illustration of the use of the questions, consider the following problem:

I bought a number of apples for two cents each, and the same number of oranges for three cents each, paying 55 cents for the whole; how many did I buy?

Query 1. The unknown quantity is the number of apples, which is also the number of oranges. Therefore, x = the number of apples and also the number of oranges.

Query 2. The cost of the apples and oranges is 55 cents; it is also represented by the cost of the apples plus the cost of the oranges. The apples cost $2x$ cents and the oranges cost $3x$ cents; both cost $2x+3x$ cents.

Query 3. $2x+3x=55$.

Solution:

$$2x+3x=55$$
$$5x=55$$
$$x=11$$

Proof:

$$2(11)+3(11)=55$$
$$22+33=55$$
$$55=55$$

If pupils are taught to attack the simple problems in this way, even at the expense of some time and some apparent formalism, they will acquire a habit invaluable in the more difficult work.

36. Proof. Pupils will become self-reliant if they are taught to prove their work in every case. The real proof in the solution of an equation is to insert the values of the unknown quantities in the original equation, as is illustrated in the preceding section. It is well, sometimes, to require pupils to make the substitution in the example itself.

37. Negative Numbers. The most troublesome thing in the early stages of algebra is to give a clear comprehension of a negative number. It is well to defer the introduction of this puzzling matter until the pupil has learned to solve simple problems with positive numbers and has at least added and subtracted positive numbers. Then the necessity for negative quantities in algebraic expressions may be shown and their relative value and meaning made clear by familiar, concrete illustrations. The thermometer scale and dates before and after Christ are types of the illustrations to be used.

It will be helpful then to distinguish clearly between the two uses for the signs + and −. The expression $a+b-c$ may be read *a plus b minus c*, to show that the signs there are signs of operation. a, b and $-c$ may be read "Positive a, positive b and negative c," to show that the signs + and − indicate the nature of the quantities. In reality, every quantity has a sign of its own, but when the quantity is positive we do not write its sign unless it becomes necessary to distinguish it. When the signs mean to add or subtract, teach the pupils to read them *plus* and *minus*; when they determine the nature of the quantity, to read them *positive* and *negative*.

38. Signs of Aggregation. Pupils are liable to have trouble with the signs of aggregation, but this is largely the fault of the text-books, for in the solution of practical problems it is not often the case that difficult conditions arise. It is enough to teach the significance of signs of aggregation, and to show how to dispose of them in simple combinations.

Occasionally such expressions as, $x-[2x+(x-2y)+2y]-3x-\{4x-[x+(\overline{2y-x}-y)-y]\}$ are met. While at first glance these appear difficult, they are easily conquered if the pupils are taught to remove but one sign of aggregation at a time, re-writing the whole expression each time. With practice of this nature, pupils soon learn to remove the signs of aggregation from very complex quantities.

39. Factoring. Important as factoring is in arithmetic, it is of much greater importance in algebra, and pupils should not only be taught all the basal principles of factoring but should be kept practicing the art till they see at once the marks of a composite quantity and know how to factor it. Then it must be instilled into the minds of all that there may be an opportunity for factoring in almost any problem, and that he who sees the opportunity and profits by it will save himself almost endless complications and work. Factoring leads in algebra to a kind of cancellation that is sometimes almost a necessity and always a help.

The text-books give the principles relating to the divisibility of algebraic quantities and the rules for factoring in special cases. The rules, too, are explained with sufficient clearness, and the teacher will be able to devote the greater part of her energies to seeing that the ideas are put into practice. At frequent intervals, until long after the subject is passed in its natural position, the class should return to the subject in review.

WORK BY GRADES

40. Explanatory. It is a particularly difficult task to lay out the work in arithmetic by grades so that it will be of service in all localities; yet a well-balanced scheme may be helpful almost anywhere from the fact that the several topics in arithmetic are presented in practically the same order, whether number work begins with the first year or is deferred until later.

One qualification, however, should be made: The tendency now is to introduce into the lower grades the elements of many subjects which previously had been deferred until the upper grades; yet in the end in all schools there must come a time when special stress is laid upon each separate subject, and that period is the one to which the work is assigned in the suggestive course which follows. To make this idea more clear, mensuration, as practically applied to surfaces, is given as a topic for the fifth year, but countless problems in various forms of mensuration will have been solved before that year is reached.

As was stated at the beginning of these methods in arithmetic, it is assumed that in the first three years the pupils will have been given an acquaintance with all the fundamental operations, with small compound numbers and with the idea of common fractions.

41. Fourth Year. The work of the fourth year begins with a review of what has been done before, and if the pupils are found decidedly lacking in any of the things mentioned above, time enough must be taken in the review to perfect them in their knowledge. Thereafter the burden of the work will be included under the following topics:

Reading numbers into billions.

The fundamental operations with whole numbers, including long division. (Pages 12-14, Sections 14-16.)

Factoring by inspection, and prime numbers under 100. (Page 15, Sections 17-19.)

Cancellation. (Pages 16-17, Section 20.)

Making change. (Pages 19-20, Sections 25-26.)

Common measuring units.

Oral work in fractions of small denominators. Reduction to lowest terms. Fractional parts of a dollar.

42. Fifth Year. We may summarize the work in the fifth year, as follows:

Review, especially long division.

Review and complete the tables in compound numbers; reduction, both ascending and descending, and the fundamental operations with compound numbers.

Factoring continued.

Greatest common divisor. (Pages 17-18, Sections 21-22.)

Least common multiple. (Pages 18-19, Sections 23-24.)

Addition, subtraction and multiplication of fractions, principally oral and always with small denominators. (Pages 20-22, Sections 27-28.)

Reading and writing of decimals; also the fundamental operations as applied to decimals. (Pages 24-29, Sections 31-35.)

Simple exercises in percentage. (Pages 33 and 37, Sections 37 and 42.)

Mensuration of plane surfaces, including problems in plastering, papering, etc. (Pages 60, 66, 68, Sections 23, 26 and 29.)

Much oral work and many simple examples in all subjects, to give facility in operations.

The simple business forms, especially bills and accounts.

43. Sixth Year. By the time the pupils have reached the sixth year they are ready for a great variety of practical problems whose range is only briefly indicated in the following outline:

Common fractions and decimal fractions reviewed and perfected.

"The Three Problems" in common fractions and in decimal fractions. (Pages 23-24 and 31-33, Sections 30 and 36.)

Compound numbers.

Longitude and time. (Pages 50-51, Sections 13-15.)

Analysis.

Measurements: rectangles, triangles, circles. (Pages 61-66, Section 25.) Solids. (Pages 67-68, Sections 27-28.)

The introduction of percentage and its simple applications. (Pages 33-37, Sections 37-42.)

44. Seventh Year. Pupils of the seventh year should be able to do strong work in arithmetic. They should be masters of the fundamental operations, should be able to add, subtract, multiply and divide with common and decimal fractions, accurately and rapidly. If they are not proficient in these respects there must be many review lessons to correct all forms of weakness. The special work of the grade is as follows:

Full study of percentage and its applications (Pages 40-45 and 46-47, Sections 1-8, and Section 10, in part), including:

Commission.
Brokerage.
Profit and loss.
Interest.
Banking.
Insurance.
Storekeeping.
Mensuration, continued.

45. Eighth Year. If by chance the eighth-year pupils are not proficient in all forms of computation, they must be given practice and drill to bring accuracy and speed. Inaccuracy will be harder to correct here than in the lower grades, but in compensation for that the pupils will be found old enough to follow reasoning with less difficulty and thus may be expected to have more time for practice. The principal topics to be considered in this year are as follows:

Trade discount. (Pages 42-43, Section 5.)
Commercial paper, including bills, notes, checks, drafts, etc.
Commission.
Simple interest.
Partial payments. (Pages 45-46, Section 9.)
Exchange. (Page 48, Section 11.)
Bank discount. (Pages 46-47, Section 10.)
Stocks and bonds. (Pages 48-50, Section 12.)
Mensuration of pyramids, cones, spheres, etc.
Algebraic equations and the simple facts of literal quantities. (Pages 70-73, Sections 31-36.)
Metric system. (Pages 56-60, Sections 20-22.)

46. Ninth Year. The work of this year might well begin with a general review of the entire field of arithmetic for the purpose of giving greater facility and accuracy in computation. Besides this, wider applications may be made of the principles of business arithmetic, and a study made of business forms and accounts. Several special topics have been reserved for consideration in this year:

Ratio.

Proportion.

Powers and roots. (Pages 51-56, Sections 16-19.)

Elementary algebra, without quadratics. (Pages 70-74, Sections 31-39.)

Possibly some phases of inventional geometry during the latter part of the year.

TEST QUESTIONS

1. Tell exactly how you could make the following problem seem real to a pupil:

The length of a tank is 100% greater than its width, and its width is 200% of its depth. If the width is 2 yards, how many gallons does it contain?

2. Determine the ratio of the diameter to the circumference of a circle by taking the average ratio in the following objects, viz.: lead pencil, cent, ten-cent piece, quarter of a dollar and half a dollar. Tabulate your work or tell how you measured and computed it.

3. Using assumed names, write a promissory note for \$500, in proper form, dated January 1, 1905, and bearing interest at 6 per cent. \$100 was paid June 16, 1906; \$10 January 26, 1907, and \$100 June 26, 1907. What was due December 10, 1907?

4. Discuss the relative security in sending money by registered letter, postoffice money-order, and bank draft.

5. How will you show a pupil (a) that a difference of 15 degrees of longitude make a difference of one hour in time, and (b) that places east have later time?

6. Extract the square root of 104,329.

7. What advantages are there in the metric system? Why has it not been more generally adopted in the United States and Canada?

8. What differences can you see in the methods of arithmetical instruction suited to the fourth and to the eighth grades?

CHAPTER THREE

GEOGRAPHY

1. Scope of the Subject. The many and widely varying definitions of geography are proof that there is a marked difference of opinion among leading authorities as to what this branch of study should include. Doubtless some of the definitions are too comprehensive, and include in geography facts and principles that more properly belong to geology and astronomy. On the other hand, such a definition as "Geography is a description of the earth's surface" is too meager, since it omits one of the very important factors in determining the science, namely, man. The human phase of geography is that which lends the greatest interest to the subject; therefore, it must not be overlooked. Hence, the truest conception of geography, for school purposes, at least, is a description of the earth's surface as the home of man. This idea should form the central thought in every subject considered, and the relation of the subject to man should be shown.

From its nature geography is closely related to many subjects, but we should always consider that it has a definite feature as a science by itself, and the branches of science to which it is so closely allied, such as botany, zoölogy and meteorology, should not be included in geography. The exclusion of such subjects will enable both teacher and pupil to get a clearer conception of what geography is and also simplify the work in that subject.

2. Departments of Geography. Geography is usually considered under three departments—mathematical geography, physical geography and political geography. Mathematical geography treats of the form and size of the earth, measurements upon its surface, its motions, and, in its broadest consideration, the relation of the earth to the sun and other bodies of the solar system. Physical geography includes those phenomena upon which life upon the earth depends, and which, taken as a whole, constitute environment. The term *physiography* is often applied to this department of the subject. Political geography treats of man and his work. Each of these departments merits further consideration.

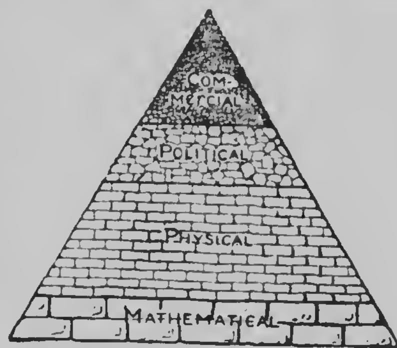
3. Relation of the Departments of Geography. The relation of these three departments of geography should be clearly understood by the teacher, since such knowledge enters into all plans for teaching the subject.

(a) Mathematical Geography. In the elementary course of study only such portions of mathematical geography should be considered as are necessary to give the pupils an understanding of the other departments. The form and size of the earth, its motions, latitude and longitude (pages 50–51 of this volume, Sections 13–15), include the subjects that should be considered in the elementary course. Beyond the elementary facts of each of these topics it is not safe to go, because further discussion involves conceptions and generalizations which are altogether too abstract and too difficult for pupils of public school age.

(b) Physical Geography. Physical geography is really the foundation of the subject for school purposes, and the teacher should have a thorough knowledge of this department of the science. That knowledge should include the great facts of physical geography, such as the facts of relief; the relative positions of the great land masses and oceans; the underlying principles and laws of climate; the effect of climate upon life; the distribution of life, both vegetable and animal, and the effect of all these on man and his work.

The teacher should have a few illustrations of these facts well thought out, and be able to apply them as needed. The following are good examples: comparison of the temperature at the foot of a mountain and on its summit, on a summer day; comparison of the climate of the British Isles with that of Labrador, and the comparison of winter in Manitoba and in British Columbia. Comparison of animal and vegetable life should also be made in a similar manner.

While these great facts and their relations to each other and the laws upon which they depend must be understood by the teacher, the systematic study of physical geography should not be attempted below the high school. The truths which the pupils in the elementary school need to know should be taught as facts as occasion requires. The causes for the phenomena discussed can well be deferred until a later period.



DEPARTMENTS OF GEOGRAPHY

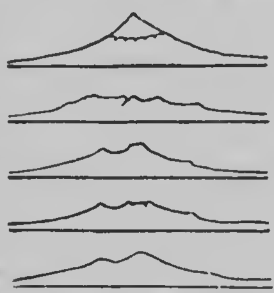
(c) Political Geography. Political geography treats of man and his work. This has the greatest interest for pupils, and properly occupies the chief attention in the geography work of the elementary grades. The relation of political to physical geography, and its dependence upon that department of the science, are brought out and emphasized in the method of treatment of the subject. We cannot study the geography of any race or nation without studying its environment and seeing how that environment has affected its social, political and industrial life. Therefore, the desired end is reached in the most satisfactory manner by using political geography as the center of instruction, and relating to that such facts in physical and mathematical geography as may be necessary.

(d) Economic Geography. The world's industries have assumed such vast proportions, and are, through modern means, so closely linked together, that they constitute a department of geography a knowledge of which is of the utmost importance. Economic geography includes a study of the industries and commerce of the world and their economic relations to mankind. It is also known as commercial and Industrial geography.

4. Purposes. The chief purposes in teaching geography are (1) to give the pupils a knowledge of the facts of geography found in their immediate vicinity, such as the animal and vegetable life, and the occupations with which they meet every day; (2) to lead the pupils to understand the underlying principles and laws of geography, such as the laws governing temperature, rainfall and the distribution of life; (3) to lead the pupils to apply these laws and principles in determining geographical conditions of places with which they are not familiar by experience; (4) to lead pupils to see how geographical conditions control the customs, habits and occupations of men; (5) to enable the pupils to see how and to what extent man has affected geographical conditions, as by the construction of canals, by irrigation, and by denuding large areas of forests; (6) to create an intelligent interest in the great world and its activities.

5. Preparation of the Teacher. 'Teachers cannot teach that which they do not know. If teachers know little else but mental pictures of maps and an isolated mass of conglomerated facts, they cannot teach geography." Many superintendents and principals from their experience realize the truth of this statement. Doubtless more teachers fail to secure the desired results in their geography work from lack of sufficient preparation than from any other cause. The broad field covered by geography and its relation to numerous other branches makes a thorough preparation on the part of the teacher an essential to success. This preparation should be along the following lines:

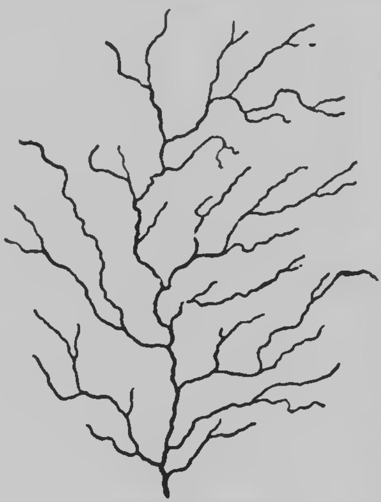
(a) Geography. As already stated, it is not enough for the teacher to know simply the facts of geography, such as the names and locations of places and capitals and the boundaries of provinces and countries. She must understand the principles and laws of the science and their application, for instance, such as the relation of altitude to temperature, the relation of winds and altitude to rainfall, the principles governing the distribution of life, both vegetable and animal, and the relation of all these conditions to man and his work. The teacher must have a general idea of how the progress of the race has been determined by geographic conditions, and she should understand how such conditions affect the industries of her immediate locality and of the country at large, so that she can explain why the people in Manitoba raise wheat, those in Alberta raise live stock, and those in northern Ontario engage in mining and the manufacture of pulp and nickel. She should also be able to give the geographical reasons for the location and size of the chief cities of the world, such as London, New York, Paris, Calcutta and Hamburg, and to show why the great lines of transportation have been located where they are. Above all, she should be able to give the reasons for the customs, manner of life and forms of government in the leading nations of the world.



OUTLINES OF MOUNTAINS

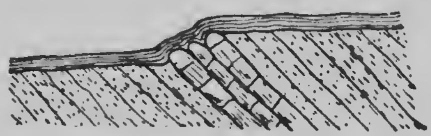
(b) Elements of Natural Science. The intimate relation which geography sustains to physics, botany, zoölogy, geology, meteorology and chemistry makes it imperative that the teacher have a knowledge of at least the elements of these sciences, for without this knowledge she cannot make the application of the fundamental principles and laws of geography, nor will she be able to work out or understand these principles. A good text-book in each of these subjects should form a part of every teacher's library.

(c) Descriptive Power. Much of the pupil's knowledge of geography must be obtained through descriptions, and the teacher should be able to give vivid and accurate descriptions of people and places. If she does not possess this power naturally, she can acquire it by study. (Volume Three, pages 294-296, Section 3.) She should also be able to use the blackboard. McMurry says, "The teacher who cannot use the blackboard freely for illustrative purposes is shorn of half her strength at the start." This does not mean that the teacher needs to be an artist, but that she must be able to make simple sketches similar to those shown in the illustrations and, to do this with ease and freedom, so she can use the crayon at the same time that she is giving verbal descriptions. The illustrations of the outlines of mountains, a river system and the formation of rapids and cataracts show what any teacher ought to be able to do in the way of blackboard illustrations in geography.



A RIVER SYSTEM

(d) The Text-Book. The teacher must know the text-book from a teacher's point of view. No text in geography can be followed absolutely, and many texts are unsuitable because of their plan and subject-matter. The primary geographies are usually the most difficult. All of the older books attempt to give a systematic treatment of the subject; therefore, their contents comprise a mere skeleton of maps and facts. Some of the more recent books are a great improvement upon the older ones, but even the authors and publishers of these have been too fearful of breaking entirely away from old traditions to produce books best suited in all respects to the needs of the children. Nearly all text-books contain too many petty details and fail to give sufficient space to the great facts of geography.



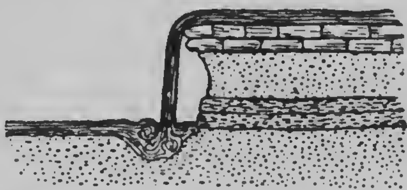
THE FORMATION OF RAPIDS

Concerning these works, one of our leading authorities says:

"The crucial test of the value of the text-book in geography is not so much what it contains as what it doesn't contain. A text in which the fundamental principles have been scuttled and sunk in a sea of irrelevant details may have a cyclopedic value, but it is not worth much as an educative factor. * * * The text of the ordinary advanced geography contains about fifteen hundred geographical names and the maps about five times as many in addition. As a matter of fact, the average man or woman of intelligence is rarely familiar with more than three or four hundred geographic names, even in a very general way."[1]

It is, therefore, important that the teacher get a clear conception of the scope and plan of the text-book before it is introduced into the class. Such a conception can be obtained only through a comprehensive study of the book from beginning to end. It is not enough to keep one or two lessons ahead of the class; the teacher who attempts to use any text-book in geography in this way is sure to meet failure.

(e) Literature. Many localities are rich in legends, historical incidents and literary allusions. The teacher should know where to find these, and how to use them to the best advantage. A method for collecting and arranging such selections is given in Section 21.



THE FORMATION OF A CATARACT

(f) Knowledge of the Work as a Whole. The teacher must be able to see the end from the beginning, otherwise she cannot plan wisely; even in those schools provided with complete courses of study this is necessary. The teacher must determine what she will accomplish each week and month; what points need special emphasis, and what can be passed over lightly or omitted altogether. With a definite plan of this kind before her, she may so direct the

[1] Redway: *New Basis of Geography*

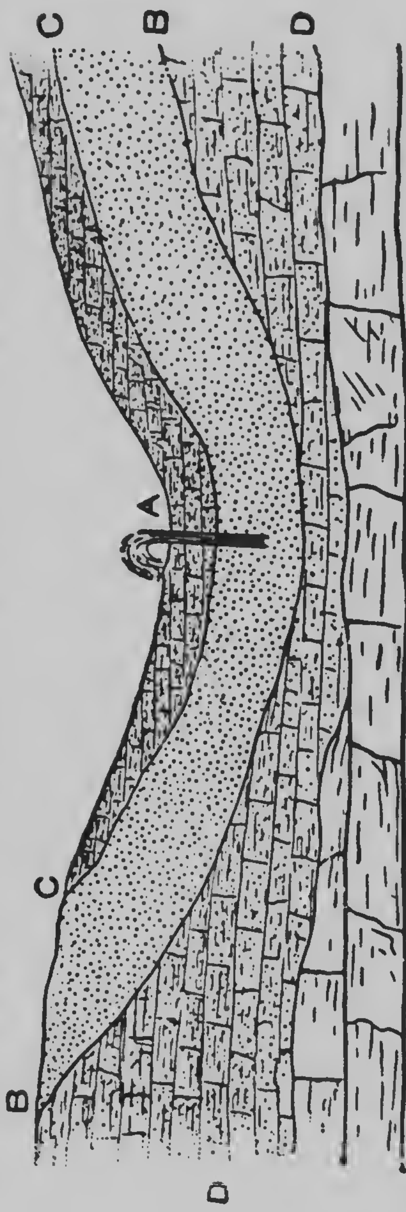
study of the pupils as to keep them interested and at the same time prevent waste of effort.

6. Conditions. In many schools pupils begin to study geography from the text-book when they enter the fourth year. In most cases the pupils would probably acquire a better knowledge of the subject if the study of the book were deferred until the middle of the fourth year, or the beginning of the fifth; but teachers have to take conditions as they find them. If pupils have received proper training, when they enter the fourth year they should know the names and uses of the plants and animals common to their locality; something about the migration of birds, and be able to recognize the most common birds; the occupations of the neighborhood, and the necessity for them; the coming and going of the seasons; the direction of the winds; the difference in the length of day and night in summer and winter; something about erosion and the transportation of eroded materials, and they should recognize the home as the center of life. They should also have made a study of the schoolgrounds and the immediate surroundings. If the class is strong, this study should have been extended to include the school district; if the school is in a village, the study should have included the village.

The pupils should know what a map is, from drawing maps of the localities studied, and they should have learned the meaning and use of a scale. They have probably also become acquainted with the chief articles of food and clothing. Unless they have had at least this preparation, they are not in a condition to begin the study of any text-book in geography, and the teacher will need to do considerable preliminary work.

Whatever the previous preparation of the pupils may have been, the text-book should not be wholly set aside, if pupils have been provided with copies. Many parents are not easily convinced that their children are learning anything of value unless they use books. Moreover, if the pupils have brought their books to school, they will be sadly disappointed if not allowed to use them; therefore, the teacher is under the necessity of making the best use of the book that she can.

7. Home Geography. Regardless of the introduction of the text-book, the study of home geography should be continued. The importance of this phase of geography work is too often underestimated. It should have a regular place on the daily program and be given its full share of time. Home geography lays the foundation for the study of foreign geography, because through it, and through it alone, can pupils obtain concrete illustrations of ideas which enter into their concepts of geographical forms. The oral lessons should be continued and elaborated, provided the



AN ARTESIAN WELL

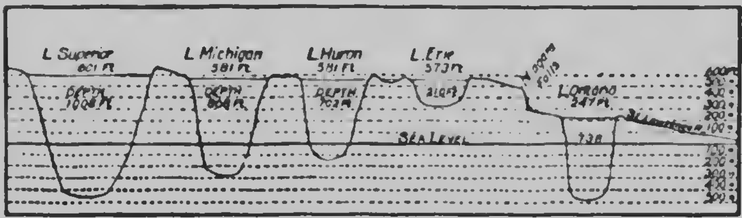
BC represents a layer of gravel or porous earth saturated with water. A and D represent layers through which the water cannot pass. When the well is bored at A, the pressure of the water [illegible] the higher level in BC forces it up through the pipe and forms a flowing well.

pupils have a knowledge of the subjects named in Section 6. A study of the features of the landscape forms a good introduction to the work of the fourth year. In almost every locality springs, brooks or rivers, swamps and prairies, or hills, valleys and meadows can be found. The leading features of the surface of the locality can be used to excellent advantage and should always be drawn upon to furnish concrete illustrations of descriptions found in the text-book. The same use should be made of plants and animals, the most important crops, the chief industries, and the lines of transportation of the locality.

The study of a railroad naturally leads to the consideration of some of the towns and cities through which it passes, and in this way the pupils begin to extend their knowledge of the locality. A brook or river has almost limitless possibilities. The constant changing of the banks, the character of the bed, where the current is swift and where it is slow, the deposit of sediment in some places, and the wearing away of the earth in others, afford excellent illustrations of erosion and the formation of alluvial or flood plains. By tracing the divides and slopes of a small stream, the children soon learn the area drained by it, and thus get a concrete illustration of its basin, which needs only to be enlarged by their imagination to apply to a river basin. Mountains, hills, valleys, prairies and other natural features can be studied in the same way.

The occupations of the locality are equally helpful. They are types of great classes of industry that are found over the country and over the world. Thus home geography serves a double purpose; it causes the pupil to become acquainted with the geographical facts of his locality and also brings him in contact with types of great geographical facts which he follows throughout the study of the subject.

The connection of these lessons in home geography with the text-book is easily made by having the pupils read from their geographies descriptions of objects like those they are studying, then asking them to discover in what respects the description must be modified to fit the object to which they wish to apply it. By such exercises the pupils soon learn that the main facts in the printed description will apply to local objects, but that details are different for each hill,



ALTITUDES AND DEPTHS OF THE GREAT LAKES

valley, river and other object studied. In this way the class becomes acquainted with the broad application of the general truths of geography.

8. Study of the World. As soon as the pupils become acquainted with their text-book and form some conception of what geography is, they should be taught something about the world as a whole. The form of the earth is best taught by the use of a small globe or an orange. At this stage a number of small globes which the pupils can handle are much more useful than a large, mounted globe. The conception of the rotundity of the earth is difficult for children; even some adults never get a clear idea of this fact. If the earth is round, why does it always look flat or mountainous? is a question constantly recurring in the child's mind. With a small globe or an orange this difficulty can in a measure be explained away. Have the pupils take a piece of paper large enough to cover at least half the globe, and in the center of this cut a round hole about one-half inch in diameter; then lay the paper on the globe so that the part in which the hole was made touches the surface. How does the part seen through the paper look? Why? Explain that the portion of the globe seen through the hole in the paper is relatively much larger than any portion of the earth that we can see at one time. Some of the simple proofs of the earth's rotundity, especially that of seeing ships enter and leave the harbor, should also be explained. Hemispheres, the division of the earth's surface into land and water, the names of the continents and oceans, their relative position and general forms should also be taken up in connection with this first study of the world as a whole. Only the most striking general features should be touched upon, but these should be given sufficient attention to fix them firmly in the minds of the pupils.

9. Selection of Topics. After the pupils are started in their work, the teacher should exercise her best judgment in the selection of topics, whatever the plan of the book that she has to teach. Two pitfalls should be avoided: attempting to teach a multiplicity of details which to the pupil form no part of the general whole and which obstruct or wholly prevent his comprehending the general effect, and attempting to lead pupils into special lines of observation which are of interest to the teacher, but from their nature cannot interest pupils of immature minds. Children can grasp simple wholes, even when they are large, but they cannot analyze complex subjects. The teacher should always bear this in mind in the selection of her topics. Another guiding principle is, "The number of classes of geographical facts is not great, while the number of individuals in each class is legion." The selection of a few important representative class topics is therefore of much greater value than the study of any amount of detail.

The following topics will be found suggestive: (1) Those topics which are fundamental, and run through all the grades; as climate, erosion, forms of water, relation of industries to location, commerce and government. (2) Topics of interest in the immediate locality; as the hills, streams and valleys, the leading industry of the district or town, the courthouse, the city or village hall, a railway station. (3) Special topics: places of historic interest, such as Quebec, Niagara River and Waterloo; places of remarkable scenic beauty or grandeur, as Niagara Falls, Yellowstone Park, Rocky Mountains Forest Reserve.

By confining the study to a few significant topics which have a bearing upon the work of the entire course, enough time can be devoted to these topics to make them real and lifelike. The teacher must remember that mere memorizing of facts is not knowledge. A fact in geography has no value to the pupil unless it has some significance for him; that is, unless it points to something that he knows from experience. The topics selected for the class beginning the use of the text-book should be simple and should bear a close relation to some of the home geography topics referred to in Sections 6 and 7. Some of the topics should also correlate with the history stories studied at this time. See Volume Five, page 171, Section 13.

10. Study of a Province. Some of the most successful teachers of geography advocate devoting at least the first half of the fifth year to the study of the province in which the school is located. These teachers claim, and with good reasons, that the province is a unit large enough to embody many of the principles which the children are becoming conscious of in their study of home geography, and to show the interrelation and application of these principles to life; and that the study of the province gives the child an understanding of the meaning of geography which he will not gain if he passes immediately from home geography to the larger outside world. The province is also typical of a country, and when the child obtains an idea of the province, as a political unit, this idea needs but little modification to adapt it to a country. Most courses of study recognize the importance to the pupil of a knowledge of the province in which he lives, and make ample provision for provincial geography.

In the fifth year extent, outline, and large, graphic features should be studied. These should include the chief mountain ranges, principal rivers and other bodies of water, prairies, plains and large valleys, if they are found, and the location and extent of the natural resources.

The leading industries and occupations and the chief centers of trade and manufacture should also receive attention. The study of these will naturally lead to the study of transportation. The leading lines of railway should be traced upon the map, and the most important railway centers located. Similar lessons should be given on navigable rivers and canals, if any are found within the province.

In the last part of the year a few lessons on the government of the province should be given. The capital should be located; the plan for electing the provincial officers, and the general duties of some of the most prominent of these officers should be discussed. The election of legislators and the making of laws should be touched upon, as should the courts and their duties.

The work should be upon the same plan as that used in the study of a country, then when the class changes from one unit to the other there will be no occasion for confusion.

11. Oral Instruction. Text-books are but guides in the study of any subject, and without exception they should be supplemented by oral instruction. Pupils in the intermediate grades need a great deal of oral instruction, because they have not arrived at that stage of maturity which enables them to interpret fully what they read. Teachers are often deceived by the fact that pupils read a book readily. It does not follow that they comprehend the meaning of what they read. Whether or not they are able to do this can easily be determined by asking them a few pointed questions upon the subject-matter. An elementary geography presents many difficulties to the child. It contains a large number of new words, its style is different from that of other books that he has read, and its arrangement is often such that he is unable to see in it any plan or purpose. If he is to master this book he must receive such instruction as is necessary to enable him to overcome these difficulties.

Another reason for oral instruction in geography at this time is that these lessons should contribute to the development of the pupil's memory, imagination and reason. Pupils at this age grasp more clearly and remember much better such facts as are presented to them in oral lessons. One reason for this is that the teacher can enter much more fully into the description of places than it is possible for the text-book to do. These vivid word pictures, supplemented by suitable blackboard sketches or other illustrations, give the pupils a clear mental picture of the object described. The oral description also holds the pupil's attention much more closely than the printed page.

Again, oral instruction affords opportunity of presenting problems for the pupil to solve which the text-book cannot contain. In the study of the lumber industry, for instance, the pupil should be given time to solve such problems as how the lumbermen get the logs to the mills and how the lumber gets to market. The Southern farmer has a large crop of cotton. What steps must be taken to exchange his crop for money? These and similar questions constantly arise in the discussion of geography topics. The solution of some of the problems found in such questions will require but a moment, while that of others will require so much time that the answers must be deferred until a future recitation. By injecting such problems into the recitation, the pupils are thrown upon their own experience; arriving at the solution not only strengthens their reasoning powers, but it also helps them to make a vital connection between the geography lessons and their daily lives. (See Volume Three, pages 264–268, Sections 10–11.)

The amount of oral instruction which is directly related to the lessons in the text-book will, of course, depend upon the pupils' preparation for the book before it is introduced. Pupils who have done the work outlined in Sections 6 and 7 will require less than those who have not had such preparation. During the first year that the book is used considerable oral instruction will be necessary, such reference to the text being made as will enable the pupils to connect the lessons with the book. With each succeeding year the time spent in studying the text will increase, and that devoted to oral instruction will decrease proportionately, since pupils are constantly growing in their power to master books. However, the successful teacher of geography will never cease to supplement the text with oral instruction whenever she feels that this work is needed.

PREPARATION. Oral instruction in geography requires extensive and thorough preparation on the part of the teacher. She must have such a knowledge of the subject to be presented as will enable her to make it real and lifelike to the pupils. For steps in the preparation of an oral lesson, see Volume Five, pages 168–171. The directions for a history lesson apply as well to lessons in geography. But the teacher should be a keen and close observer. Geography at first hand is written not in text-books and works of travel, but in the great book of nature, and she who would be successful must read this book and develop a love for its teachings.

Cautions. (1) Geography deals with a large number of subjects which are also treated in other sciences, such as botany, geology and meteorology. In no subject is there greater danger of digression from the topic at hand. Therefore, remember that geography treats its topics from a *geographical* point of view; that other sciences treat them from a different point of view. *Stick to the text,* and avoid confusing the pupils by the introduction of irrelevant matter and unnecessary details.

(2) Do not attempt to cover too much ground, but weave a large number of interesting details around a few central topics.

(3) Do not talk too much in oral work. Ask a few pointed questions which will lead the pupils to observe and to think. When they have learned what they can, supplement their efforts with such clear, concise descriptions and explanations as are necessary.

12. Excursions. Excursions are of two classes—real and imaginary. Those of the first class consist of trips that the class and teacher make to nearby places. Those of the second class consist of imaginary journeys that the pupils make to distant cities, other parts of the country and foreign lands.

(*a*) Real Excursions. Excursions afford opportunity for the study of types, and should constitute a part of the work in home geography. The excursions should be planned with reference to available places and to the season of the year. During the winter, where the climate is severe, they should be confined to objects within doors, except on rare occasions. In the South excursions to outdoor points can be made throughout the year. The plan for the term or year should also give as much variety as the pupils can use to advantage, such as the study of the features of the landscape in the neighborhood, of some of the different manufactories and one or more stores. Local conditions vary to such an extent that specific selections cannot be given.

The excursions should be carefully planned. If possible, the teacher should visit each place beforehand, and if the excursion is to a manufactory or store or any other business with which the visit will possibly interfere, permission to visit the place should be obtained from the proprietor or manager. In her visit to such a place the teacher should, if possible go over the ground with the foreman or someone who is thoroughly familiar with the different departments and their relation to each other. At this time she should determine what she wishes the pupils to study and then plan her trip through the building so as to have the class see the various departments in their proper order and relation. Unless this precaution is taken, at least one-third of the value that should be obtained from the trip will be lost.

The pupils should be told one or two days before the excursion is to take place what is to be done, and they should obtain the consent of their parents to go on the trip. If the excursion is to a factory or any place where machinery is in operation, only a small number of pupils should be taken, unless the teacher can have a number of assistants from the older pupils or patrons who will take charge of the children in small groups; otherwise, serious accidents are liable to happen. The pupils should be kept together, and their attention should be directed to what the teacher wishes to have them see. Unless this is done, very much will be lost because of the confusion arising from the novelty of the place and the many things which tend to distract the children's attention. With classes in the lower intermediate grade, attention should be directed only to the most important features of the work. With older classes such details can be added as they will understand. It is well to have the children ask the proprietor, or foreman, questions; or for the teacher to ask the questions in the presence of the class, so they can hear the explanations The excursion should furnish material for two or three lessons, and the work should be completed by having the pupils give first a complete and connected oral account of what they have seen, and then a written account of the same. (See Volume Three, pages 264-268, Sections 10-13.)

If a house or other building is being erected in the neighborhood, encourage the children to watch the progress of construction. Inquire after the source of all the material that goes with the building, and trace each kind of material back, if possible, to its original source—the farm, the forest, the mine and the quarry.

Excursions are attended by certain difficulties which the teacher should foresee and overcome. These are the difficulty of controlling children out of doors or in strange places, the tendency of some of the children to give their attention to trivial matters and those things which are in no wise connected with the point in hand, and the opposition which some parents raise to the proposed scheme. Such opposition is usually genuine on the part of the parents who entirely misconceive the purpose of the trip and do not understand how pupils can learn unless they are in school studying books. A visit to the parents and an explanation of the purpose and work will usually remove their objections. One or two talks with the pupils before the first excursion, giving them an understanding of what is expected of them, will usually prevent in a great measure the other difficulties.

(b) IMAGINARY EXCURSIONS. This method of study affords considerable variety in the geography work and is of particular interest to pupils in the fifth and sixth years. Such excursions should begin with imaginary journeys to places near by, which some of the pupils may have visited. If the school is in the country, an imaginary excursion to the town where the community transacts most of its business will make a suitable beginning. Another can be taken to the county seat, and another to the nearest large city or the large city with which the community is most closely connected through its business relations. This work can, of course, be extended to various parts of the Dominion and to foreign countries. The danger is that it may be overdone. Not all study in geography should be taken up in this way, but the trips should be planned whenever they will serve the purpose of a good review or lend additional interest to the work which the class is doing.

Imaginary excursions should be planned with as great care as real excursions, and they should be made as real as possible. The distance to the point to be visited, the best means of travel, the most important objects to be seen, the habits and customs of the people, the various industries in which they are engaged and other matters of interest should be carefully considered. Books of travel, text-books, and especially the elaborate circulars issued by the leading railway and steamship companies, should be consulted by both teacher and pupils in the preparation for these journeys. Great assistance can be derived from pictures. The school that has a stereopticon with a valuable collection of slides, is fortunate, but the stereoscope, and pictures without the use of a lens, add interest and give valuable information.

(c) LETTER EXCURSIONS. Correspondence between pupils in the geography class of one school with those in a similar class in another school far distant can sometimes be arranged, and it adds very much to the value and interest of the work.

Any teacher desiring to introduce such a feature into the geography work, especially in connection with these excursions, should write the superintendent or principal of the school with which she desires to institute correspondence. If the plan is accepted, then certain pupils should be designated to correspond with those that may be named by the teacher in charge of the class in the other school. The pupils should describe such objects and conditions in their locality as they think will be of interest to their correspondents, and the letters which they receive will contain similar information. The teacher should have oversight of this work to the extent of suggesting the information that should be given and requested. These letters become the property of the class and are read in the recitation by those receiving them, so that all can have the benefit of the correspondence. Different pupils can be appointed to conduct the work from month to month, as long as it is desired to continue the plan.

13. Maps. The first idea that the term *map* usually conveys to one is a conventionalized representation of the whole or a portion of the earth's surface. The map may include only the schoolgrounds or it may embrace the whole world. Between these two extremes there are unlimited gradations. The school work in geography usually requires the pupil to study three classes of maps—political, physical and relief.

(a) Political Maps. The first maps which the pupil studies are those from which he gets his first conception of what a map is. They contain contour, direction, and whatever other facts it is considered desirable to place upon them. If the first map is of the school grounds, those following it can be extended so as to include the locality adjoining these grounds; then they may take in the township and even the county; but such map work should not be carried too far. If the school is in a village, a map of the village which shows the principal streets and any public park or other prominent features may be attempted, but maps of large towns and cities should be avoided at this time. In case maps of the county are studied, they should contain only the chief feat-

From a photograph

CONSTRUCTING RELIEF MAPS OF SOUTH AMERICA ures, such as the principal towns, most important highways and leading railroad lines.

When the pupils make the transition from home geography to that of the world they begin to study maps representing continents and countries, and a set of wall maps is indispensable. These maps should be simple and clear, bringing out only the most important features.

(b) Physical Maps. Physical maps represent the surface of the country in relief. There are two kinds of maps used for this purpose: those which represent the various altitudes by difference in color, and those showing relief forms by such shading as will represent highlands and lowlands. Each of these classes of relief maps has its ardent advocates, and the best geographers seem to be about equally divided as to their merits. For the younger children especially, a shaded map which shows highlands and lowlands in relief form is more desirable than one showing these forms by difference in color, because the children are unable to image the forms represented in this way. It is also quite probable that clearer ideas of relief are obtained by the use of this class of maps throughout the grades in the elementary schools, notwithstanding the fact that some of our best textbooks use the other form.

(c) Relief Maps. True relief maps are really models of the region represented so as to show the surface approximately as it is found. Such maps are of great value in giving pupils a conception of the general structure of a continent or country, but in order that they may accomplish this purpose the pupils need at the beginning to have a concrete illustration of what such maps represent. This illustration is easily obtained by having the pupils, with the teacher, model a region near the schoolhouse. If a small stream is in the vicinity, a portion or the whole of the basin drained by this stream can thus be modeled. A hill, a railway cut and a road passing over a hill and through a valley also afford good illustrations of regions that can be used to advantage. If the pupils begin construction of relief maps with something of this kind, they see at once what the map represents, and when they model a continent the form is much more real to them.

Various materials can be used in making relief maps, such as sand, putty, and papier-mache. If the schoolroom contains a sand table, or if proper molding boards and a quantity of fine sand can be obtained, perhaps this is the most convenient and least expensive material that can be employed. Its manipulation, however, requires more skill than that of putty or papier-mache. The papier-mache is probably the most available material, because it can be manufactured on the spot at little or no expense. Take a quantity of old newspapers, tear them into small pieces and soak them in water into which a solution of gum arabic or mucilage has been poured, the proportions being about a tablespoonful of mucilage to a gallon of water. After the paper has soaked several hours, it can be made into pulp by working it with the hands or stirring it with some implement until it is thoroughy macerated. When needed for use it should be taken from the pail in small quantities and have all of the surplus water squeezed out. Newspapers thus treated form a very plastic material, having a gray color. This can be easily worked, and the mucilage causes the pulp to harden and become firm as it dries.

Whatever material is employed, the construction of the map should be planned before the work is begun. Each pupil should draw upon the molding board, or other surface upon which the map is to be made, an outline of the continent or country. This will enable him to bring his map into proper form as he constructs it. Most of these maps are too complex to admit of completion at one period; hence, the work should proceed in sections from day to day. The work is most easily done by modeling the principal mountain ranges, then arranging the coastal plains and interior lowlands. Large forms are most easily modeled, so it is evident the continents do not present so much difficulty as a country or province.

(d) Map Reading. The teacher should be able to understand all the markings on the map and margin. The children must learn direction; the meaning of the scale and how the scale is used to determine distance; the meaning of parallels and meridians; the irregular coast line with its projections and indentations; the location of the mountains, lowlands, lakes, rivers, cities and other prominent features; and their attention should be called to the various markings that represent these different features until they become thoroughly familiar with them. The pupils in the seventh year should also learn to read the margin of the map, and from this find the latitude and longitude of places.

It is difficult for children to form correct mental pictures of the objects which these markings represent. The use of pictures in connection with the study of the map affords one of the best means for connecting the map with what it represents. If the class is studying the map of British Columbia, for instance views of Mount Sir Donald, Robson Peak, Kicking Horse Pass, and general views of the mountains, show what the marks indicating mountains actually represent. Making relief maps of a locality is another excellent way to help pupils make the connection between the map and the object. Both plane and relief maps of the locality should be constructed, and the teacher should continue supplemental instruction until the features represented upon the map become realities. Vancouver should not be a mere dot, but a great city, throbbing with life and containing many spots of historic interest. Sir Donald should be a great mountain, lifting its summit above the clouds and having its sides covered with loose, irregular fragments of rock. The black line crossing the United States from north to south should be the great river, with its changing banks bordered by fertile fields and bearing upon its bosom the commerce of great states. Pupils will not see these things without help. and any device that will enable them to picture what the map represents, is good.

(e) Map Drawing. Map drawing is one means of expression; when properly used the art gives the pupil additional power and enables him in a few minutes to give a better idea of what he knows about a country or other locality than will any amount of questioning. Map drawing is entirely distinct from map modeling. While in a few instances highly finished maps which require the expenditure of a great deal of time may be of sufficient value to warrant their construction by pupils who have a special aptitude for that kind of work, in general they should not be attempted. The simple

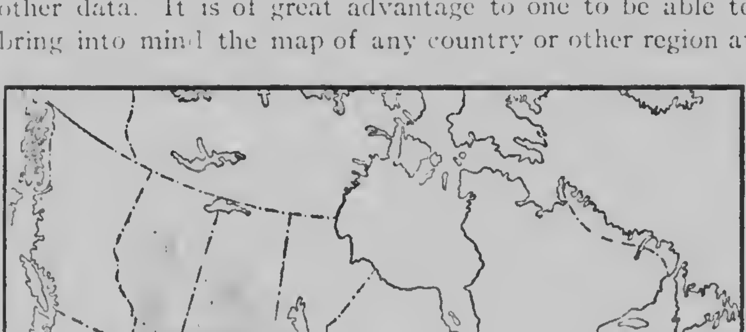
OUTLINE MAP

outline map which can be produced rapidly and with a few strokes with the pencil or crayon, is by far the more valuable for class work. With a little practice most pupils become quite skilful in the construction of such maps. Occasionally text-books contain elaborate systems of construction lines for drawing maps. These should be avoided. The time required for drawing the plan is often greater than that necessary for drawing the map. The only construction lines of value in case any are needed, are those representing the parallels and meridians. These the pupils can soon learn to draw, but it is usually better to have them study the map carefully and then draw without guiding lines of any sort. In this work the chief aim is not perfection in outline but the acquisition of ability to express form and location.

Printed outline maps are now furnished by a number of publishing houses at a nominal cost, and these can be used to good advantage in making progressive maps, both in geography and history. The outline is accurate and the time necessary for making this is saved. The maps can be filled in as the lessons proceed. These maps are also useful in locating the various industries in the country, as lumbering, the raising of wheat, the fur trade, and coal mining. Usually it is best to have the map represent only a single industry; by this plan the fact studied is strongly emphasized.

OUTLINE MAP OF BRITISH COLUMBIA

(f) MAP STUDY. Pupils should be trained in the study of maps until they have formed the map habit. By this is meant the habit of looking up on the map the location, relative area, distance, and other geographical data of places about which they read or study, unless they already know these facts. Each of these facts is worthy of notice, but it is of little value unless it is properly related to other data. It is of great advantage to one to be able to bring into mind the map of any country or other region at



WHEAT REGIONS OF THE DOMINION

will. This is a kind of knowledge that the business man finds of use in commerce, and another kind is that which is closely related to it, namely, the ability to recall along with the map the physical and political conditions of the region which it represents. The map as a representation of the location of a country also represents its surface, climatic conditions, products and people. When all of these facts are associated with the map they make it mean vastly more than a patch of color, and each added fact helps to fix the map in mind.

The map habit is formed only by persistent practice. Have a map where it can easily be consulted in the geography recitation and require pupils to point out upon it the places named as they recite. Require pupils also to look up on the map all places mentioned in the reading lessons, history and other subjects. Require occasional map sketching and in every way possible lead the pupils to realize the value of maps, but do not give map exercises which require the mere searching out of the location of places and tracing of boundaries of political divisions. These facts should be learned incidentally; exercises of this variety are lacking in interest and are thoroughly distasteful to the pupils. An excellent exercise is to have one of the pupils read a few important news items from a daily or weekly paper and let the class locate the places named without referring to the map. After the last item has been read, the maps can be consulted. An occasional exercise of this sort is of far greater value than any number of stilted map lessons.

Caution. Do not attempt too much. Map location forms only a small part of the work in geography, but it should yield clear, definite and permanent results. Children should know the essential map locations, and know them well, such as the location of London, New York, Montreal, Winnipeg, the Mississippi River, the Rocky Mountains, the Mediterranean Sea and the Suez Canal. They should know the location of the different provinces of Canada, and of the leading countries, bodies of water, and cities of the world. In learning these facts they should learn how to find upon the map the location of any other place it becomes necessary for them to know.

(g) GLOBES. Every school should have a globe. The most useful globe is a small, inexpensive one which can be handled with ease and safety by the pupils. Elaborate pieces of apparatus of this kind usually contain so much that they confuse the younger children. Only a few things should be attempted with the globe in elementary geography. These are the study of the form of the earth, of the relative positions of the continents and oceans, the cause of day and night, as shown by the rotation of the earth, and an understanding of the meaning of parallels and meridians and their position. Most of these facts the pupils will discover for themselves, provided their attention is directed to them by the teacher and they are allowed to handle the globe in obtaining answers to the questions. Many teachers make a mistake in attempting to solve problems with the globe which are entirely too difficult for elementary pupils.

DENSITY OF POPULATION

14. Graphic Illustrations. Statistical data when expressed in figures mean but very little to the average adult and practically nothing to children. The comparative extent and value of our great industries, the value of our exports and imports, also of our trade with the leading commercial nations and the relative position of the Dominion among the leading nations in area, population, agriculture, manufacture, commerce and other important matters, are facts that pupils should learn during their study of elementary geography, but some other means than the use of figures must be employed to impress these facts upon their minds. If we say that the oat crop of Canada in 1911 was 348,187,600 bushels (for memorizing, 350,000,000), the figures give them little idea of the reality. If they are asked to reduce this vast number of bushels first to pounds and then to tons, it will not enable them to realize clearly the meaning of the statement.

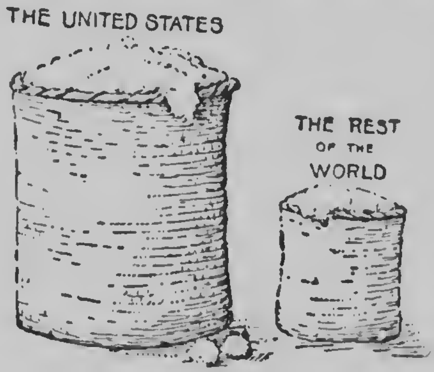
It will help to impress the meaning of so great a number and so large a quantity to ask them to find how long it would take them to count the number, if they counted at the rate of sixty per minute for ten hours each day. This will give them an interesting calculation, and when they find that, omitting Sundays and allowing 365¼ days for a full year, it would take more than thirty years to count it, they will gain some faint idea of the vastness of the number. It will help still more to tell pupils that Canada ranks third among the nations in the production of oats.

Comparative ideas are really the important conceptions to give pupils. Pictorial or graphic representation should be used as largely as possible in aiding the pupils to get relative conceptions. The amount of oats grown in Canada, as compared with the rest of the world, may be shown as in the picture of two sheaves. It is a fact that the United States produces more corn and more cotton than all the rest of the world. Simple illustrations like those on the next page will fix these facts in the memory much more definitely than any amount of repetition of the fact in words, either orally or in writing. On most children the writing of a statement, however, makes a more lasting impression than hearing it or repeating it aloud.

THE WORLD'S OAT CROP

Canada's exports of flour have trebled in three years. Her exports of grain have more than doubled in the last five years. In the forty-four years since Confederation the annual production of minerals increased from $10,000,000 to $105,000,000; railway earnings from $12,000,000 to $189,000,000; and manufactured goods from $221,000,000 to $1,165,975,000. In the same period the population of the Dominion has increased from about 3,000,000 to 7,204,838. Figures of area are also a good basis for comparisons. Thus Canada is eighteen times as large as France or Germany, and it contains one-third of the area of the British Empire. These facts and the comparative areas of continents and countries, length of rivers, population of cities and many other important and interesting facts can be graphically represented. The circle, the rectangle, the line and the pyramid are the simplest and most valuable devices, and any one of them can be used with the older classes. However, pictures similar to those described in the illustrations above are more valuable for the younger classes. The use of colored crayons also helps to make the impression more vivid; for instance, if the teacher wishes to illustrate the relative numbers of the human race embraced in the three great forms of religion—paganism, Mohammedanism and Christianity—a circle or square representing the entire population of the world, divided into three parts which will illustrate the relative proportions and

THE WORLD'S CORN CROP

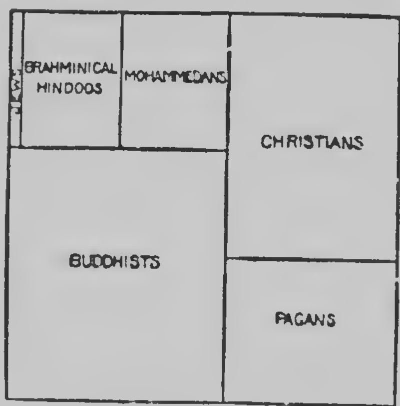


THE WORLD'S COTTON CROP

having each division of a different color, brings out the fact very clearly.

15. Pictures. Present methods of illustrating books and periodicals make pictures so numerous and so inexpensive that every school can have its picture cabinet for illustrating the geography and history lessons. It is also to the advantage of the teacher to have a collection of her own which she can use to supplement the school collection.

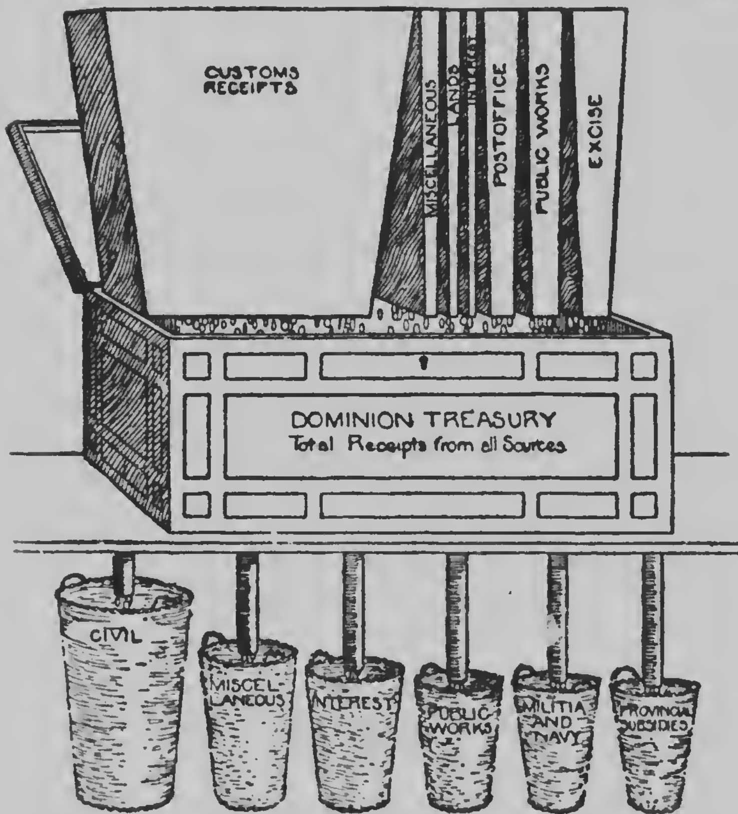
(a) SELECTION. Photographs, engravings and plain and colored halftones are the styles of pictures most easily obtainable. Of all these, the plain halftone used in illustrating the best magazines and textbooks is the most valuable, because it is the most easily obtained and the least expensive. Hundreds of such pictures can be clipped from periodicals without any expense. Photographs are very desirable, and when one can afford them a limited number adds much to the interest and value of the collection. Views with the stereoscope are especially useful, because the instrument enables the pupils to obtain a good idea of the relief forms presented in the pictures. This feature can also be brought out, though not as well, by using a good magnifying glass, such as a reading glass, with ordinary halftones.



GREAT RELIGIONS OF THE WORLD

Pictures should be selected with great care. Those designed for the lower grades should be simple and contain only strong general features. Complex views should not be used in these grades. The collection should contain such a variety of views as will represent coast lines, strong physiographic features and the activities connected with great industries. Both pupils and teachers should aid in making the school collection. Colored views should be selected with caution. Cheap colored pictures are not true to life, and should in all cases be avoided. In general, plain halftones are much more satisfactory than cheap colored views, and the bulk of the collection will naturally consist of these and of photographs. A plain halftone, made from a photograph, has much greater educational value than a fanciful colored picture.

(b) Mounting and Filing. Pictures should be mounted



RECEIPTS AND EXPENDITURES OF THE DOMINION GOVERNMENT

in some manner that will preserve them. One of the most convenient devices is to use heavy manila paper, cutting it so that there will be a margin of at least one inch around the picture. The title, if not printed on the picture, should be written under it, and whatever description needs to accompany the view should be written upon the back of the mount.

An inexpensive and convenient device for filing consists of large envelopes. The pictures can be arranged by countries or continents, as desired, and the title of the group may be written upon the back of the envelope. This arrangement enables one to find at once whatever pictures the cabinet contains bearing upon the subject in hand. With proper instructions as to care in handling and replacing the pictures in the envelopes from which they are taken, pupils should be allowed free access to the picture cabinet.

(c) Uses. Some teachers secure much better results from the study of pictures than others, because they know better how to use them. Failures arise from unwise selection, from lack on the part of the teacher to study the picture and decide the points to which the attention of the class should be called, and from presenting too many pictures at a time. If you do not have a stereoscope or other lens through which the pictures can be viewed, the stereoscopic effect can be produced by closing one eye, and with the other looking at the picture through the hand folded into a tube like a telescope. This simple device is often very helpful. The following suggestions will be found helpful in the use of pictures:

(1) See that the pictures selected illustrate the point in hand; if they do not, do not use them. Here a word of caution in regard to illustrations in the text-book is necessary. The desire of authors and publishers to introduce a large number of pictures for the purpose of making these works appear attractive sometimes leads them to use such as do not illustrate the text-matter, and when you discover that the pictures and the text do not agree, you should follow one of two plans; either ignore the picture entirely or give an oral description which will enable the class to use it intelligently.

(2) Call attention to what you wish the pupils to see. This is especially necessary with the younger classes and in all classes with pictures that contain a large number of objects; otherwise some of the pupils will give attention to one feature of the picture and others to another, and possibly some will fail to see the points which you wish observed.

(3) Question the pupils so as to have them bring out in their observation the points desired. The answers to these questions will enable you to discover any errors in observation or judgment and to correct these at the time.

(4) When the class is large and there are not enough copies of the picture to enable all to study it at the same time, hold the picture before the class and call attention to the points to which you wish to direct their attention. This saves time and waste of effort.

(5) Finish the exercise by having the pupils describe the picture from memory. This oral description can be followed by a written one, if desirable. (See Volume Three, pages 294 and 301, Sections 3 and 6.)

(6) Use the same picture as many times as may be necessary to secure the desired result.

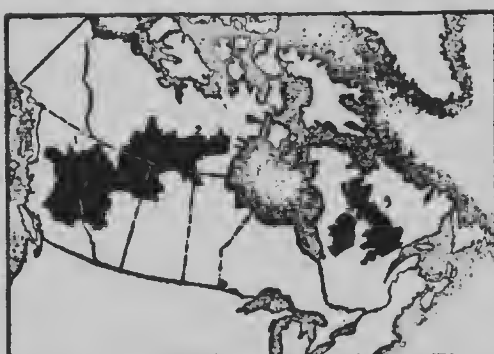
(7) Be sure that you connect the work of the picture with the text-matter in the lesson, provided the picture is used for the purpose of illustrating the text.

SKETCH OF A MOUNTAIN GORGE

(d) SKETCHES. Simple blackboard sketches are often of great advantage in making descriptions plain. A defile in the mountains, a railway cut, the form of an iceberg, the relative height of mountains, the kind of dwellings people construct in different parts of the world and many other facts can be vividly brought out in this way, if the teacher is skilful with the use of the crayon. These sketches should not be elaborate but should consist of only a few lines which will bring out the features desired. Any teacher wishing suggestions for blackboard illustrations will find *Chalk Illustrations*, by Eliza H. Morton, very helpful.

16. The Historical Element. The relation of geography to history is discussed in Volume Five, pages 163-164. At this point we wish to speak of the historical element in geography. We must not lose sight of the interest which people take in places because of events that transpired in them. Gettysburg is an unpretentious village among the hills of Pennsylvania, but the great battle fought there has given it a world-wide celebrity that brings to it thousands of visitors every year. Concord, Lundy's Lane, Plymouth, Quebec, Waterloo and scores of other places have like interest. The historical incidents should be brought out at the time the class studies the locality in which the places are situated.

The development of any region depends upon its geographic conditions, and in the study of the civilization of a locality we cannot overlook the fact that they depend upon physical conditions. Western Pennsylvania is a great manufacturer of iron and steel because it abounds in coal and iron ore; the Mississippi Basin is the richest agricultural region of the world because of alluvial soil; the flood plains of the great rivers of the Old World, the Po, the Nile and the Ganges,



COMPARATIVE SIZE OF FRANCE (1), GERMANY (2), BRITISH ISLES (3), AND THE DOMINION have been the homes of powerful nations since the dawn of history. These facts should be brought out with the older pupils.

The history of names is also of interest to children. This line of work can be developed by asking the class to answer such questions as, For whom was Lake Champlain named, and why? What is the origin of such names as Canada, Toronto, Quebec, Montreal, Winnipeg, Vancouver, Victoria, Regina, Calgary, Nova Scotia, Prince Edward Island, New Brunswick, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia?

Ask the pupils to note how many places in Canada have names exactly like places in the British Isles, or with the word "New" before the old country names. This observation will lead to a clearer understanding of the history of the early settlement in different parts of the country. Naturally many of the geographical names in Canada are Indian names, and around these names may be woven romantic tales that will kindle a love for history.

Another interesting exercise in names consists in having the children who are studying the United States discover how the different states received their names. Again, why are there so many French names in the Mississippi Valley, and why are there so many Spanish names in California, New Mexico and Arizona?

A word of caution may be necessary at this point. In considering the historical element in geography just sufficient emphasis should be given to this element to lend interest to the geography lessons. It should not take precedence in this study as in case of the study of history. Were the class studying the history of the southwestern portion of the United States, they would be interested in tracing out the expeditions of the early Spanish explorers and the founding of the various missions in that part of our country, but in studying the geography of the region the only attention that should be given to tnese facts is that which shows the pupils that the names found there were given by the early

Spanish settlers. Again, the geography of great cities, Montreal, Quebec, Winnipeg, Boston, New York, for instance, would be incomplete without reference to their beginning and growth. In nearly every phase of political geography we find a historical element which should not be ignored.

17. The Literary Element. For more than three-quarters of a century the writings of Sir Walter Scott have been drawing people of other lands to visit the scenes of events that never transpired and the homes and haunts of people that never lived. The geography of Scotland should not be passed over without calling attention to the localities immortalized by this great writer. In a like manner the geography of Nova Scotia requires a reference to *Evangeline*, that of New England to *Snow-Bound* and to some of Thoreau's remarkable descriptions. The geography of Cambridge, Mass., is incomplete without reference to the Old Elm and Craigie House, and *Hiawatha* has done for an otherwise insignificant waterfall near Minneapolis what the *Lady of the Lake* did for the Trossachs in Scotland. Many of our poets have woven into their songs the scenic beauty of our own and other lands. The literary element in geography should not be neglected, therefore, since it adds interest and meaning to the subject. (See Volume Three, pages 293-294, Section 2.)

18. Advanced Geography. Advanced geography is the title usually applied to the text-book following the elementary geography. The work done before this book is reached should have prepared the pupils for its use. The teacher, however, must make a thorough study of the book, to get a conception of its scope and plan. Some advanced geographies still in use begin with general definitions and follow these with lessons on mathematical geography. The plan of such a book should not be followed. If the previous work has been done properly the pupils will have learned the definitions of most of the terms that they will use, and they should learn others as the work leads to them. Most of the abstract generalizations called for in lessons on mathematical geography are altogether too difficult for pupils of this age. With such a book the better plan is to begin with the study of a continent or country which the work in the grade below most naturally leads up to. However, since at least one-half the time spent upon the advanced geography should be devoted to the Dominion, it is usually wise to begin work with our own country, unless the work in the grade below strongly points to some other plan.

In the main, the plan of the book for the study of continents and countries should be followed; otherwise, the pupils will become confused between the plan presented by the teacher and that found in the text. Type studies will enable the class to avoid repetition and are also valuable for supplementing the lessons in the book. Most advanced geographies contain too much, and the teacher should select the most important portions and place emphasis upon them. The great countries, such as the United States, Great Britain, France, Germany, Russia, China and Japan, should receive special attention. Unimportant countries, such as Spain, Portugal and Persia, can be passed over lightly, and if time is short, some of them may be omitted. Recent developments, such as the progress of civilization in Africa, the construction of the Panama Canal, and the introduction of a national legislature into Russia, should receive attention in connection with the study of the countries with which they are associated.

The amount of supplementary work which can be done with the class in advanced geography is limited only by the capacity of the class, the time they can devote to the subject and the sources from which material can be obtained. Classes having access to numerous reference works and to good libraries can of course accomplish much more than those deprived of these aids. Good newspapers and periodicals are always available, and there is seldom an issue of such a publication that does not contain one or more articles which can be used with the work in geography. Among those worthy of special mention, because of the direct bearing of many of their articles upon geography, are the *National Geographic Magazine*, published by the National Geographic Society, Washington, D. C., *The World's Work*, and the *American Review of Reviews*, both of New York City.

19. Commercial Geography. Before they leave the elementary school, pupils should acquire some knowledge of the sources of supply, the processes of manufacture, the methods of distribution, and the cost of our most common commodities. Whenever possible, commercial geography should constitute a part of the work of the highest grammar grade of the graded schools and of the oldest pupils in the rural schools. The introduction of this subject adds interest to the work and helps to retain the older boys in the rural schools. See *Coal*, Volume Three, page 304; also, *The Study of Corn*, pages 6–20 of Volume Five.

If commercial geography cannot be taken up as a regular study, much can be accomplished by studying great types of industries from an industrial and commercial point of view. Such types as wheat, corn, cotton, coal, petroleum, iron and steel, the manufacture of textiles, banking and exchange, transportation, the influence which such inventions as the steamboat, the locomotive, the telegraph, and the various applications of electricity have had upon the leading industries of the world and the influence of commerce upon civilization are illustrations of topics that can be taken up successfully on the plan of type studies. For outlines for these type studies, see the lessons on *Coal* and *Corn*, above mentioned.

By whatever plan commercial geography is pursued, the pupils should be led to realize the geographical conditions upon which industry and commerce depend. Pupils should also understand how value is added to material by the expenditure of labor upon it, both in manufacture and in transportation, and how inventions and the division of labor have reduced the cost of many commodities; and they should also learn something of the elementary principles governing credit and exchange. Such knowledge is of the greatest practical value. In no other way can pupils be led so easily to realize the interdependence of different parts of the world.

"One of the greatest lessons of all is to discover how every part of the earth is now made to contribute to the needs and welfare of every other part, and to see with what expenditure of energy, capital and ingenuity the aggressive races of Europe have built canals, opened ocean highways and continental railroad lines. The iced meats of Australia soon find their way to London, and refrigerator fruitcars cross the continent of North America in a few days. These topics lead us close to the present trade rivalry of the great powers for the commerce of the world, and to the question how the prices of staple products are fixed by the world market."[1]

20. Comparisons. Comparative studies bring out the points of resemblance and difference between similar features in different localities or unlike features in approximate localities. A comparison of the Andes with the Himalayas, of the Nile with the Mississippi, or of Eastern with Western civilization affords good illustration of this kind of studies. The teacher can lead the pupils to make such comparisons by asking them to answer such questions as, Why were the Japanese successful in the late war with Russia? Why is the population of the Mississippi basin more evenly distributed than that of the basin of the Nile? How do methods of farming in the central portion of the Dominion compare with those in China.

21. Aids. The teacher's aids in geography fall under the four heads, material illustrating industries, clippings, pictures, and books.

(a) Material. By interesting pupils and patrons, the teacher in almost any school can collect a small cabinet of specimens useful in illustrating geography. The specimens should be of products not common in the locality. All cabinets need specimens of raw material produced in foreign lands, such as cocoons of the silkworm, hemp fiber and the fiber of cocoanut. Specimens which illustrate the various processes in the manufacture of common articles, as cotton

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[1] McMurry: *Special Method in Geography.*

and woolen cloth, boots and shoes, wheat flour, the latter showing the various stages of the wheat from the time it enters the mill until the finished product is prepared, are also of great value.

By arranging to exchange specimens with schools in different parts of the country, valuable additions can often be made to the geography cabinet. It is also well occasionally to buy specimens which cannot be obtained at home or by exchange. Unfortunately, there are no dealers who make a specialty of handling this material for school purposes.

(b) CLIPPINGS. Newspapers and periodicals contain many articles valuable for the geography class. Teacher and pupils should be constantly on the watch for such articles. Clippings should be filed in accordance with directions given on pages 109–110, Section 15. They should always be at the disposal of the pupils, under the restriction that the clippings be handled with care and always placed back in the envelope from which they were taken, when the pupils are through using them. In connection with the clippings there should also be kept a card index of the articles in magazines which cannot be cut, and of chapters in books which bear upon the subject. This index increases in value from year to year.

(c) PICTURES. The selection, mounting, filing and use of pictures have already been described in Section 15.

(d) BOOKS. The following list of books is divided into two classes, those suitable for the teacher and those that can be used by both teacher and pupils.

(1) *Books for Teachers.* Only such works are mentioned as can be procured at nominal or moderate prices:

Special Method in Geography. C. A. McMurry. 217 pages. Macmillan Company. This is one of the most helpful works that the teacher can obtain. It gives full directions for the selection of material for the study of types.

New Basis of Geography. Redway. 225 pages. Macmillan Company. This work is valuable for showing the foundation upon which geography under the present methods of teaching rests, and it should form a part of the equipment of every teacher of the subject.

The Teaching of Geography. Geikie. 202 pages. Macmillan Company. A work containing many valuable directions and suggestions.

Man and his Work. Herbertson. 136 pages. Adam and Charles Black, London. Though an English publication, this work can be obtained of most dealers in the United States. It is of especial value in showing the influence of geographic conditions upon human activities.

Methods and Aids in Geography. King. 518 pages. Lee & Shepard. This work contains many valuable suggestions and devices, though its statistical matter is decidedly out of date.

How to Study Geography. Parker. 400 pages. Appleton & Company. This is one of the International series and gives a more scientific treatment of the methods of studying and teaching geography than any other work included in the list. Some portions of it are somewhat difficult, but they will repay the study necessary to enable the teacher to understand them.

Manual of Geography. Redway. 175 pages.

By the same author: *The Reproduction of Geographical Forms.* 84 pages. D. C. Heath & Company. The *Manual* renders the latest discoveries in geography valuable for the use of teachers and contains chapters on clay and sand modeling and map drawing. The book has for its purpose the grouping of the various forms and outlines of relief into types more difficult than teachers of elementary schools usually care to undertake.

Lessons in New Geography. Trotter. 182 pages. D. C. Heath & Company. Contains many valuable hints and topics with suggestions for some of the most recent methods.

International Geography. Mill. 1088 pages. Appleton & Company. A comprehensive treatise of the countries of the earth, each being treated by an author specially qualified to write upon the country which he described. For its price it is the most useful reference work in geography in existence.

Physical Geography. Davis. 428 pages. Ginn & Company. An excellent and quite comprehensive elementary text-book upon this subject. Contains many valuable illustrations, and the text is easily undertsood.

Introduction to Physical Geography. Gilbert and Brigham. 380 pages. Appleton & Company. An excellent elementary work for both teachers and pupils.

Chalk Illustrations. Morton. 200 pages. A. Flanagan Company. This is a suggestive handbook for making free-hand sketches. It contains a large number of illustrations and full directions for making blackboard drawings.

The New Practical Reference Library. 5 volumes. The Hanson-Bellows Company. This is an excellent reference work for both teacher and pupils. Simple in style, of recent date, printed in clear type, beautifully illustrated, and sold at a price which brings it within reach of everyone, this work forms a valuable accession to the teacher's library.

(2) *Books for Teachers and Pupils.* The various series of geographical readers put out by the different publishing houses, as well as such books on travel as the Boy Traveler series, the Zigzag Journeys series and Family Flights series, are especially interesting to pupils, and they contain many geographical facts presented more completely than it is possible to do in a text-book. The more of such books the pupils have access to, the more complete understanding of geographical subjects they will be able to obtain. Every school should have an atlas, a globe, and an encyclopedia that can be read and understood by the pupils. In addition to the above works, the teacher will find very useful the *Statesman's Year Book;* the *Canadian Year Book;* the *Canadian Almanac* published by Messrs. Copp, Clark & Co., Toronto; *Five Thousand Facts about Canada*, Canadian Facts Publishing Company, 667 Spadina Avenue, Toronto.

WORK BY GRADES

22. Fourth Year. The following outline is suggested for the work of the fourth year:

(1) Collect results of previous study.

(2) Local physiography; hills, valleys, mountains, prairies and rivers. (Section 7.)

(3) Springs, brooks, lakes, ponds, swamps.

(4) Trade and occupations of the immediate locality.

(5) Maps. (Section 13.)

(6) Excursions and imaginary journeys. (Section 12.)

(7) The world as a whole; form, size, day and night. (Section 8.)

(8) Natural divisions of land and water.

(9) Continents and oceans.

(10) Location and extent of North America and its leading physiographic features, or study of the state. (Section 10.)

(11) Topics relating to history stories. (Volume Five, pages 168 and 171–172, Sections 12, 13 and 15.)

(12) Local Government. (Volume Five, pages 192–193, Section 33.)

23. Fifth Year. The work of the fourth year should be continued as follows:

(1) Review work of the previous year.

(2) North America. Chief physiographic features; soil, climate, productions, people, political divisions.

(3) Smaller type studies of the Dominion, such as a coal mine, Niagara Falls, wheat raising. (Section 9.)

(4) The Dominion as a whole. Great divisions of surface, river systems, Great Lakes, climate, provinces, chief products, chief manufactures, ten largest cities, chief railway and water routes.

(5) Study of the province reviewed and extended.

24. Sixth Year. Most of the time of this year should be devoted to the other countries of North and South America. Follow the plan for continents and countries given in the previous section:

(1) Other countries of North America. Same plan as for the Dominion.

(2) South America. Same plan as for North America.

(3) West Indies.

(4) Topics suggested by history lessons. (Volume Five, pages 168 and 171, Sections 12–13.)

(5) Study of maps, making the work more minute than the previous year.

25. Seventh Year. The work of this grade should consist of the study of Europe and Asia, and a special study of the Dominion; also of the chief facts of climate and mathematical geography:

(1) Eurasia. (Section 22, Topic 10.)

(2) Europe.

(3) Leading countries of Europe. In connection with each country locate its colonial possessions.

(4) Less important countries of Europe.

(5) Asia.

(6) Leading countries of Asia.

(7) East Indies.

(8) Africa.

(9) Australia.

(10) Races of men.

(11) Great commercial routes of the world.

(12) Special study of the Dominion, following the plan of text-book. (Section 16 and 17.)

26. Eighth Year. The work of the eighth year should consist of:

(1) The general study of Asia and Africa, with special attention to recent developments in those grand divisions.

(2) Great empires of the world, as wholes, including colonial possessions, method of government, resources and commercial advantages of each.

(3) Different forms of government.

(4) Distribution of heat, isothermal lines.

(5) Winds. Rainfall. (Volume Five, pages 61–66, Sections 38–44.)

(6) The ocean, tides and currents.

(7) Distribution of natural resources of the world, forests, mineral, fuels and metals.

(8) Location of great agricultural regions. Compare with each other.

(9) Astronomical zones.

(10) Change of seasons, giving attention only to the chief causes.

(11) Commercial geography by type studies of great industries, with special view to their commercial importance.

27. Ninth Year. The work of the ninth year will consist of the study of commercial geography, or of physical geography from the text-book. The plan of the book should be followed.

TEST QUESTIONS

1. Show how geography differs from botany in its treatment of cotton and allied subjects, and from meteorology in its treatment of climate.

2. Show how you would lead a sixth year class to see why London is the greatest commercial and financial center of the world.

3. Give a brief description of the surface of the locality in which your schoolhouse is situated and show to what extent you can make use of lessons on this region in teaching the natural divisions of land and water to a fourth year class.

4. Make a freehand outline map of the province in which you live, placing in it the principal rivers and mountain ranges, the chief cities and the leading trunk lines of rail-

way. Do this without a map of the province before you. How many minutes did you spend upon the drawing?

5. Show why and in what particulars oral instruction in geography requires of the teacher more extensive and more thorough preparation than does the use of the text-book.

6. What is the relative importance of the study of maps and the study of the text, for pupils using the advanced geography? Give full reasons for your answer.

7. Explain by the use of a globe your method for teaching the cause of day and night to a fourth grade class.

8. What places in North America have been made famous by the writings of great authors?

9. Give your opinion of what constitutes a good text-book in elementary geography. What books come nearest to your ideal?

10. Give a plan for teaching commercial geography in the eighth year, when no text-book is used.

11. Which of the four divisions of geography would you present almost exclusively to young children? In what grades may economic geography safely be introduced?

12. Of what other sciences should the teacher have considerable knowledge in order to present geography acceptably?

13. Make an outline of what should be included in the presentation of home geography.

14. How would you correlate an imaginary journey in a geography lesson with other school subjects?

15. What educational advantage is gained from map drawing beyond acquiring geographical facts?

16. By concrete illustration show the correlation of history, geography and literature.

17. The zones of various products of our agriculture are fairly well known to you. Construct a map showing other portions of the world where the same crops are produced. Of what advantage will this be to the geography class?

18. Give reasons for or against use of water color in map drawing.

19. Give reasons for your opinion regarding production maps.

28. Type Study on Lake Michigan

Suggestions as to Method

(*a*) This topic admits of a great variety of illustrative data, including pictures, maps, and advertisements of steamships and lake summer resorts.

(*b*) The lake scenery of shores and islands for all the inland seas should be represented in pictures.

(*c*) Drawings and pictures of the harbors of Duluth, Chicago, Port Arthur, Toronto, Kingston, Buffalo, etc., are much needed.

(*d*) The great ore docks on the shores of Lake Superior and the machines for unloading ore along Lake Erie can be represented in pictures.

(*e*) A large map of the Great Lakes showing the routes of the four chief kinds of shipment and the large lake ports can be drawn by the pupils.

(*f*) In connection with ship-building get pictures of the big shipyards and of the large passenger and freight steamers. Compare with ocean steamers.

(*g*) The comparison of the Upper Lakes with Lake Ontario and the lower St. Lawrence, and of the five Great Lakes with the Mississippi River and its navigable waters and large cities is striking in results.

(*h*) As series of lakes, cities and rivers are formed, drill upon them repeatedly until they are fully fixed.

Outline of Topics

1. General survey of Lake Michigan. Physical character.
2. Influence of the lake on commerce. Four chief products for shipment.
3. Passenger traffic on the lakes.
4. Ship-building on the lakes.
5. Causes for the rapid growth of Chicago.
6. Comparison of Lake Michigan and Lake Superior.
7. Lake Huron and Lake Erie.
8. Summary regarding the large cities on the lakes.
9. Comparison of lake transport with that on the Mississippi River and its branches.
10. Lake Erie and the St. Lawrence.
11. Other great lakes and inland seas of the world.

LAKE MICHIGAN

1. Lake Michigan is that one of the Great Lakes which lies wholly within the United States. With an area of 23,000 square miles, it is slightly larger than the province of Nova Scotia. Its surface lies 581 feet above sea level and it is in places more than 800 feet deep, so that its bottom lies partly below sea level.

Its shores are mostly low and sandy. Near Michigan City, Indiana, the white sand hills pile up to a hundred feet in height. The sand dunes or ridges reach back some distance from the shore line. The shores are regular except at the north, where Green Bay on the west reaches down a long pointed arm into Wisconsin, and Great Traverse Bay farther east, with smaller bays, breaks up the coast of Michigan. Several rivers of considerable size and length carry their waters into the lake from Wisconsin and Michigan. All the streams flowing into Lake Michigan drain an area of 37,000 square miles, or a region one and a half times as large as the lake itself.

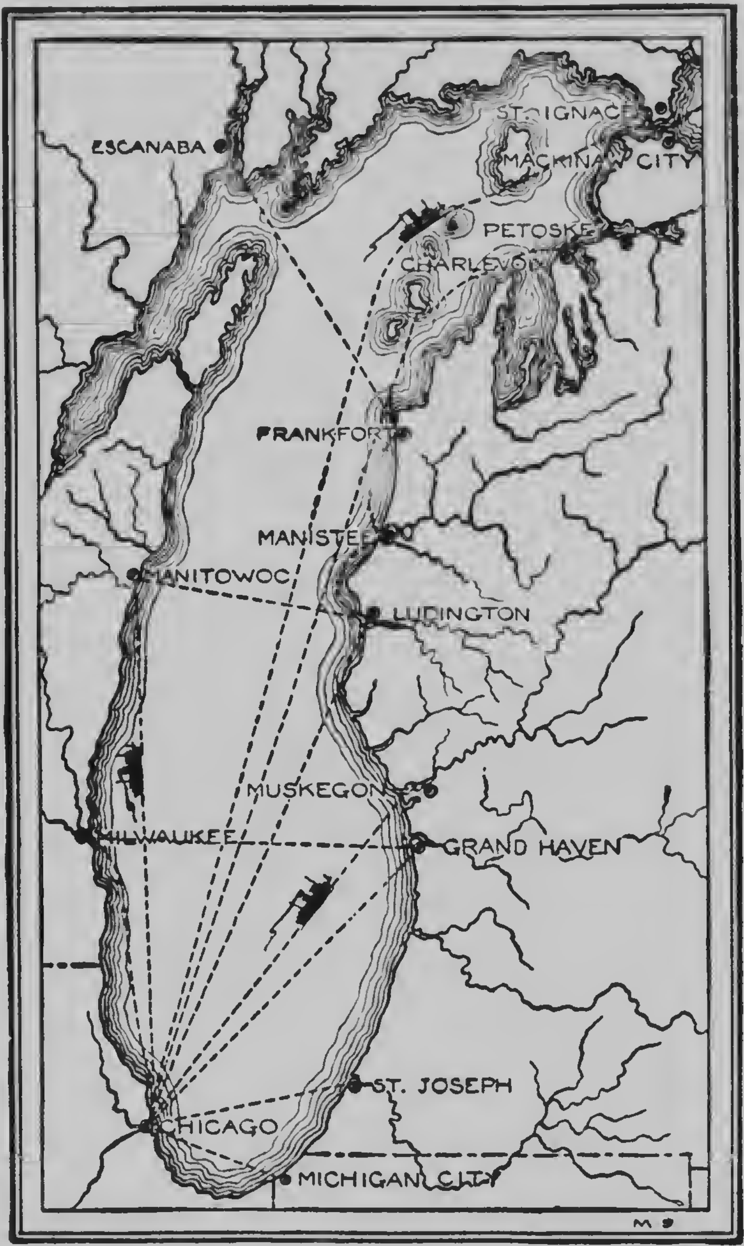
Lake Michigan extends southward from Mackinaw 350 miles and has an average width of about sixty miles. At the widest part one cannot see across it and seems to look out on an ocean.

The lake waters, being colder than the land, temper the air in summer, so that breezes from the lake are refreshing in July and August. Along the western shores of Michigan the lake waters modify the frosty air of spring so as to protect the peach orchards.

The islands and bays along the northern shores of Lake Michigan are so cool and pleasant in the sultry summer months that they are much visited by tourists and those seeking cool summer homes.

2. Lake Michigan reaches like a long finger far southward till it touches the rich prairie and farming regions of Indiana and Illinois.

In an early day farmers living within sixty or eighty miles of Chicago found it a good outlet for shipping their grain and



CHIEF COMMERCIAL AND PLEASURE ROUTES ON LAKE MICHIGAN other products to eastern markets. From the south end of the lake it is easy and cheap to ship goods to Buffalo and by way of the Erie canal to New York City and by way of the ocean to Europe. England and Germany and France are the best customers for the products of Illinois and Iowa and of all the states lying southwest of Chicago for a thousand miles. Before the railroads were built grain and meats could not be easily brought into Chicago for any distance except by the old Illinois and Michigan canal. But in recent years great double track railroads reach out in all directions from Chicago, so that it has become the greatest railroad center of the world.

On the shores of the lake are several large cities, as Chicago, Milwaukee, Racine and Muskegon, which share in this traffic. Milwaukee has an excellent harbor, protected by a breakwater, and since it is favorably located with reference to farming land, timber land and mines it has a large shipping trade. Its receipts by way of the lake are considerably smaller than its shipments, though it receives much coal from the east over the lake route. Racine, the second city industrially in Wisconsin, has also a good harbor, and has steamship connection with other lake ports. Its shipments consist mainly of farm produce and manufactured products. Muskegon is on Muskegon Lake, which is connected by a channel 200 feet wide with Lake Michigan. This channel is deep enough to admit large vessels, and the harbor of Muskegon is one of the finest on the lake. There is daily steamship communication with Chicago, Milwaukee and other lake ports, and the trade in lumber and farm produce is large.

Lake Michigan is chiefly important as a water route for shipping goods eastward. For about four months in winter the harbors of the lake are closed up with ice, but during the other eight months the ship traffic up and down the lake is so great that it is hard to measure it. The four chief products freighted on the lake vessels are grain, iron ore, lumber and coal.

For about sixty years Chicago has been a very large lumber-shipping point, collecting white pine lumber from the streams and sawmills of Michigan and Wisconsin and shipping it by rail to the west and southwest. More than forty years ago the Chicago River was crowded with wooden vessels loaded high with lumber. But the pine woods in Michigan and Wisconsin are nearly exhausted, and this trade has now dwindled to small size.

In recent years the iron mines of Michigan and Minnesota have been sending millions of tons of iron ore to Chicago, Joliet and Gary, and the ore-carrying vessels coming down from Lake Superior are of vast size. A single vessel has sometimes brought a cargo of more than 12,000 tons to South Chicago. At the great steel works of Chicago the red ore from the ships is piled up in mountain-like heaps before passing into the blast furnaces.

Chicago as a grain-collecting center is so important that eighty-three elevators with a capacity for 63,000,000 bushels have been built. Much of this grain is shipped east to Buffalo by the lake freighters. On the return voyage the vessels are loaded with coal from eastern Pennsylvania, which is then distributed from Chicago and Milwaukee to the people of the west.

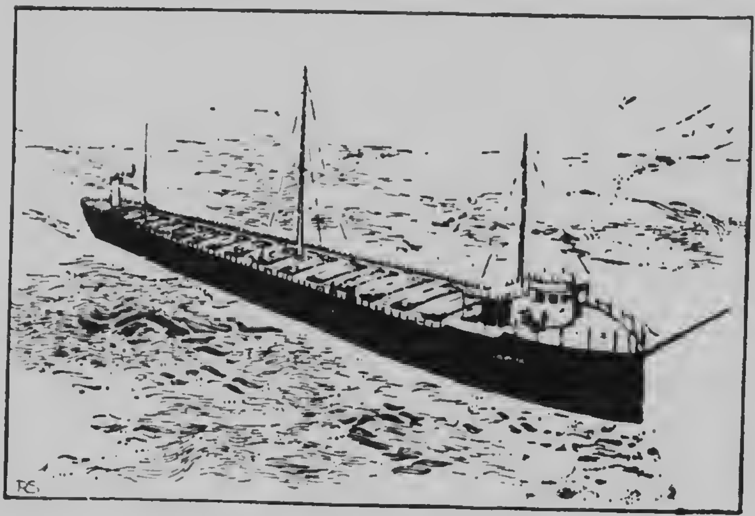
Besides these four staple products which make up the bulk of lake shipments, a large amount of other merchandise is sent westward to Lake Michigan cities by water, as wholesale groceries, machinery and manufactures.

3. Even the passenger traffic for summer tourists has grown to be an important part of the lake commerce. Some of the passenger vessels on the lakes cost more than a million dollars each, and carry as high as 2,500 passengers. In 1907 sixteen million passengers sailed on the lake steamers, and out of this number only three lives were lost by steamer travel and two of these by accidental drowning. The tourist travel on the lake steamers in summer is extensive, including Lake Superior and the other lakes.

4. To supply the large number of ships on the lakes extensive shipyards must be found somewhere on their shores. Chicago is one of the centers for ship-building. The

old wooden sailing vessels have largely disappeared before the huge steel monsters that now plow the lakes, some of them more than 600 feet long and capable of carrying from 10,000 to 12,000 tons of freight. The shipyards supply work to thousands of men and bring support to their families.

The frames and sides of these great vessels are made of steel beams and plates. The cabins of the freighters and the



WILL CARRY 10,000 TONS OF IRON ORE

One of the great fleet of ore boats on the Great Lakes

parlors and staterooms of the passenger steamers are finished in mahogany and display decorations which rival the great ocean steamers. The demand for lake transportation has been so great that large fortunes have been made by the owners of shipyards at Chicago, Detroit, Cleveland and other lake ports.

Lake Michigan is important for its fisheries. Trout and white fish are brought into the markets of Chicago in large quantities.

5. The importance of Lake Michigan for commerce is best shown by the rapid growth of Chicago. Within the short

period of one lifetime it has grown from a village to a world city of the largest size. Although Chicago had but a small harbor and that was gained by deepening the river and constructing breakwaters and docks, its nearness to the great grain-growing states and the rich upper half of the Mississippi valley has caused its remarkable growth. Chicago lies also at the point where Lake Michigan must connect with the water traffic of the Mississippi River, via the Illinois. The old Illinois and Michigan Canal was first built to join these waters. The Drainage Canal from Chicago to the Illinois, where it is extended down the valley, will some time complete this great traffic route and give Chicago access to the Gulf of Mexico for heavy barge transport.

In olden times the outlet of Lake Michigan was by way of the Des Plaines and Illinois Rivers to the Mississippi. The Drainage Canal has again turned the waters in a steady flow down this old course. In time this may develop into a great water route to the Gulf and thus greatly cheapen freight rates southward and to other lands. In this way Chicago on the lakes would have as good an outlet to the Gulf for her products as toward the east. A strong effort has been made in recent years to secure a deep water-way from Chicago to St. Louis, but such a plan has not yet been adopted by the legislature of Illinois.

6. Lake Superior is a larger, deeper and colder body of water than Lake Michigan. Its northern shores are rocky and almost mountainous, and numerous short rivers flow into it from all sides. The storms on its broad sealike expanse are like those of the ocean. But during the eight months of navigation an immense commerce is conducted by hundreds of huge lake steamers. The whaleback ships for grain and the long steel cruisers for iron and copper ore traverse the lake from west to east, bringing coal on their return voyage.

At Sault St. Marie are mighty locks to let down these big freighters to the level of Lake Huron.

When we come to compare Lake Superior with Lake Michigan, we find the cities of Duluth, Port Arthur and Fort William all commanding, like Chicago, a wide range of western traffic. Situated at the western extremity of the lake, they reach far westward toward the wheat-producing lands of Manitoba, Saskatchewan, Alberta and the United States. In 1907 more than eighty million bushels of grain were shipped from Duluth and Superior, and the Canadian Northwest promises to surprise the world with its production of wheat, oats, barley and flax. Port Arthur and Fort William on the north shore are even more important for the shipment of Canadian grain.

From Duluth the heaviest shipments are iron ore. It requires 800 great ore ships to carry the iron ore eastward on the Great Lakes, and in 1907 they transported more than forty million tons of ore, mostly from Minnesota.

On the other hand, Duluth is the chief center from which coal, brought west by the steamers on their return trip, is scattered by rail through the northwestern states.

Recently a ten million dollar steel plant has been built at Duluth, and some people prophesy that Duluth will soon grow to a city of a million people and be a rival to Chicago. The copper mines on the south shore of Lake Superior also send heavily laden ships down the lakes with their rich ingots.

7. Lake Huron and Georgian Bay together are larger than Lake Michigan. The numerous islands and inlets of Georgian Bay make a wilderness and pleasure ground for fishers and summer wanderers. Lake Huron is a passage-way for all the water traffic from Lake Michigan and Lake Superior, and like all the lakes it has its great city, at Detroit, corresponding to Chicago and Duluth. An immense commerce passes through Detroit River, larger than along any similar stream in the world. The remarkable growth of Detroit and its great manufactures show the advantage of its position.

Lake Erie, though not half as large as Lake Michigan, is of very great importance among the four larger lakes. It is especially important because of the large number of populous cities clustered along its southern shore, beginning with Toledo at the west end and terminating with Buffalo at the east end. No other lake in the world has such a series of fine cities. All these cities receive large ore shipments from Lake Superior, and either work the ore over into steel products or send it on to the Pittsburgh district. Coal from the eastern part of Pennsylvania is received at Buffalo and Erie and shipped westward.

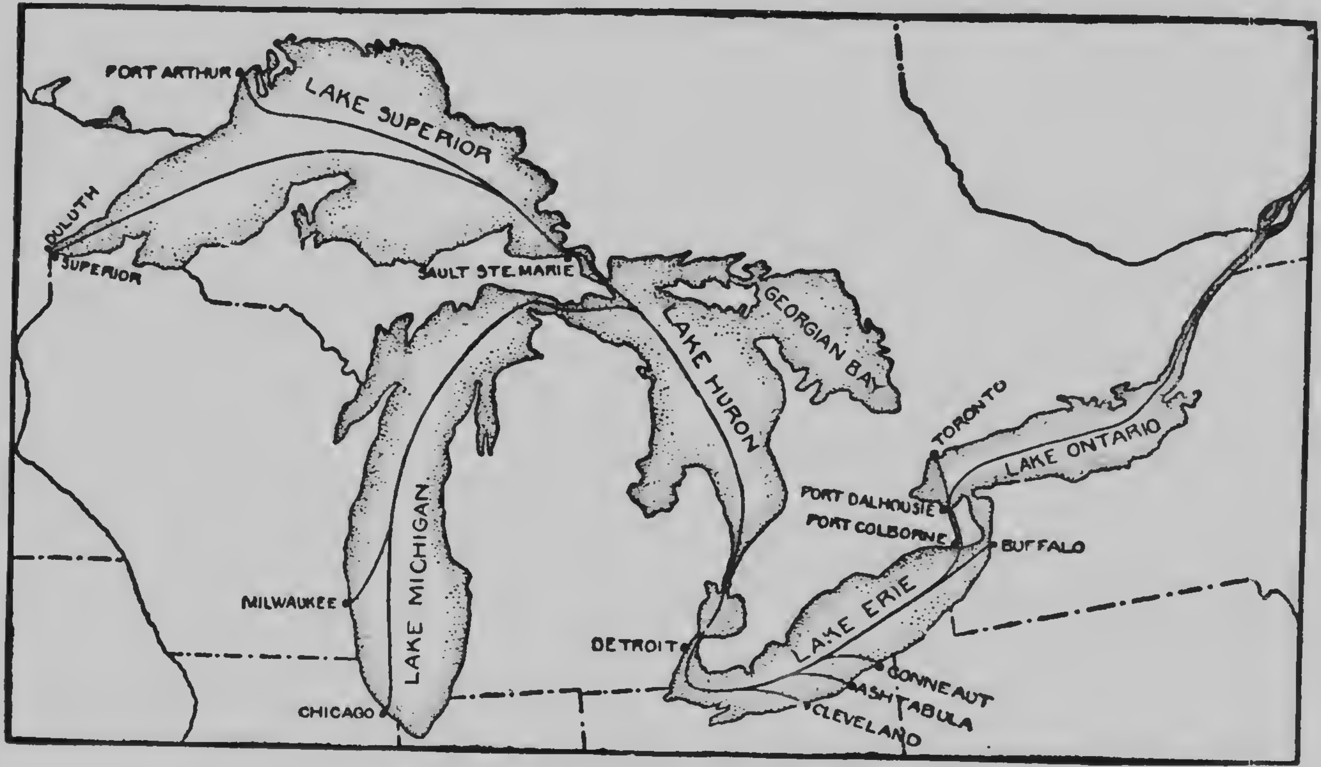
Buffalo occupies a place at the east end of the four Great Lakes of almost equal importance to that of Chicago at the west end. All the heavy lake shipments from the west terminate at Buffalo and are transferred to canals or railroads. The vast water power of Niagara Falls is developing extensive manufacturing establishments along the Niagara River and at Buffalo. It seems probable that Buffalo will become the center of the largest general manufacturing interest in the United States, while Niagara Falls is rapidly growing as a Canadian center. Buffalo holds the key to the commerce coming from the west and the return wave of trade from the east.

The four Great Lakes which we have thus far described belong together and are parts of one big system of water traffic between the east and the west.

8. Great cities are located both at the upper end and at the outlet of the lakes. All of these cities share in the huge transport of lumber, grain, iron ore and coal. The chief center of lake ship-building is at Detroit. At Fort William, Port Arthur, Cleveland, Toledo, Chicago, Buffalo and Milwaukee and several other cities are large ship-building plants. In 1908 more than half of all the tonnage built in the United States was of ships built on the lakes. The great steel vessels built at Detroit and other lake ports rival those built in the famous shipyards of the Clyde at Glasgow.

By comparing the important cities on the four large lakes with the cities located on the St. Lawrence and its tributaries, we find that the lake cities somewhat surpass those of the whole St. Lawrence Valley.

9. There was a time when the steamboat traffic on these rivers was of large dimensions, but in recent years it has greatly lessened. The ship traffic of the Great Lakes has been growing with gigantic steps, while the river trade has become



CHIEF COMMERCIAL ROUTES ON THE GREAT LAKES very small. Why is this difference so marked? It was once thought that the 10,000 miles of navigable waters of the Mississippi River and its branches would form a vast system of inland water traffic. But instead of growing in the last forty years the river steamboat traffic has steadily and rapidly declined. There has been much talk of a deep waterway from Chicago to the Gulf, also from Pittsburgh and St. Paul to the Gulf. But at the present time the railroads monopolize the freight business and the rivers do not count for much.

The lakes, on the other hand, have become vastly important in heavy freight transport. The lake rates are much cheaper than the railroad rates, and in the large business of shipping between the east and the west they are saving both shippers and consumers many millions of dollars yearly. It looks now as if the freight traffic on the Great Lakes would grow steadily larger. Such cities as Duluth, Buffalo, Chicago, Cleveland, Detroit and Milwaukee are growing so fast that they may well rival the chief seaports along the Atlantic seaboard.

On the shores of the Gulf of Mexico, New Orleans, Galveston and Mobile have much importance, and when the Panama Canal is opened, they may take on a larger trade, but as yet they have no such importance as the lake ports.

10. Lake Erie and the St. Lawrence are largely cut off from the traffic of the Upper Lakes by Niagara Falls, although the Welland Canal is considerably used. The Erie Canal and the New York Central and other railroads divert most of the western traffic to New York City. The deepening of the Erie Canal to a broad and deep barge canal at a cost of more than one hundred million dollars has already made the Hudson River and New York the outlet for the commerce of the lake regions.

The northern shores of the Great Lakes lie in Canada, and a number of promising cities have sprung up along their shores, as Toronto and Hamilton on Lake Ontario, Port Arthur and Fort William on Lake Superior. Canada, however, has not yet developed the lake traffic as has the United States.

11. There is no other series of great lakes in any country that will compare in importance with those of our St. Lawrence system. The Nile rises in a series of equatorial lakes of large size lying in the tropics, but they can never rival the Great Lakes in commercial importance. The Mackenzie system has some large lakes in the cold, bleak north, but they are frozen most of the year. The great inland seas between Europe and Asia, the Black and the Caspian, are the only inland waters that could be well compared with our Great Lakes, but while they are very much larger than the lakes, they are not so important in the number of great cities, nor in the extent of commerce they supply. The Black Sea as an outlet for the grain of southern Russia might be compared to the upper lakes, with Duluth and Chicago as shipping centers.

Historically considered, the Mediterranean has been the most important of all the great inland seas. All the great nations of antiquity sprang up around the shores of the Mediterranean, and the ruling cities of the world, as Rome, Alexandria, Constantinople, Carthage, Tyre and Sidon, Ephesus, Athens, etc.

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29. Type Study on Mt. Shasta

Suggestions as to Method

(a) Use large maps freely in carefully locating all the important volcanic mountains and regions described.

(b) In explaining the shape and extent of lava flows on the mountain side, use diagrams and blackboard sketches.

(*c*) The different zones into which the mountain is divided can be well shown with different colored chalks. The upbuilding of a volcano by successive lava flows can be easily illustrated by crayon sketches. The whole life history of a volcano should be interpreted on the basis of causes at work producing certain results. The children can see this causal relation at every step.

(*d*) Collect a series of pictures showing volcanic eruptions and volcanic mountains. Le' the children collect and study such pictures. The explanation of such pictures by children may sometimes require a whole lesson.

(*e*) In making comparisons let children note specifically the points of likeness and difference between volcanoes. The summarizing statements at the close should be clearly grasped.

(*f*) In the expansion of the topic by comparison let the children form series of volcanoes in regular order, which they drill upon until they can give the series promptly, pointing out the locations on the map.

Outline of Topics

1. General description and position of Mt. Shasta.

2. How the mountain grew. The lava flows or coulees. Explosive eruptions of fragmental material. Side eruptions and cones.

3. Pluto's cave.

4. The tearing down of the mountain

5. Three distinct zones developed on Mt. Shasta. The highest zone, or zone of glaciers.

6. The forest or middle zone. The canyons.

7. The barren flat belt at the foot of the mountain. Great springs.

8. Summary regarding the life history of Mt. Shasta through the ages.

9. Comparisons with Mt. Hood and Mt. Rainier as to position and formation.

10. Other volcanic peaks and districts in the Sierra Nevada and Cascade ranges.

11. The great lava plains of eastern Washington and Oregon.

12. Rocky Mountain volcanoes.

13. The volcanoes of Alaska and Mexico.

MOUNT SHASTA

1. Mt. Shasta at the head of Shasta Valley and near the source of the Sacramento is a volcano that has ceased to be active. At Mt. Shasta the Sierra Nevada and the coast range come close together, and this volcano stands almost at the point of union of the two.

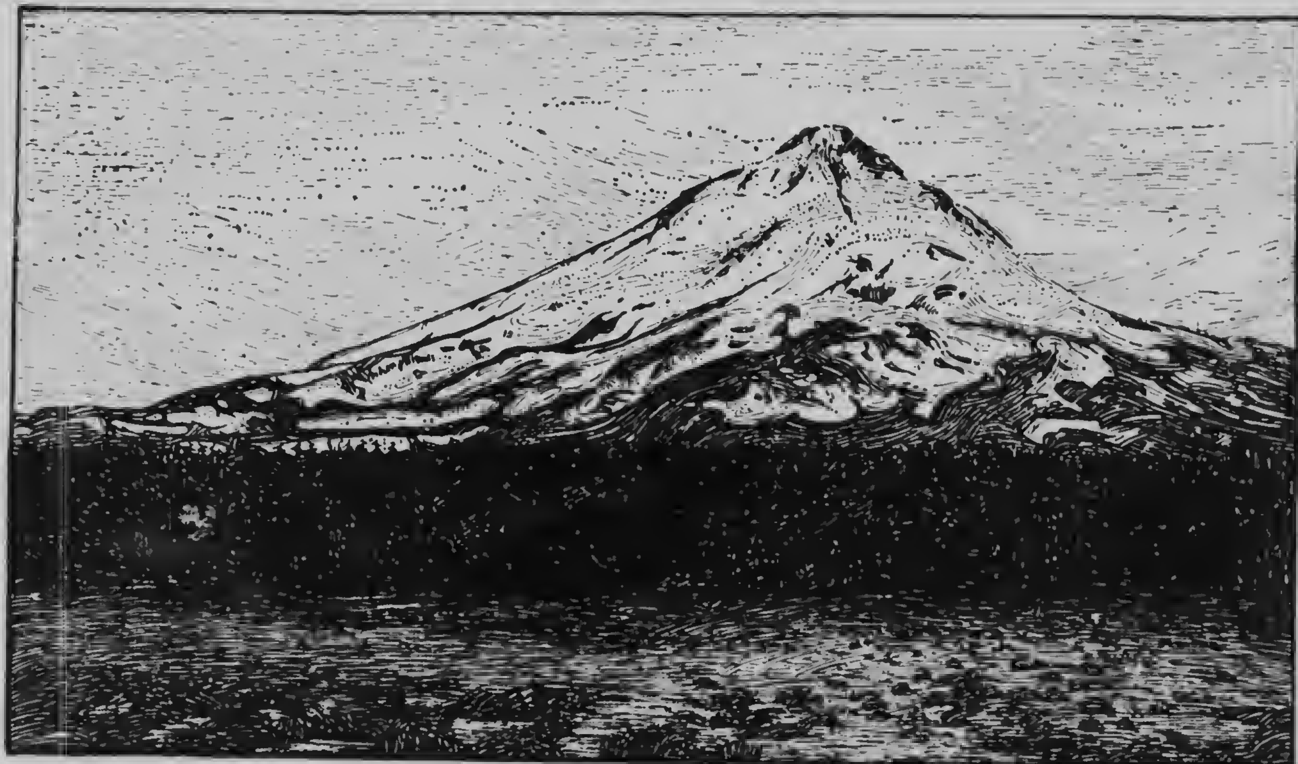
While there are mountains of considerable size all about it, some of them 2,500 feet higher than any of the Appalachians, Mt. Shasta towers a mile above them all and is a commanding object in the landscape of Northern California.

Its higher valleys and slopes are white with snow and glaciers even in summer, and its middle sides are black with lofty forests.

Mt. Shasta stands on a plateau nearly a mile above sea level and then rises about two miles above its base. Its base is about seventeen miles across, and its slopes, which are gentle toward the base, grow steeper as one ascends, till toward the summit they are quite rugged, and steep cliffs appear.

2. Mt. Shasta consists of rock materials which have come up through its crater and smaller openings in its sides from the intensely heated matter of the interior of the earth. It is supposed that this melted rock material, usually called lava, has been forced out by steam and explosive gases formed in the earth when the intense heat converts the water into steam. In the opinion of geologists this huge mountain was built up very slowly and gradually through thousands and tens of thousands of years by eruptions or overflows of this lava material, usually from the hollow top or crater of the mountain, but often through cracks or vents in the sides.

The lava material of one of these eruptions spread out on the mountain side is called a *coulee*. Usually the melted rock material rises slowly in the great pot-like crater, steaming and bubbling, driven up by the deep forces in the earth, until it pours over the lower side or lip of the crater. This great stream of liquid lava then flows slowly down the moun-



MT. SHASTA, CALIFORNIA, FROM THE EAST
(Drawn from a photograph made by the United States Geological Survey)

tain side, and as it cools with exposure to the air it hardens and changes into rock. Often it is cracked and split into great blocks in the act of cooling, so that the surface is very rough.

Several of the more recent lava flows or coulees can now be clearly seen on the sides of Mt. Shasta, although it may be many years since the latest took place. On the northeastern slope of the mountain are several coulees, each of which can be plainly marked. The longest of these is about four miles in length. Lower down it widens out, but its edges on the sides are steep and it ends in a steep bluff. The top part is nearly flat, though sloping down. These latest lava flows, toward the top of the mountain, were thick and stiff so that they did not flow far, but built up the upper sides of the mountain like great thick shingles. Most of these coulees end in steep bluffs, sometimes 500 feet high, and they overlap one another something like the shingles on a house. As the whole mountain was built up slowly by these lava flows, the earlier ones were, of course, covered up by the later.

These eruptions and lava flows took place only occasionally with long periods of fifty years, more or less, between, so that we can hardly imagine the enormous length of time required to build up a mountain.

A second mode of building up this volcano was by violent eruptions which suddenly hurled masses of molten material, ashes and rocks, into the air. This material, called fragmental, then tumbled back upon the top and sides of the mountain. The fragmental material is blown to pieces and much broken up and can easily be distinguished from the more solid lava flows.

Sometimes a lava flow consisted of a very thin, watery, molten lava which flowed far down the mountain side and then followed the valleys many miles. One such great lava flow ran down fifty miles along the upper Sacramento Valley, filling up the bed of the stream and changing its course.

Such lava flows would build up the lower basin and valleys beyond the foot of the mountain.

As Mt. Shasta grew higher by successive eruptions and its neck-like crater grew longer (two miles and more), the pressure of the lava upon the sides was so great that it broke through in several places, and coulees were formed at the sides and lower down. Sometimes these side exits poured out such a quantity of lava as to build up cone-shaped hills and mountains. One of these cones at the southwest foot of the mountain is 2,000 feet high, and is a striking landmark called Cone Mountain. Higher up on the side a series of smaller cones was formed along a line of weakness in the mountain side. Sometimes these side eruptions grew into small mountains with craters in their summit. Some of these crater-bearing cones can still be seen on the north and northwest side of Mt. Shasta. Black Butte on the northeast has a double crater distinctly marked.

At the southwest is the cinder cone from which escaped the great coulee that flowed fifty miles down the Sacramento valley. The cone is 600 feet high, with a well-defined crater.

Mt. Shasta is really a double volcano, as seen from the north. The lower of the two peaks, Shastina, which is 2,500 feet lower than Shasta, has in its top a crater.

3. Toward the base of the mountain at the northeast and at the southwest, the ground sounds hollow under the tread, and indeed long caves are found. Pluto's ca[illegible] on the north has been explored more than a mile, and is from sixty to eighty feet high and from twenty to seventy feet wide. A closer inspection will show that the cave runs [illegible]arallel to a lava flow. In fact, it was formed by the molten lava in the center of a coulee flowing out through the lower end and leaving a crust of lava over a long cave. Such [illegible]aves are not uncommon in volcanic regions.

4. Thus far we have discussed the forces that built up the huge mass of Mt. Shasta. But gradually the fire and internal heat of the earth subsided, and in their place came storms, snow and ice, and the whole top and upper part of the mountain resemble regions of arctic cold. The winds from the

Pacific bring fierce storms, and the snow piles up hundreds of feet high. The tearing-down forces have begun their long work and are slowly wearing down the sides of the mountain.

5. Since the work of pulling down the mountain has begun, three distinct zones have developed: (1) The barren summit covered with snow fields and glaciers but bare of vegetation, because of the arctic cold; (2) The middle belt of forests from 10,000 down to about 4,000 feet above the sea; (3) The dry flats that lie about 3,000 feet high around the bases of the mountain.

There are five glaciers on Mt. Shasta; Whitney glacier on the northern slope, pushing down the valley between Shastina and Shasta, comes from a snow field higher up and is two and one-half miles long and from 1,000 to 2,000 feet wide. In its slow, grinding movement down the valley it has carried down a vast amount of rock and sand material and has piled them up in a great mass at the lower end, forming what is called a terminal moraine. All the five glaciers on Mt. Shasta have carried much rock material with them to lower levels, and are gradually, indeed very slowly, tearing it down. At the foot of the glacier a stream is formed by the melting ice that pours down the steep slope, then plunges over a fall several hundred feet and passes down a deep canyon which it has worn out. In the warm days of spring and summer the snow and ice of the glacier melt so rapidly as to form a flood. The milky water from above tears down the canyon, cutting it deeper and sweeping sand and gravel toward the foot of the mountain.

6. The middle zone of Shasta is a great forest belt made of cone-bearing trees, among which the sugar pine is the largest. It often stands 200 feet high and has a diameter at the butt of ten or twelve feet. This middle zone of the mountain receives heavy rains carried by the wet winds from the Pacific Ocean, and its forests are well supplied with moisture.

Cutting down through this middle belt of forests lie deep canyons, some of them from 600 to 1,000 feet deep, with steep or sloping sides. Where the forests stand, the tangled roots and thick vegetation hold the soil and prevent wash, but in the canyons the rock materials are wearing down rapidly.

7. On the lower levels near the foot of the mountain the streams are swallowed up and disappear in the sand, especially in summer. In the fall and early spring there are abundant rains and the whole land is rich in grass and flowers, but the summers are long, dry and hot, and the lower belt around the foot of the mountain becomes dry and parched.

In the beds and sides of the streams at the mountain base are immense springs, gushing from the roots of the mountain. The mountain is made up of volcanic material which is loose and porous and absorbs moisture. For this reason the melting water from the snows and glaciers sinks into the sides of the mountain and reappears in great springs lower down at the foot of the mountain.

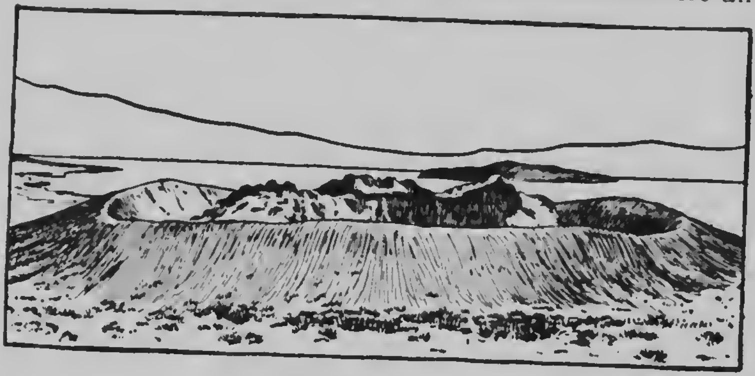
8. Glancing back at the whole life history of Mt. Shasta we see that the gradual building up of such a huge mountain must have occupied many thousands of years. The eruptions, if they took place only at intervals of many years, as is now the case with many active volcanoes, would add very slowly to the mountain's height. Yet Mt. Shasta seems to be made up entirely of erupted material.

Its history therefore reaches so far back into the past that it is hard for the imagination to estimate the time. Finally the interior heat forces slowly died away.

There is today one spot on the side of the mountain where noxious gases still come forth and where there is some heat still felt. But now for many years at least there have been no eruptions or lava flows, and the cold winds, snow and ice have long been at work crumbling and grinding the mountain, which had been built up by the great heat forces. This work of tearing down the mountain will doubtless go on for thousands of years to come. It also is a slow process, and we can hardly imagine how long a time it will take to level down this huge mountain again.

9. In the northern part of Oregon, about thirty-five miles west of Portland, there rises a beautiful volcanic peak known as Mt. Hood. It rises far above the high ridge of the Cascade range and is the most commanding object in the landscape.

The upper part of the mountain is glittering white, and all its lower sides are clothed with forests of deep green. Its summit is reported by mountain climbers to contain part of a volcanic crater. From the top of this mountain, standing on a narrow rock, one can look down steep precipices for thousands of feet. Like Mt. Shasta this peak is a volcano whose upper portion is covered with snow and ice and



PANUM CRATER, IN CALIFORNIA
Lake Mono and Paoha Island in the distance

whose middle portion or belt bears great forests well supplied with moisture by the Pacific winds.

The most commanding mountain peak of the whole Sierra Nevada and Cascade ranges in the west stands out alone in southern Washington, Mt. Rainier. This is a volcanic mountain 14,525 feet high, and standing alone it can be seen as it rises majestically from sea level to its white summit. It is a difficult mountain to climb because of its height, the snows and glaciers which cover its summit and sides, the steepness of its upper portions and the fierce winds sweeping across its frozen summit. The geologists who climbed to its top found there partial walls of a huge crater and within this a smaller crater at its edge whose walls form the present summit of the mountain. The crater was nearly filled with snow and ice.

From this lofty summit the mountain climber looks down upon the map of western Washington. Puget Sound is spread out like a winding crooked lake. The Cascade range looks like a low ridge of mountains. Mt. Adams and Mt. St. Helena, two large volcanic peaks, stand to the south, and the Olympic mountain beyond Puget Sound to the northwest. Like Mt. Shasta, Mt. Rainer is a volcano whose huge bulk has been built from lava flows and explosive eruptions. Standing out alone it is even more striking and majestic in appearance than Mt. Shasta. The glaciers formed in its upper slopes descend farther into the deep valleys of the heavy forest zone. This mountain is the most striking object in the view from Tacoma and also from Seattle on Puget Sound.

California, Oregon and Washington each has its great and beautiful volcanic mountain. In all the Pacific coast mountains these great volcanoes are the outstanding peaks whether rising above or from the midst of mountain chains.

10. But each of the states named has many other lesser volcanic peaks, as Mt. Baker, Mt. Adams and Mt. St. Helena in Washington. In Oregon not only Mt. Hood, but Mt. Pitt, Mt. Jefferson and the Three Sisters are volcanic cones, and thirty miles north of Lake Klamath is a crater lake five miles across which occupies the crater bowl of an ancient volcano.

In California, the Sierra Nevada mountains have two very interesting volcanic districts, one called the Lassen's Peak district in northern California; the other the Lake Mono region of the central part of the state, both very curious and interesting. Each of these districts shows a group of volcanic peaks and craters.

11. Eastern Washington and Oregon with a part of Idaho are covered with a vast sheet of lava in places 4,000 feet thick. The lava is here spread out over a more or less level country, covering an area about four times as large as the state of Illinois. It has been a difficult problem for geologists

VOLCANIC AREA OF NORTH AMERICA

to explain where such a vast quantity of lava came from. It seems that part of it along the eastern foot of the Cascade range flowed down from the series of volcanoes we have been describing, but most of it is now believed to have oozed up from the interior of the earth through cracks or fissures. The lava, being in a very watery, molten condition, spread out widely over the plains for hundreds of miles. The lower part of the Snake River has cut a deep gorge down through this lava bed, forming a canyon 4,000 feet deep and fifteen miles wide.

The broad lava plains of Washington and Oregon have a very rich soil caused by the crumbling of the volcanic rock, and vast wheat fields display the richness of the land.

12. The Rocky Mountains contain also some interesting remnants of volcanoes. The Spanish peaks sixty miles south of Pueblo in Colorado are worn-down relics of once lofty volcanoes.

In New Mexico are found well-preserved craters from which the lava flows can be traced, e.g., Mt. Ocate in the northern part of the state.

13. In Alaska, beginning on the mainland and extending from Mt. Wrangell hundreds of miles southwestward in a narrow belt through the Aleutian Islands, is a series of more than fifty volcanoes, many of which are still active. Eruptions and earthquake shocks have been often experienced in recent times.

In Old Mexico, south of Mexico City, is a series of great and towering volcanoes, among which are Orizaba, 18,200 feet high, and Popocatepetl, 17,876 feet. They have been climbed to their tops where great deep craters are found which have been somewhat active in modern time. . Farther south, extending through the states of Central America, is a numerous series or belt of active and extinct volcanoes. North America therefore seems well supplied with volcanoes.

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30. Type Study on the Coast of Norway

Suggestions as to Method

(*a*) Let the children examine the larger maps illustrating these various deep-cut, rocky coasts, and their location with regard to the continents and oceans. Let them observe the strong points of resemblance, in respect to mountain districts just back of these coasts, also forests, fisheries, islands and cities. Let them note the relative distance of these coasts from the equator, whether to the north or south. Let them note the character and occupations of the people upon such shores and islands.

(*b*) The geographies and supplementary readers contain pictures which will help further to illustrate the scenery of these coasts.

(*c*) A rough free-hand sketching of these coasts with their chief islands and bays will help the children to fix the facts.

(*d*) A comparison of the causes producing like results on the coasts of Norway, Scotland, British Columbia, Alaska, Patagonia, New Zealand and other coastal regions explains clearly many scattered facts in various parts of the world on the basis of principles, but it forms a series of important facts worthy of review and drill until they are well fixed in mind.

Outline of Topics

1. Physical and climatic character of the coast of Norway.
2. The fjords.
3. The ice fields and glaciers. Greenland.
4. The islands.
5. The fisheries.
6. Lumbering.
7. History of Norsemen and Vikings.
8. Customs and dress of the people.
9. Comparison with Scottish coast and islands. Ireland.

10. Comparison of coast of Maine, Newfoundland, Labrador.

11. Comparison with the Alaskan coast.

12. Comparison with coast of Patagonia.

THE COAST OF NORWAY

1. The sea-coast of Norway for about fifteen hundred miles is very rocky and mountainous. In the summer time it is much visited by travelers on excursion steamers from England and the south. In winter time the days are short and the northern part of Norway does not see the sun for months. Thousands of islands, rocky and steep, are scattered along the shores.

A voyage to this rocky coast in summer time is interesting because of the grand scenery of the deep gorges or fjords which reach far up into the mountainous country.

The Norsemen who first discovered the shores of North America came from this rocky coast of Norway. Many Norwegian immigrants have also found their homes in our northern states.

Partly on account of the warm ocean currents from the west which bathe the coasts of Norway, the climate is much warmer than we might expect. This is also true of England, Scotland and Ireland, while the corresponding coasts of Greenland and Labrador are cold.

2. The most interesting part of the shore scenery is the fjords or deep, crooked bays which reach far into the land. There are a dozen of these great arms of the sea, from fifty to a hundred miles in length.

The Hardanger Fjord is the most southerly and the finest of the west-coast fjords. The steamer passes between rocky islands into the mouth of this deep bay which winds its crooked way 114 miles into the heart of the mountains. The steamer sails up against the towering precipices, and turning an angle comes to a new scene in the changing panorama. High up on the slopes of the mountains the glaciers are seen pushing their way down the valleys from the broad snow fields on the high plateaus above. Foaming waterfalls are seen breaking down over the rocky ledges. At the head of the fjord is the village of Odde with its old-fashioned square houses whose roofs of birch bark and turf are covered with wild flowers and shrubs.

THE BROKEN COAST OF NORWAY

Near Odde are some of the finest waterfalls in the world. One of these is the Skaejaeggedals, 550 feet high. Another fall has a series of cascades dropping 2,225 feet.

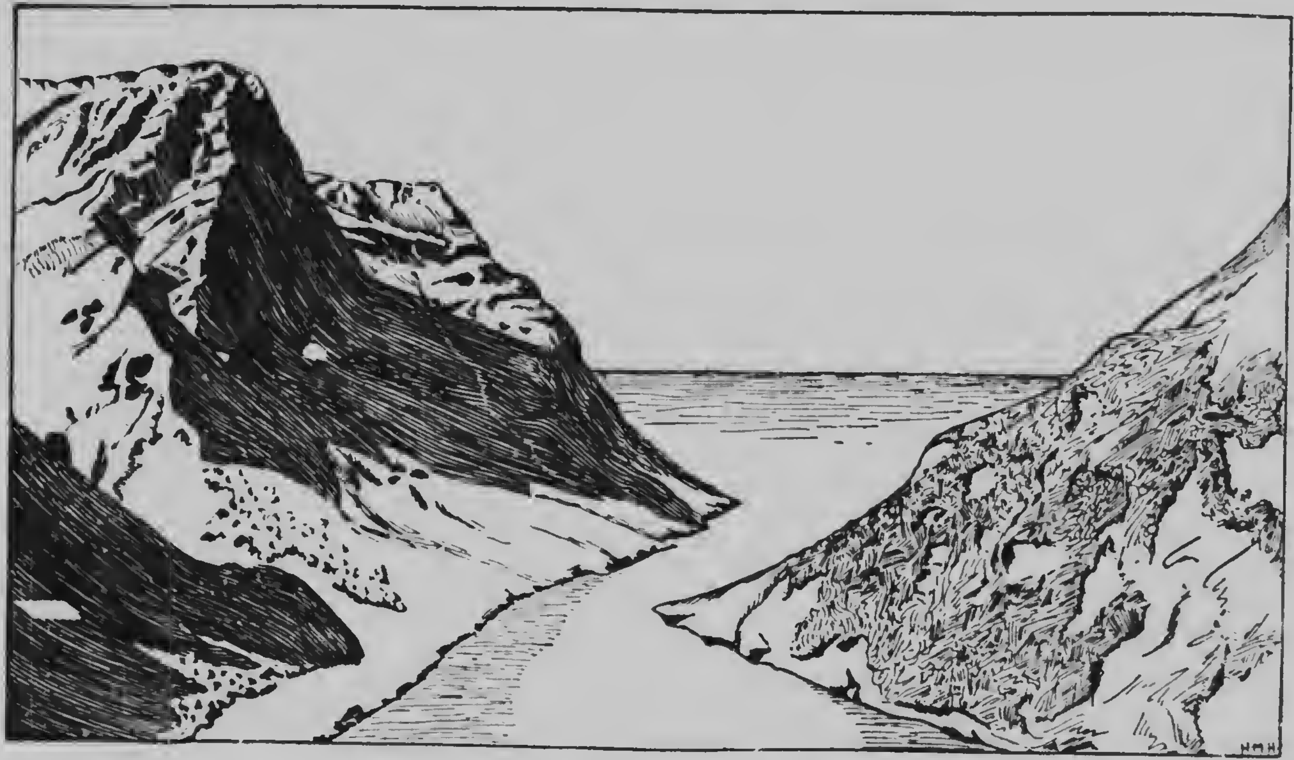
The Sogne Fjord, farther north, is 136 miles long, and in places is more than 4,000 feet deep. It has also about a dozen branch fjords. One of these, the Naerö, is wonderfully wild. The steep walls rise thousands of feet above the water, and the water at the foot of the precipice is very deep. The Nord Fjord has grand and picturesque scenery.

The entrance is guarded by a maze of islets; there are vast ranges of snow-capped mountains in the background, and in the foreground are wooded hills dotted with small cultivated fields. The farmsteads in the Nord Fjord have an air of prosperity that recalls the Hardanger and the waters of the fjord reflect the tints of the farms and foliage—glittering blues where the waters are deep, and translucent yellows and greens where they are shallow. Costumes, like the landscapes, are varied in color and individual in form. The women wear close-fitting red or green bodices; and the men wear knee-breeches, white stockings, red coats with high collars and stiff felt hats. (Monroe.)

The Geiranger Fjord is about eleven miles long and from two hundred to four hundred yards wide. Its perpendicular walls rise to heights ranging from three thousand to five thousand feet. Over these steep cliffs plunge many waterfalls, and when the tops are covered with clouds, they seem to fall direct from the sky. The series of waterfalls known as the "Seven Sisters" is probably the most beautiful in the Fjord. Seven silken streaks of white fall from the overhanging cliffs to the fjord below. (Monroe.)

3. These deep fjords were worn out in part by the glaciers which in ancient times covered the mountains of Norway. These glaciers came down from the great snow fields on the mountain slopes and plateaus and they scoured out the valleys on their way to the sea. The power of glaciers to do this work is shown by the depth of the valleys. Beside the mountain walls from 2,000 to 4,000 feet high the water in the gorges is sometimes 4,000 feet deep, and the sides of the mountains are worn smooth by the great masses of ice that once wore down these valleys.

On the plateau southeast of the Hardanger Fjord is a great snow field twenty miles long and in places ten miles wide. The winds from the Atlantic bring the snow storms in winter which pile up the snows upon this plateau many hundreds of feet deep. From this great snow field the glaciers are formed which push down through the valleys on the rim of the Hardanger Fjord. Farther north are two extensive snow fields, each of which covers more than 500 square miles. These broad snow fields are but the small



A NORWAY COAST SCENE
The entrance to a fjord

remnants of the immense ice field which once covered the whole of Norway to a depth of about 6,000 feet. A similar vast sheet of ice now covers Greenland and moves slowly toward the west coast.

In the northern part of Norway the glaciers do not melt away, because of the colder climate, but push down through the valleys until they reach the sea. In the Alps also are extensive glaciers, covering the higher slopes and plateaus, and gliding down through the valleys in long ice streams. The highest mountains of Norway are but 8,400 feet in elevation, but on account of their far northern location the snow fields lie much lower on the mountains and do not melt away with the summer heat.

4. Scattered along the coast are numberless islands, big and little. One writer states that there are 150,000 islands on this jagged shore. Many of them rise steep and rocky out of the water, and some are smooth and rounded with the scour of the glaciers. There are many winding passages among these thick-set islands, and the scenery from a steamer yacht is remarkably beautiful. About one-eighth of the population of Norway lives upon these islands. The people are largely engaged in ship-building, fisheries and commerce upon the ocean.

5. About 80,000 men along the coast are employed in the fisheries. Swarms of fish feed and spawn along this shore because of the great quantity of fish food in its waters. The cod fisheries are the most important and extend hundreds of miles along the middle and northern coast. In the Lofoten islands alone 4,000 men are engaged in the cod fisheries. The fish weigh from eight to twenty pounds, and are sometimes five feet long. They are cleaned and hung from wooden frames head downward and dried· others are salted and dried upon the broad flat rocks, then sent to coast cities like Trondhjem, Stavanger and Bergen, and thence shipped to Germany and other southern lands. The herring and mackerel also migrate to these waters. Many are caught and barreled and sent to southern markets.

Salmon streams are also found along this coast but are not now so productive as formerly and are controlled by Englishmen.

The Norwegians also send out fleets of vessels to engage in the big sea fisheries of the Arctic Ocean for whales, seals and walrus. Their fishing waters extend from Greenland on the west to Nova Zembla in the far northeast. It is a rough, comfortless life, full of hazard, and many lives are lost, but these bold, hardy seamen are willing to take the risks. All the men, captain and sailors of the crew, share in the catch.

The fisheries of the Norwegian shores greatly resemble those along the coast of New England centering at Gloucester. The hundreds of fishing schooners which sail from the New England coast to the banks of Newfoundland are like those of Norway fishing about the Lofoten Islands and farther north. New England also sent formerly many whalers north to the Arctic seas for whale and seal. The fisheries of Norway yield about seven million dollars a year.

6. The forest industries of Norway are still more important. A large part of the mountain sides is covered with cone-bearing trees, spruce, fir, pine, or birch, with some oak and elm. The exposed rocky shores on the west coast are somewhat barren of forests, but the sheltered east slopes are wooded. The rains borne by the sea winds are favorable to the growth of forests, so that about one-fifth of Norway is well wooded. Sawmills and lumberyards are found in the valleys and on the lower courses of the streams. The logs are sped down the mountain sides and floated on the rivers to the sawmills. The lumber industries of Norway bring a profit of about eighteen million dollars a year. A large business has sprung up in the manufacture of paper from pulp made from the Scotch spruce.

The lumber business of Norway is much like that of Maine and the Adirondacks, where the forests are being rapidly used up for lumber and paper-making. The Great Lakes region and the upper Mississippi River in Minnesota have been for many years the center of big lumber production, but the forests are now giving out and will not be able to supply the great demand for timber products.

7. From the rocky coast of Norway in the Middle Ages (from the seventh to the tenth century) came the fierce bands of ocean pirates and plunderers known as the Vikings. They ravaged the coasts of England, Scotland and Ireland. They plundered Normandy and the French coasts and set up kingdoms there. They even sailed into the Mediterranean lands and established their power in Sicily. They sailed to Iceland and the coasts of New England and were the most dreaded warriors of that age. They were the first to explore the American coast.

8. The Norwegian people of the present time are noted for their simple manners and democratic ways. There is no noble class of country gentlemen as in England. The people are honest, thrifty and industrious. The country is not rich in products and the people are not given to luxury and wastefulness.

Although about 25,000 emigrants have been coming yearly to North America, the population in Norway has been increasing somewhat rapidly.

9. The rocky coast of Norway reminds one strongly of the west coast of Scotland. The numerous rocky islets and deep bays or friths of the Scottish coast were also formed by the scour of glaciers and the storms of the Atlantic, as in Norway. The Scottish highlanders along the barren rocky coast are in character and independence much like the Norsemen. An examination of the west coast of Ireland shows the same broken and rugged coast line, with deep, penetrating bays and rocky headlands.

10. Boys and girls who have studied the map of Maine have noticed what a wilderness of deep bays and rocky islets it shows. Passamaquoddy Bay, Penobscot Bay, Casco Bay, Mt. Desert Island, and scores of rocky isles and headlands remind one strongly of the Norwegian coast. The heavy glaciers, as in Norway, scoured out these deep valleys and smoothed and rounded the cliffs and headlands. This coast

ON NORWAY'S WESTERN COAST

MICROCOPY RESOLUTION TEST CHART

1.0 2.8 2.5

3.2 2.2

3.6

2.0

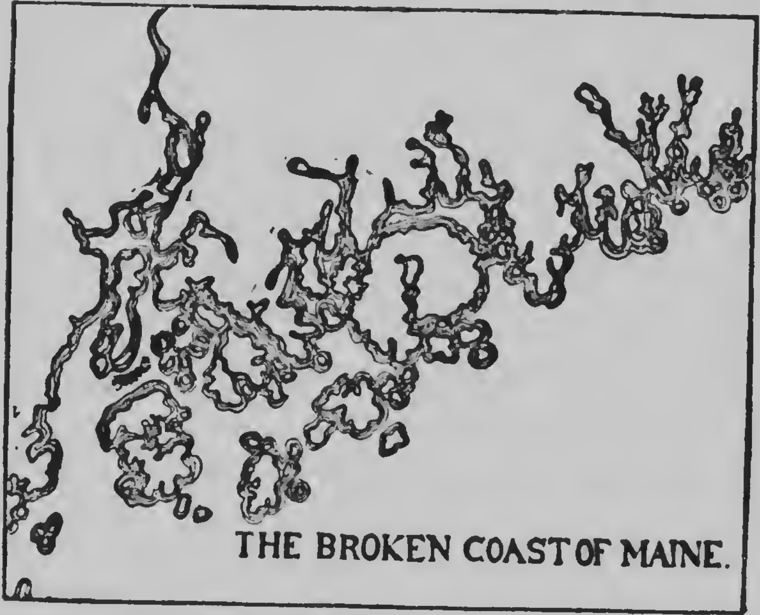
1.1

1.8

1.25 1.4 1.6

APPLIED IMAGE Inc

of Maine is also a delightsome summer resort for thousands of people who wish a cool seaside home in hot weather. Back in the hills and mountains of Maine are still extensive forests, and along the shore profitable fisheries. The coasts of Nova Scotia, Newfoundland and Labrador exhibit a similar rugged and jagged front toward the ocean, where rocky cliffs and broken islands with deep bays offer shelter and harbors for the fishermen along these coasts. Greenland along its western



THE BROKEN COAST OF MAINE.

coast displays at the present time a great ice-sheet that forces its way down the westward slope into the valleys and bays and is scouring out deep fiords similar to those now seen on the shores of Norway. The west shores of the Atlantic from Greenland down to Maine are now far colder than the eastern shores of the Atlantic in Norway, Scotland and England.

11. An examination of a large map of North America from Puget Sound to Alaska brings to our notice another broken and mountainous coast, thickly set with rugged

islands. A voyage by steamer through the winding channels among rocky islands and headlands of this coast rivals the famous scenery of the Norway fjords. Excursion steamers make this trip in summer for the pleasure of tourists. The mountain chains along the Alaskan coast rise higher as they get farther north, till Mt. St. Elias, near the coast, is 18,000 feet in height. The heavy rains from the Pacific bathe these coasts with moisture so that big forests cover the lower slopes. A warm current from the Pacific also warms this whole region and produces mild weather far to the north. In all these respects the coasts of Alaska and Norway are much alike. The coast northward from Puget sound abounds in salmon fisheries which are very productive, and farther north the seal are found upon the islands.

The coast of Alaska is, however, much richer in coal and metals than is that of Norway, and is developing great productive wealth.

12. Far to the southern extremity of South America on the west side is still another mountainous and island-studded coast. It extends 1,200 miles to Cape Horn and is a wilderness of broken islands and rocky headlands.

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31. Type Study on St. Petersburg

Suggestions as to Method

(*a*) In many books which are now in common use in the schools there are excellent pictures and maps of modern cities. The usual geographies will help greatly. The geographical readers also are well illustrated with views of cities. The larger cyclopedias contain maps of the larger cities. But the completest maps are those found in the modern guide books. Make good use of such maps and pictures.

(*b*) Such a study suggests historical readings of several interesting kinds, as Motley's essay on Peter the Great; Macaulay's essay on Frederick the Great; Plutarch's Julius Caesar; the Life of Napoleon, Bismarck, Queen Elizabeth, etc.

(*c*) The natural advantages and disadvantages of cities for commerce and government can be studied out on maps of Europe and the relative locations of large capitals fixed.

(*d*) The comparison of cities in regard to size, advantage of location and the longer or shorter periods of their history will be found interesting, and will help to fix important eras of European history.

(*e*) Each city is also a representative of a nation and people. Its growth, progress and history are a standard for the whole.

(*f*) It would be well at the end to inquire how many great cities there are in Europe whose importance is due not to a ruler but merely to commerce, as Hamburg, Liverpool, Glasgow, Marseilles, etc.

Outline of Topics

1. How Peter came to build it. The advantages and disadvantages of its location.

2. The building of the city.

3. A government center; public buildings; contact with foreigners.

4. Peter's city becomes a center for Russian commerce by building canals and highways, and later railroads.

5. Later growth of other cities in Russia.
6. Peter's statue and the great royal palaces and churches.
7. Moscow, Riga and Odessa.
8. Constantinople and Constantine.
9. Berlin, Frederick the Great. King William and Bismarck.
10. Paris, Louis XIV and Napoleon.
11. Vienna, Francis Joseph.
12. Rome, Julius Caesar.
13. London, Elizabeth and Victoria.
14. Ottawa.

ST. PETERSBURG

1. The city of St. Petersburg is the newest of the great capital cities of Europe. It was founded by Peter I, usually called the Great, only a little more than two hundred years ago. It is younger than Boston and Philadelphia, and yet it is the largest city of Russia and one of the big capitals of the world. But for Peter the Great, it would never have been founded at all.

When Peter became czar of Russia as a young man, his kingdom had no good seaports. Archangel was on the frozen northern seas. Russia was shut out from the Baltic and had no possessions on the Black Sea. Commerce with foreign countries was thus shut off and Russia was itself a sort of backwoods, benighted country.

Peter became interested in building ships and went to Holland, where he worked for some months as a ship's carpenter, learning the trade. He had a great scheme in his mind for making Russia a strong nation in its commerce and shipping, although Russia at that time had no seacoast worth mentioning.

In order to secure land along the Baltic he managed to bring on a war with Sweden, in the course of which he got possession of a part of the coast of the Baltic, and then he selected the present site of St. Petersburg as a place for this city which was to become the capital of Russia. It was a miserable place in which to build a city. For miles all about the land was swampy and very unhealthful. The River Neva poured its flood waters into the Baltic at this point, and often flooded the whole region. A strong wind from the west sometimes piled the waters up ten feet or more above the usual level. The country to the east and north was full of marshes and lakes, and to the south was barren and had very few inhabitants. The city lies far to the north, on the parallel of 60 degrees, as far north as the southern point of Greenland. The winters are long and very cold. And yet in the midst of these mud marshes Peter was determined to build a great seaport and his capital city.

2. The czar had despotic power and compelled a hundred thousand men to leave their homes in Russia, hundreds of miles away, and set them to work upon his new city. The hardships and exposures were so great that most of them died.

Piles were driven down into the mud to form the foundations of large buildings. Every nobleman was compelled to build a house or palace in Petersburg. Stone was brought from a distance and in vast quantities. The foundations of enormous buildings were laid on the millions of piles driven into the swamps. Peter lived in a small wooden house on the banks of the Neva and watched the quick growth of his city. This little house is still preserved as the home of the great czar.

At all costs Peter was determined to have a great seaport. Forts were constructed and commerce began to develop between Russia and other countries of western Europe. The principal harbor was at Kronstadt, some distance from St. Petersburg, and smaller vessels brought the goods to the city. A channel was later dredged from Kronstadt to the city to enable larger vessels to come up to the wharves of St. Petersburg. Extensive wharves were built along the shores of the islands at the mouth of the Neva. The city itself was built partly upon these islands, and the many channels of the river with the islands between make it somewhat like Venice and Stockholm. The river and channels are solid with ice five or six months of the year and the bridges are not much needed at such times.

Streets were laid out through the marshes and filled up; public buildings were constructed, a large parade ground for soldiers was made by filling up a swamp; canals were built connecting the city with the great lakes and rivers to the east and southeast. Great highways had to be built through the surrounding swamps connecting the city with the mainland to the south and east. It has been said that hundreds of thousands of lives were lost in founding and building up the city by Peter the Great, and even now it is an unhealthful locality. The extreme, changeable climate and the exposure to west and north winds make it severe upon health, and the death rate among the people is very high.

3. But in spite of the unfavorable location of the city and its high death rate it has grown rapidly and has become one of the great world capitals. Peter made it the capital of his huge empire. The government buildings and offices were constructed here. Moscow, the old capital, was deserted by the court and many of the nobility. Many splendid palaces were built by the nobility in the new city. Foreigners also came in large numbers to enjoy the benefits of the trade that began to develop in St. Petersburg. It thus became a city of mixed population, where the Russians came in contact with the progressive ideas of other countries. Science, manufactures, modern inventions and education were taken up by the better classes in the new city, and later in Russia, and these things have had a large influence upon the government and institutions of the Russian people.

4. In order to make St. Petersburg an important export center for Russia it was necessary to build canals connecting the Neva River and its great lakes with the headwaters of the Volga and the Dnieper. These canals were built at much expense by the Russian government, but they poured the product of the great central plain of Russia into St. Petersburg and for 150 years the capital city has been the great export center for more than half of Russia. The imports

from western Europe have entered Russia by the same door.

Railroads centering in St. Petersburg were built much later along both shores of the Gulf of Finland and toward the east, south and west. These railroads also had to be built across the swampy districts for many miles before reaching the rich and more thickly populated parts of Russia.

5. Manufactures have naturally developed at St. Petersburg because it is such a center for the collection of raw materials. Textile wares, machinery and rails and tobacco are among the more important. But there are few large manufacturing plants such as are found in Chicago. Moscow, the old capital, is more important as a manufacturing center than St. Petersburg. Russia has very extensive house industries where products are made by hand in the homes of the people, but it has been slow in developing the great factory system common in England and America.

6. In St. Petersburg are found a number of monuments and palaces which remind us directly of Peter the Great and of his absolute government. On a square in front of the Senate House and overlooking the Neva is a great bronze statue of Peter the Great on horseback. The horse is galloping up the slope of a huge rock and gaining an outlook over the river.

The admiralty and the great winter palace of the czar are immense buildings which stand on the banks of the Neva and look across it to the fortress of Peter and Paul, surrounded at the back with gardens and parks.

The church of St. Isaacs near by has an immense dome like the capitol at Washington, but gilded with gold. Its columns are built of costly stones, and it contains gold carvings and beautiful ornaments. This church cost about twenty millions of dollars. There are many other great and gorgeously decorated churches in St. Petersburg.

Within a few miles of St. Petersburg are a number of royal palaces which are used as residences of the emperor.

7. The old capital of Russia was Moscow, and it has the greatest of the royal palaces, the Kremlin. Moscow was the place that held to old customs which Peter wished to change, and for this reason Peter wanted the capital changed to St.

STATUE OF PETER THE GREAT
Erected at St. Petersburg

Petersburg. Moscow is now a greater manufacturing city than St. Petersburg.

Riga, on the Gulf of Riga, has grown to be an important outlet for Russian products toward the Baltic and western Europe. It has a more favorable location for shipping than St. Petersburg.

Odessa, on the Black Sea, has also grown to great importance for the shipment of grain and agricultural products to the Mediterranean lands. The railroads that have been built in the last fifty years have turned traffic toward the southern ports, as Odessa and Astrakhan, instead of sending it to the north.

8. The city of Constantinople was founded by Constantine the Great in 330 as the new capital of the Roman Empire. It had been a city for hundreds of years before, so that it is one of the oldest of European cities. But it was rebuilt on a grand scale by Constantine. A massive wall was constructed around the new city. Beautiful marble palaces decorated with the finest Greek sculptures were erected. A large forum and theaters were built, and vast sums of money were spent in making the new capital the most beautiful and sumptuous city of the East. Its location on the Bosporus is the natural one for a great city, as its position commands the traffic between Europe and Asia and between the Black Sea and the Mediterranean. Its climate also is temperate and favorable. In all these respects it is the opposite of the city of St. Petersburg, which lies more than 1,400 miles almost directly north of it across the Black Sea and Russia.

Constantinople was taken from the Christians by the Turks in 1453, and since that time it has been the capital of the Turkish Empire. It has one of the oldest and most magnificent churches in the world, orginally built as a Christian church, and later by the Turks converted into a Mohammedan mosque. As St. Petersburg is the center for magnificent Christian churches, so Constantinople is the chief place for Mohammedan mosques, with their slender minarets rising over the seven-hilled city. The complete control which the city of Constantinople had over all commerce passing out of the Black Sea was the reason Peter the Great found it necessary to build his capital far to the north on the Baltic.

9. The city of Berlin is called the Kaiser City. Frederick the Great first made Germany, or Prussia, to be respected

as one of the great powers of Europe, and Berlin, his capital city, he did much to improve.

"Unter den Linden," a broad avenue lined with magnificent buildings, is the central thoroughfare of Berlin, very wide, with several shaded avenues in one. At the east end, opposite the residence of the old Kaiser, stands the lofty bronze monument of Frederick the Great on horseback. Splendid museums, palaces, theaters, hotels, the great university and the guard house and arsenal face on this street. A beautiful bridge ornamented along its sides with statues leads this street across the river to an island on which is a small park, faced on one side by the Old Museum with a Greek front, on the other side by the ancient royal palace, a vast structure occupied by the present emperor and his court.

Berlin is the great military center of Europe. Vast armies can be gathered to this central point in a few days or even hours, and then sent out by the chief railroad lines, owned by the state, in any direction. The regular garrison of Berlin in time of peace is 25,000 men. There are important forts outside of the city.

Some sixteen miles to the southwest is the summer home of the Kaisers, Pottsdam, a wonderfully delightful suburb, with great gardens, ponds, palaces and favorite homes of the German kings and emperors.

Bismarck and King William by their remarkable success in three wars, with Schleswig, with Austria, and with France, raised Germany to a commanding position among the states of Europe, and since then Berlin has grown perhaps more rapidly than any other capital in Europe. In cleanliness, in fine streets and public buildings, in the freshness and orderliness of all city affairs, it surpasses almost any city of Europe but Paris. It is more than double the size of St. Petersburg or Constantinople. But like St. Petersburg it owes its importance chiefly to its being a capital city, the center of the royal power, and of political influences. Berlin, like St. Petersburg, has naturally few advantages. It is located on a small, sluggish stream in a poor and sandy region. But it has become, through its political leadership, a vast center of commerce, manufactures and education, as well as of military power.

10. Paris was for several centuries the most important capital in Europe. Two hundred years ago Louis XIV, the most famous of French kings, kept up a magnificent court at Paris, built great palaces and lived most extravagantly. He made Paris the political center of Europe and the ruler of court fashions. One hundred years ago Napoleon I became emperor and again made Paris the central city of Europe. Napoleon stood out as the most commanding figure of his time and for a while controlled nearly the whole of Europe. His burial place at the Hôtel des Invalides is much visited by travelers.

In the last hundred years Paris has led all European cities in first introducing modern improvements, great sewers and pure water supply, beautiful boulevards and clean streets, magnificent public buildings and museums, theaters, art collections and sanitary improvements. It is probably the most beautiful and fashionable city of the world today.

All the other cities which we have mentioned, especially St. Petersburg, Berlin, and in fact all large European cities, have followed and to a large extent imitated the city of Paris in making public improvements.

11. Vienna, the capital of Austria, during the last sixty years has been largely rebuilt upon a plan adopted by Francis Joseph, the present Emperor of Austria, more than fifty years ago when he was a young king. Vienna, which was in 1850 a very dirty, unhealthful and crowded city of 600,000 people, has become one of the most attractive and healthful cities of the world, with about 2,000,000 people. All the great sanitary improvements were carried out, a splendid series of fine public buildings erected, parks laid out, public market places established and a great school system built up.

12. The city of Rome, historically the most important city of Europe, founded about 2,700 years ago by Romulus,

has had many great men, but Julius Caesar, who ruled in Rome nearly 2,000 years ago, was the most famous. Rome at that time was the capital of the Roman Empire, which included about all of the civilized world. Most of the important modern nations have sprung from the wreck of the old Roman Empire. Rome is therefore the mother city of Europe. Its ancient ruins of the old Roman days, as the Colosseum, the aqueducts, the Pantheon and the Forum, have been visited and admired by travelers for hundreds of years.

St. Peter's, the greatest Christian church, and the Vatican, the vast palace and home of the pope, are two of the most interesting and important buildings in the world today. In the last forty years, also, a modern city of Rome has been built and modern improvements have been carried out, so that Rome, which for a long time was a very unhealthful city in summer, has become a safe residence, and a fine modern capital for Italy.

13. The greatest city of the world today is London, and during the long period of its history its two most famous rulers have been women, Elizabeth and Victoria; and perhaps no greater men have been known in England than the two poets who flourished during the reigns of these queens, Shakespeare in Elizabeth's time and Tennyson in Victoria's.

14. The capital city of the Dominion is Ottawa. It was originally a small, unimportant settlement, and later became a busy lumber camp. Since 1858, when Queen Victoria chose it as the capital of Canada, it has increased rapidly in size and beauty. On a great hill, overlooking the city and the valley of the Ottawa River, stand the Parliament Buildings, the cornerstone of which was laid in 1860 by the Prince of Wales, later King Edward VII.

As shown in the above illustrations, many great cities have owed their founding and later importance to great rulers. Likewise David and Solomon made Jerusalem a famous city, and Alexander the Great founded Alexandria in Egypt.

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32. Type Study on New Orleans

Suggestions as to Method

(*a*) Make a large local map of New Orleans showing river docks and harbor.

(*b*) Make drawings and sketches showing plan and construction of the Eads jetties.

(*c*) Study the map of the Gulf States and the position of New Orleans relative to the rivers and railroads. Also with reference to ship lines to foreign lands.

A commercial map of the world showing ocean steamer routes is needed.

(*d*) Pictures of harbors, shipping, jetties, etc., will make the ideas clear and definite.

(*e*) The comparisons of New Orleans with other ports on the Gulf and on both oceans is a good opportunity to study maps and large relations and to develop thinking power in the children.

(*f*) Give vigorous drills on the lists of cities and rivers, forming series to be remembered.

Outline of Topics

1. Position of New Orleans; its natural advantages and disadvantages.
2. Earlier and later history of New Orleans.
3. Shipments of cotton, sugar and rice.
4. The Eads jetties and their effects.
5. Interesting peculiarities of New Orleans.
6. Galveston, Mobile and other Gulf ports compared with New Orleans.
7. Probable effects of the Panama Canal on the trade of New Orleans and the Gulf ports.

8. Comparison of Atlantic and Pacific ports with New Orleans, e. g., Quebec, New York, Philadelphia, San Francisco and Portland, Oregon.

NEW ORLEANS

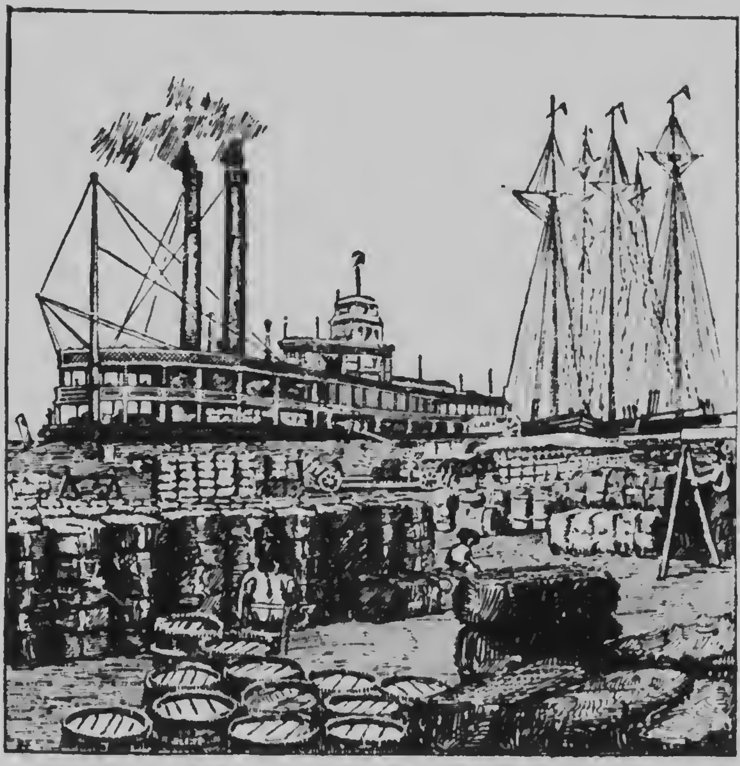
1. New Orleans, about ninety miles from the mouth of the Mississippi River, has a commanding position for controlling trade which centers about the outlet of this great river and valley. The early French settlers chose New Orleans as the most favorable point for a city which should control the river mouth. By small vessels it can be approached from the east through Lake Pontchartrain. But the main entrance for large vessels is by way of the delta mouths. The swampy delta lands south of New Orleans are too low for a good city location. Even New Orleans at flood time is threatened by the Mississippi, and it is protected by levees.

The chief importance of New Orleans is that of a seaport open to ocean traffic with the east coast of the United States, with Europe and South America and the whole world. In recent years it has become an important railroad center for collecting and shipping out the products of the South. Before the days of railroads, and even up to 1860, it was the chief center for a large steamboat traffic on the Mississippi River. But this trade has gradually dwindled to a small amount.

2. The original settlers at New Orleans were the French, and for about two hundred years they dwelt in New Orleans and settled many towns and villages in Louisiana. The country was named for Louis, the French king, and at several times the French dreamed of settling up the Mississippi Valley and of building up a great French empire in America.

But a little more than one hundred years ago Napoleon I of France decided to sell Louisiana to the United States. Jefferson was then president. He knew that the western settlers in Ohio, Kentucky, Tennessee and Illinois were very anxious to get possession of New Orleans and the Mississippi mouths, and he succeeded in purchasing Louisiana from Napoleon for about fifteen million dollars. This purchase included not only the present state of Louisiana, but all the lands west of the Mississippi to the Rocky Mountains. This purchase doubled the amount of land included in the United States

At St. Louis and at other points along the Mississippi



WHARF SCENE AT NEW ORLEANS
Bales of cotton and barrels of sugar and molasses

were French villages which lay in this territory of Louisiana. The families of the old French settlers still live in Louisiana. Many of the people still speak the French language. Some of the interesting old buildings in New Orleans are in the French style. The old French market is one of the interesting sights for visitors, and one famous festival, the Mardi Gras, is still yearly celebrated at New Orleans.

New Orleans in the South on the Mississippi, and Quebec in Canada, the chief seaport of the St. Lawrence, are both French cities and have many French buildings and customs which excite the interest of travelers.

3. New Orleans is naturally the shipping point where cotton, sugar, rice and other products of the South within several hundred miles are collected and shipped out to sea.

Cotton is the big staple product of the South, and in the fall and winter when cotton is being harvested and sent to market the wharves along the river at New Orleans are stacked high with cotton bales, and many ocean-going steamers are being loaded with cotton for Boston, New York, Liverpool, Hamburg and other cities.

Along the gulf shores in Louisiana and other states are many sugar plantations which produce quantities of raw sugar and molasses which are sent into New Orleans. Near the river at New Orleans are big sugar refineries that prepare this sugar for the market. On the wharves in the season are innumerable barrels of sugar and molasses ready for transport to eastern markets by steamship. It is the business of the hundreds of dock hands—negro roustabouts—to roll these barrels upon shipboard.

In the southland in recent years the rice plantations have become very important. Not only the swamp lands can be flooded for rice cultivation, but the rich prairie lands along the sluggish bayous and streams have been made into rice lands. Low ridges or dykes are thrown up around the fields, and water from the streams is pumped by engines upon the land at the season of rice planting and culture. Much of this rice is shipped to New Orleans, where it is cleaned, sorted in the rice mills and then packed for shipment.

4. New Orleans needs of course a deep outlet for large vessels at the delta mouths. For many years it was impossible for large vessels to enter the mouth of the river on account of mud bars found at the outlet of the various delta

mouths. These mud bars were some five miles across and were very shallow, not more than seven to ten feet deep. Many vessels trying to cross these bars got stuck in the mud and either failed to enter or were much delayed. The United States government, which looks after the improvement of harbors and rivers, for many years kept steam dredges at one or two of the mouths for the purpose of scooping out the mud and keeping open a deeper channel for ships. In this way they kept open a passage about fifteen feet deep.

DELTA OF THE MISSISSIPPI

But many ships required more than this, and there was endless trouble in getting loaded vessels across the bar.

An engineer named Captain Eads had studied the currents of the Mississippi River for many years and devised a plan for getting a deep, narrow channel through one of the mouths which would remain open and not fill up again easily with mud. His plan was to build jetty walls out of long willow mattresses, which would narrow the current across the bar and cause the current to swerve through with such strong force as to carry the mud far out into the Gulf.

He began to build these jetty walls several miles above the mouth. The mattresses were sunk in long rows along the sides of the channel but some distance from shore. Other mattresses were laid on top of the first till they rose above the water and formed a new shore line. The water was turned into this narrow channel and began soon to cut a deep way for itself. By the time he got the double line of jetties built out across the bar into the Gulf the water in the channel began to deepen and was also dredged out till it was thirty feet deep. His project was entirely successful, and since then large ships have been able to enter the mouth of the Mississippi and easily come up to New Orleans.

5. New Orleans has some interesting peculiarities. The old part of the city has the narrow streets of the French period. The houses are small, with projecting balconies. The little shops are places to buy old bronzes and curios. In the French market near Jackson Square early in the morning is a lively scene, where the clatter of many languages is heard, especially French and Spanish, and the varied booths and wares remind one of European city markets.

On account of the swampy, wet ground on which New Orleans is located, the burial places in the cemeteries are built in the form of a series of stone structures above ground in which the caskets are placed.

In times of high water the general level of the city streets is below the water in the Mississippi. This has rendered the question of city drainage difficult. It was finally settled by an engineering plan by which the sewage was pumped into the Mississippi and the excess water of rains turned into Lake Pontchartrain and Lake Bourne. By the improvement of the drainage and by good sanitary provisions the health conditions in the city have much improved, so that cholera and yellow fever can be hindered.

The old government building, used as a capitol by the Spaniards, and now occupied by the supreme court, is the place where the Louisiana territory was publicly transferred to the United States.

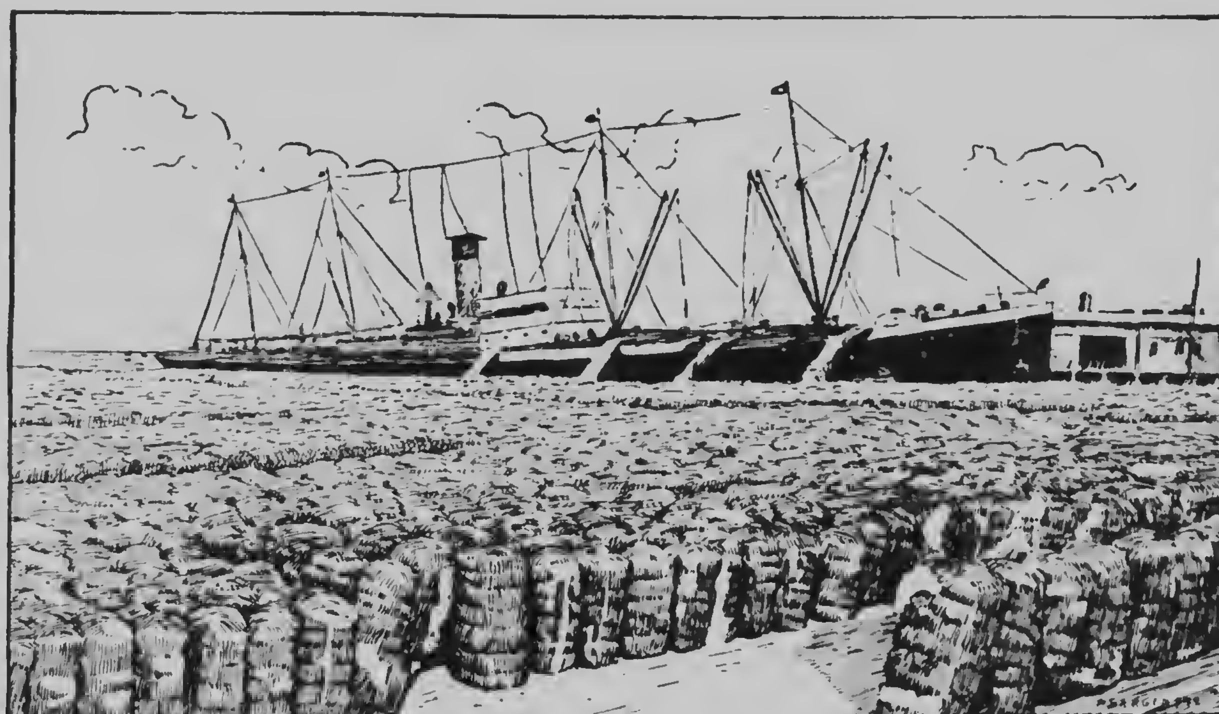
The leading square of the city, Jackson Park, has a statue of General Jackson on horseback. The battle of New Orleans, in which Jackson's army completely defeated the veteran troops of England, was fought in what is now a part of New Orleans in January, 1815. Jackson's reputation won in this battle was what raised him later to the presidency.

6. In respect to commerce New Orleans stands out far ahead of all other seaport cities on the Gulf of Mexico. In the shipment of southern staples Galveston has become a rival of New Orleans. It has stood first in the amount of cotton shipped from its wharves. It has steamship lines connecting it with New York and Boston and with the great cities of Europe and other parts of the world.

At the narrow outlet from the harbor into the ocean the government has dredged out a deep passage for large ships through a shallow bar. The passage is protected by rock jetties built out into deep water. The jetties consist of broken stone dumped into the water till a long ridge of rocks is formed rising about seven feet above the water. Heavy granite rocks weighing each several tons are placed along the tops of the ridges to resist the effect of storms. The sweep of the tide through this narrow passage between the two long rock ridges or jetties helps to keep it scoured out.

Since the disastrous flood and hurricane that destroyed the city in 1900, a great sea wall more than three miles long has been built on the seaward side of the city to protect it against a repetition of that disaster.

Mobile, on Mobile Bay, another port somewhat larger than Galveston, is important for the shipment of southern products. Cotton and lumber are the important shipments. Like New Orleans and Galveston, the outlet of Mobile Bay by which ships approach the city was obstructed by a shallow bar. The United States government here also dredged out a passage and by means of jetties provided a safe entrance up the bay to Mobile. Mobile, like New Orleans, is one of the southern cities that still preserves many of the interesting features of the old southern life.

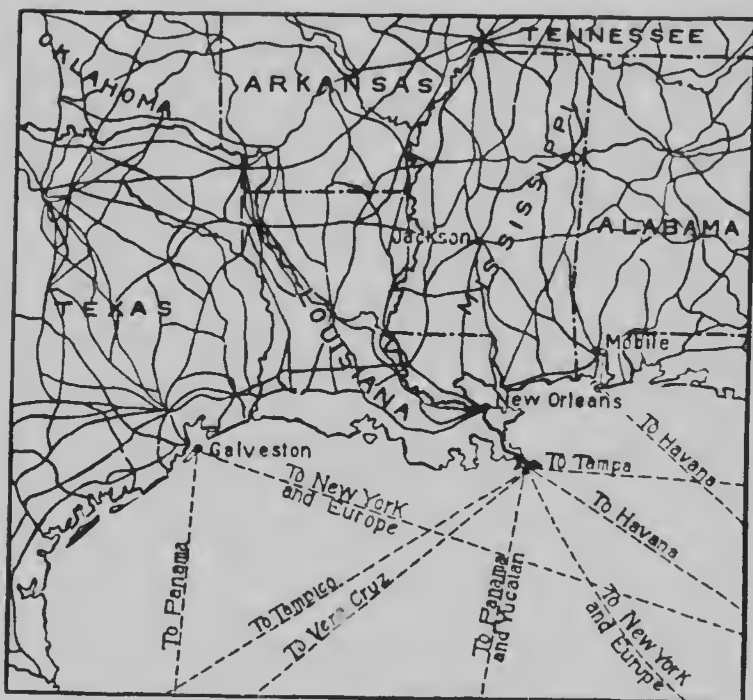


A GALVESTON WHARF SCENE

Ocean-going vessel loading with cotton for Europe

The other important port on the gulf is Pensacola, with a fine harbor and a large United States navy yard. As in Mobile, the entrance to the harbor is protected by forts.

All these southern ports are alike important for their shipment of cotton, sugar, lumber and naval stores. The



MAP OF THE GULF STATES AND RAILROADS

New Orleans is the center of a vast railroad and ocean carrying trade

entrances to their harbors have all been improved by expensive jetties and dredgings so as to secure access to large vessels. The mouths of the Mississippi have been improved at a cost to the government of about twenty millions of dollars.

7. The completion of the Panama Canal is expected to produce important changes in the movement of trade toward the south. Its opening will bring New Orleans and the

southern cities into close relation with the west coast of South America and North America, and also with the harbors and peoples of East India, China and Japan. It may be that there will be a more general movement of the products of the Mississippi Valley southward, so that the outlet for American products will be much more by way of New Orleans. The most natural outlet for the commerce of the Mississippi Valley is by way of New Orleans and the Gulf ports. Heretofore most of the products of the upper Mississippi Valley have been shipped eastward to Boston, New York, Philadelphia and Baltimore. But crossing the Alleghany Mountains is difficult, while the shipment of heavy products down the Mississippi would be easy and cheap.

8. In its favorable position for controlling trade at the mouth of the Mississippi River, New Orleans may be compared with other cities on the Atlantic and Pacific coasts. Quebec and Montreal on the St. Lawrence likewise monopolize the trade of the lower St. Lawrence.

The importance of New York City is largely due to its position at the mouth of the Hudson, which connects it by means of the Erie canal with the Great Lakes. New York is thus the main point of export for the products of the Great Lakes and of the upper Mississippi, which is tributary to Chicago, Milwaukee, Duluth, etc.

Philadelphia at the mouth of the Delaware has a similar advantage in Pennsylvania, but cannot so easily draw products across the mountains.

Baltimore, Washington and Norfolk enjoy the advantages of trade along the valleys of rivers flowing into Chesapeake Bay, as the Susquehanna, Potomac and James. Jacksonville, Florida, has an advantageous position on the St. Johns River, eighteen miles up the stream.

On the Pacific Coast San Francisco lies on the bay where two rivers enter which drain the great valley of Central California.

Portland, Oregon, has a position near the Columbia similar to that of New Orleans on the Mississippi, commanding the trade of that valley and opening to the ocean. Its chief exports are wheat and lumber. New Orleans is also important for both lumber and wheat, but its other products are more important. The Columbia River at its mouth has been obstructed with a bar dangerous to shipping.

New Orleans near the mouth of the Mississippi occupies a leading place among the Gulf ports similar to New York among the Atlantic seaboard cities, San Francisco among the Pacific ports and Chicago among the lake ports.

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33. Type Study on the Panama Canal

Suggestions as Method

(*a*) To understand fully the Panama Canal it is necessary ·   ᵗy maps, cross sections and pictures and to use the imagination .   n-structing a full and adequate mental picture.

(*b*) The engineering difficulties can be appreciated by studying the geographical conditions as based on good relief maps and cross sections.

(*c*) The advantages of the canal as a means of shortening ocean routes can be seen by measuring and comparing the distances between important cities as New York and San Francisco, before and after the completion of the canal.

(*d*) The reason why the United States reserved the right to fortify the canal may be understood by studying the effects of war upon the movements of fleets of warships.

(*e*) Study and locate the other important canals and see their importance as compared with the Panama.

(*f*) Drill children upon the location of countries and cities with relation to the canal.

(*g*) This topic applies mathematics to the solution of a number of large, comprehensive problems, e. g., What income should the United States receive from tolls when the canal is finished to reimburse her for her expense?

Outline of Topics

1. The Panama Canal the final outcome of the efforts of early explorers and later engineers to find the short route to India. History of the various projects before the United States government undertook the building of the canal

2. Choice between two plans and which was taken.

3. Sanitary conditions and improvements.

4. Engineering problems and how met: (1) Culebra Cut; (2) Chagres River; (3) the Locks; (4) Harbors.

5. Management of the work and men, and machines employed.

6. Cost of work. Comparison with other canals.

7. Effects upon commerce and cities.

8. The canal free to all nations.

PANAMA CANAL

1. The building of the canal across the Isthmus of Panama will probably be completed about 1913. It is the final outcome of many projects since the days of Columbus to find a short route from Europe to India.

Columbus and many later explorers were searching for a westward route to India. But the long stretch of land from Cape Horn to Alaska obstructed all these efforts. For a while the shortest route from London to India was by way of the Cape of Good Hope; later by way of Gibraltar and the Suez Canal. A still longer route was by Cape Horn. As soon as the narrow neck of land between North and South America was clearly explored, people began to talk of a canal to save the long journey around South America.

The Spaniards early built a road across the Isthmus at Panama to transport the treasures of Peru and the west coast of South America to ships in the Caribbean Sea bound for Spain. The rush of gold-seekers to California in 1849 made the Panama route important, and in 1855 a railroad was completed across the Isthmus at Panama. It was built by New York capitalists with great expense and hardship.

In 1881, De Lesseps, having made a success of the Suez Canal, which greatly shortened the route to India, organized a company to dig a canal at Panama connecting the oceans. The work was carried on with energy for eight years, during which about $300,000,000, mostly of French money, was spent, and then the company went into bankruptcy.

A new Panama Canal Company was organized, which for twelve years kept the project on foot, preserved the machinery, studied the climate and engineering difficulties, and finally in 1904 sold out its interest to the United States government for $40,000,000.

THE TWO CANAL PROJECTS
1. Panama Canal Route
2. Route first proposed through Nicaragua

Early in 1904 the United States bought from the small state of Panama for $10,000,000 a strip of land sufficient for the building and control of the canal, and since then the United States has pursued with energy the work of building the canal.

2. Two important questions had to be settled before the United States could undertake the work; first, whether the Panama or the Nicaragua route was the better. The government engineers had surveyed both these routes and made estimates, and many were favorable to the Nicaragua route. On account of the fact that much important work

had been done at Panama and because the United States government was able to get a full title to the necessary strip of land, Congress decided in favor of the Panama route. Second, there was much controversy between those favoring a sea-level canal without locks, and those advocating a high-level canal with two sets of locks. Congress at last voted for a high-level canal, and the work was carried on for this purpose. A sea-level canal would have required much more time and expense to execute.

SCENE IN CITY OF PANAMA
In the native section. Note the narrow and dark character of the street

3. One of the chief difficulties in building a canal was the unhealthful climate of the Isthmus and the destructive diseases, yellow fever and malarial fever, which prevailed among laborers and officers. It was thought that unless these diseases could be prevented by sanitation the canal could never be built. It had been discovered that yellow fever is communicated by a mosquito, the stegomyia, which has bitten a yellow fever patient, and thus transfers the germ to another human being. Similarly malaria is communicated by the anophales mosquito or gnat.

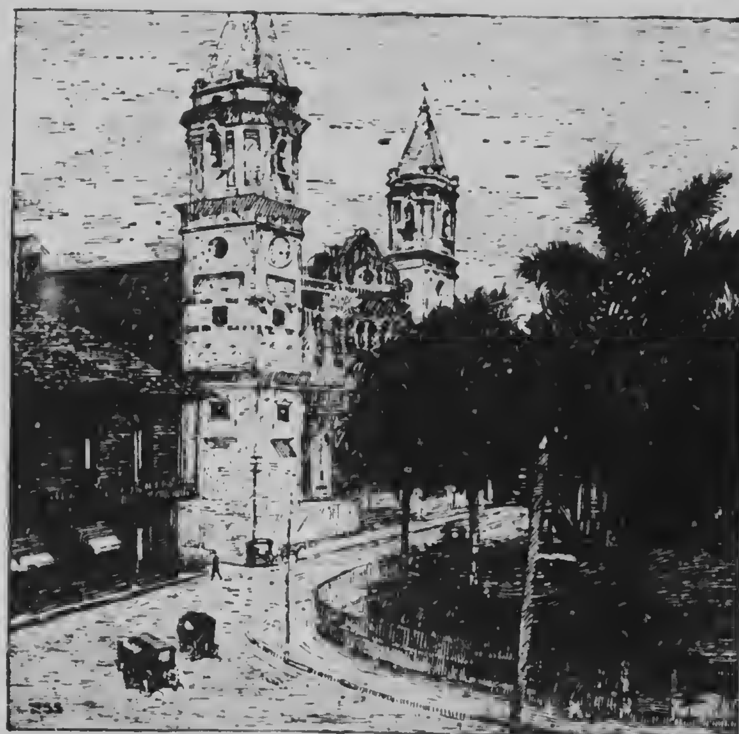
Colonel Gorgas, who had charge of the Department of Sanitation on the Isthmus, began in 1904 a war of extermination against the mosquitoes. At this time both yellow fever and malaria had broken out afresh among the men and had produced a panic. All pools and places for stagnant water were prevented, or oil was used where breeding places could not be dried or closed. Streets were paved, marshes drained, patients were placed in screened houses where mosquitoes could not reach them. There was a rigorous cleaning-up and clearing away of underbrush, and the quarters for the workmen and officers were screened to prevent mosquito bites. As a consequence yellow fever disappeared and malaria was greatly reduced. In fact, the canal zone became a healthy, cheerful place, even for white men and their families. There was no fear that the canal could not be completed because of dangerous diseases that carried off the workmen.

4. The construction of this canal involved a complex group of engineering problems. At the shortest distance the Isthmus is about thirty-six miles across. The canal is more than fifty miles in total length, forty-one feet deep, and two hundred feet wide at the bottom in the narrowest cut. The middle section, which is the greater part of the canal, thirty-one and one-half miles, has a surface eighty-five feet above sea level.

The engineering difficulties may be briefly stated as follows:

(1) It was necessary to cut through a low mountain range, the highest part of which is more than three hundred feet above sea level. For about nine miles the canal had to be blasted through solid rock. This is known as the Culebra Cut, and more than eighty million cubic yards of material, mostly rock, had to be removed and carried to distant places. A considerable portion of this cut was completed by the first Panama Company of De Lesseps. In this part of the canal thousands of men were kept at work. The drilling and blasting went on day and night, and the different levels of

the cut were laid with railway tracks upon which loaded trains were constantly moving to carry away the stone and waste. Many steam shovels were at work loading the dirt trains. A single shovel would load 1,200 cubic yards of this material on the cars in a day of eight hours.

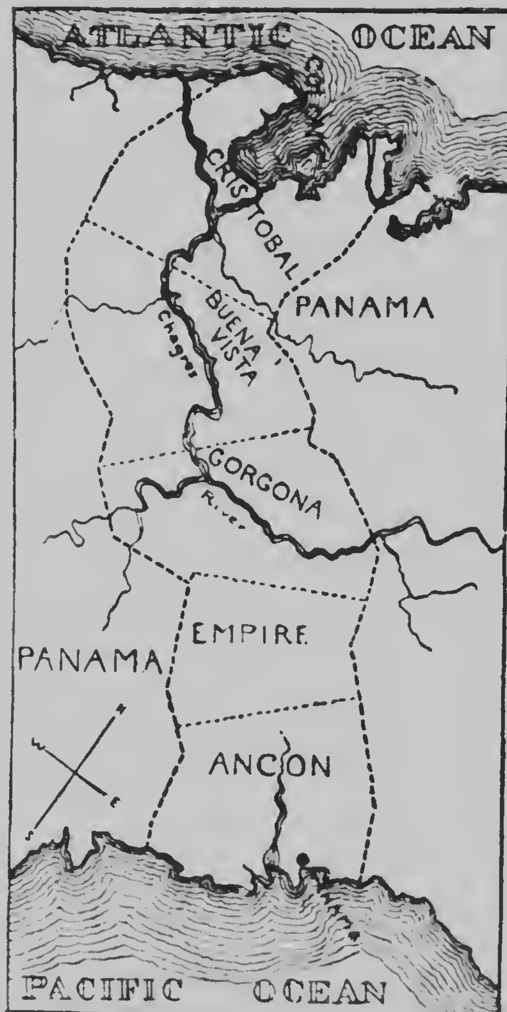


SCENE IN CITY OF PANAMA

Corner of Plaza, one of the attractive features of that capital

At the dumping grounds a patent unloader plowed along the platforms of the cars and cleared off 320 cubic yards from sixteen cars in seven minutes.

At Gorgona, near the middle of the canal, were located the machine shops, where the engines, cars, steam shovels, and varied machinery used in building the canal were kept in

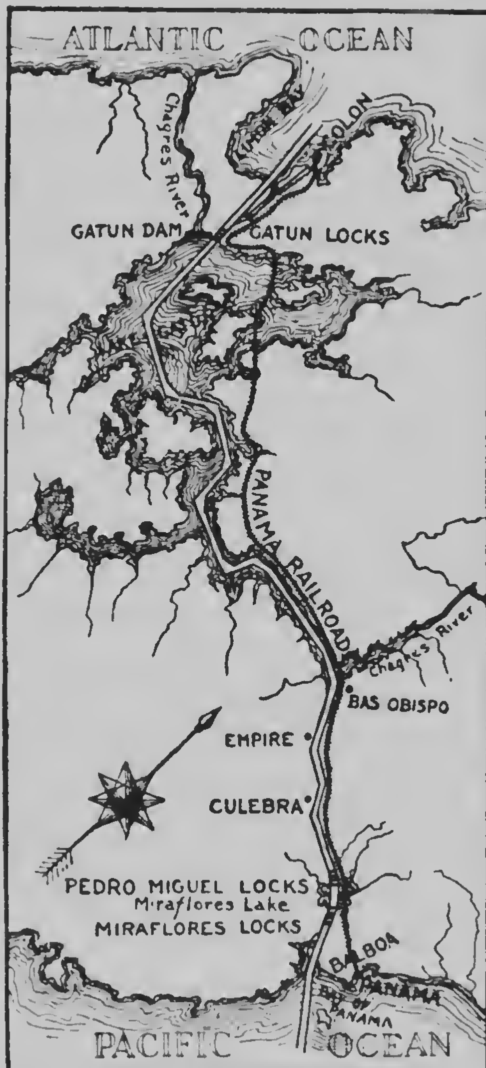


THE PANAMA CANAL ZONE

With the exception of the cities of Colon and Panama, under control of the United States

repair. Some of the important machines used, like the unloader, were invented here.

(2) The canal follows the valley of a tropical river, the Chagres, about half-way across the Isthmus. In the rainy season this river is flooded with the deluge of tropical waters, and in the dry season there is but little water. It was proposed to regulate the waters of this river by building near its mouth an immense dam, which would pond up its waters and fill the valley, producing a large irregular lake of 164 square miles area. This dam is about six thousand feet long, and fills in the space between the hills at the outlet of the valley. The valley is full of silt and offers no rock foundation for a dam, but in the center of the dam is built a solid block



ROUTE OF CANAL AND RAILROAD

of concrete resting on piles driven below. The dam is about 2,000 feet broad and is capable of resisting great pressure. The material loaded on trains from the Culebra Cut was used to build this extensive dam.

The water above the dam stands at a level of eighty-five feet above the sea and makes the high-water level of the canal, and extends through the Culebra Cut to the locks on the south or Pacific side. This high level is the main part of the canal and is more than thirty miles in length. A deep channel, five hundred or more feet in width and forty-one or more feet in depth, has been provided through the lake, as indicated on the map. There are many curves in this channel but they are gradual and suited to the movement of large vessels. Quite a number of streams pour their waters into this lake during the rainy season. In order to avoid excess of waters a spillway has been provided at the great dam at Gatun. But the lake is so large that the waters are spread out over a very large area. In order to secure a surplus of waters for the dry season it is proposed to build a reservoir in the upper valley of the Chagres River where the floods of the rainy season can be stored, at a higher level than the lake.

(3) At each end of this high level are located the double series of immense locks which are to raise the large ocean vessels from sea level to the eighty-five-feet level of the upper canal. A series of three locks is required to make this lift. Each lock is 1,000 feet in length, 110 feet wide, enclosed with solid stone walls, and is supplied with a pair of huge gates at each end. A second series of locks runs parallel to the first so that two vessels can be put through the locks in the same or in opposite directions at the same time.

On the Pacific side there are also three locks which either raise or lower vessels to the desired level. On the Pacific also it is necessary to adapt the lowest lock to a difference of twenty feet between high and low tide, while on the Caribbean side there is but slight difference produced by variation in the tides. The canal follows the valley of a small river on the south side toward the Pacific.

The canal has at all points a depth of at least forty-one feet. The largest vessel now built requires, fully loaded, but thirty-seven feet. These locks are supposed to be large enough for the largest vessels likely to be built.

The locks at Panama are larger than any yet built in the great canals of the world. It requires about fifty minutes to pass the three locks, and the passage of a vessel through the entire canal from ocean to ocean will take about ten hours.

(4) Neither Panama nor Colon has harbors large and deep enough for large ocean-going vessels, and these must be provided. The passageways from the locks to the ocean on either side must be dredged out wide and deep enough to correspond to the rest of the canal. The heavy winds from

the north at Colon will make a breakwater or some harbor protection necessary. At Panama on the south there are no storms, and no special protection will be needed.

The government of the United States claims the right to build such fortifications as will be necessary for the protection of the canal and locks in time of war.

5. In constructing the canal one of the main problems was to secure a sufficient number of efficient laborers. The French company had depended mostly upon West Indian negroes. At first the negroes proved unsatisfactory, but when they were better fed and managed, they improved in strength and industry. About twenty thousand negroes

ON THE SUEZ CANAL
About fifty miles from Port Said, at entrance to Lake Timsah

were employed, the best coming from Barbados and Jamaica. Later European white laborers were also secured, Greek, Italian and Spanish. The Spanish proved the most satisfactory. About 6,000 European laborers were employed, and about 6,000 Americans, mostly skilled workmen and officials. In 1908 there were enrolled in all 31,924 men on the canal works and the railroad. As soon as the dangerous tropical diseases were overcome there was no longer serious difficulty in securing a sufficient number of laborers and officials.

The general management and execution of the whole plan was directly under the control of the President of the United States, and the funds were furnished by congressional appropriation.

6. Colonel Goethals' lowest estimate of cost for building the canal was $250,000,000, but it may cost double this amount. It is the most expensive of the great canals of the world. The cost of the three greatest canals was as follows: Suez Canal, $90,000,000; Manchester ship canal, $75,000,000; Kiel Canal, $40,000,000.

The six other ship canals cost: Sault St. Marie, $6,000,000; Canadian Soo Canal, $4,000,000: Amsterdam, $10,000,000; Corinth, $5,000,000, Cronstadt, $10,000,000; Welland, $24,000,000. Total for the nine, $264,000,000.

The Panama Canal will cost accordingly more than the total for the nine great ship canals of the world previously built. The government of the United States with its great credit can secure money at a very low rate, two per cent, and is thus able to carry on such a project, which a private company could hardly undertake with success.

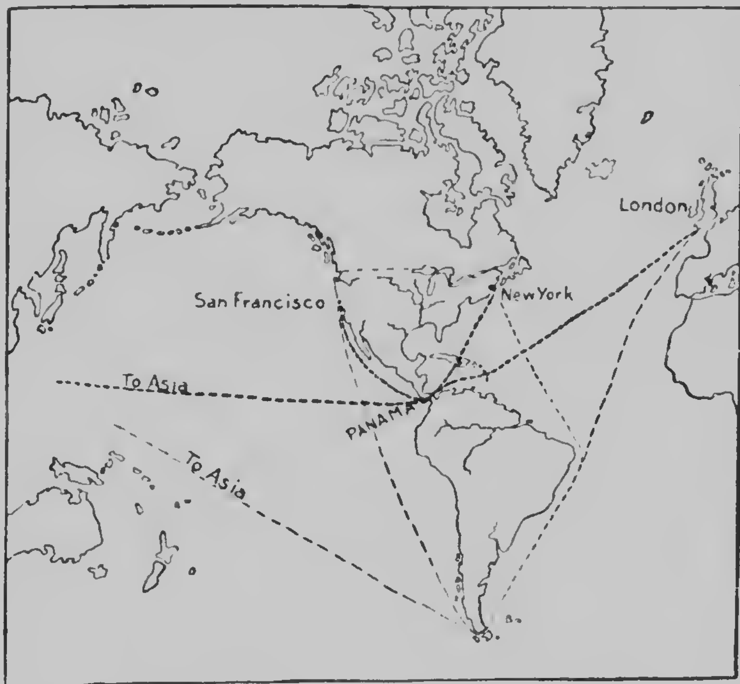
7. The effects upon the commerce of the world of the completion and free use of the Panama Canal have been much discussed.

In the United States it was regarded as a military necessity. It will enable the United States to transfer its fleets of war vessels quickly from the Atlantic to the Pacific, and vice versa. Otherwise it would be necessary to keep two strong fleets of war vessels. The famous voyage of the battleship Oregon from the Pacific to the Atlantic to share in the Spanish War was a strong object lesson for the Americans.

But for the world in general the importance of the Panama Canal is its shortening of sea routes, first between New York and other Atlantic cities on the one side, and the west coast of America and South America on the other. The distance from New York to all ports of the west coast of North America is reduced by 8,415 miles. The lumber, grain, fish and wines of the west coast can be sent by ship to New Orleans and New York very cheaply, and the manufactures of the eastern states and the products of the south can be sent to the west coast. All the ports of the west coast of South America are, on the average, 5,000 miles nearer to New York than in the past.

The products of the Mississippi Valley via New Orleans may be easily shipped to the west coast of North America and South America, and to China, Japan and the East Indies.

Europe itself is brought about 6,000 miles nearer to the west coast of North America, and on the average about 2,600 nearer to the Pacific coast of South America. New



THE CANAL SHORTENS DISTANCES

The dark lines show new routes; the light lines, former channels of trade

York and all the cities on the Atlantic and gulf coasts are brought much nearer to eastern Asia, the East Indies, New Zealand and Australia.

Transcontinental traffic on the railroads of the United States and Canada is likely to be strongly affected. The cheap water rates between the east and west coast cities will much reduce the rates on through freight. It has been said therefore that the great railroads of the United States and Canada were not anxious to see the completion of the Panama Canal.

8. The Panama Canal is open to all nations in time of peace, and the rates of toll for passing vessels will be the same for all nations. It has been said on this account that England, Germany and other European nations which have a large merchant fleet will derive greater advantage from the canal than the United States, which has very few merchant ships engaged in ocean traffic. Thus far the American merchant marine has not developed, and the carrying trade even for American products is chiefly on foreign built and owned vessels.

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34. Type Study on the Canadian Pacific Railway

Suggestions as to Method

(*a*) At the beginning of the study of the Canadian Pacific Railway make very plain the purpose of building the railway as a means of extending the Dominion of Canada from ocean to ocean and of developing the prairie sections.

(*b*) Two or three kinds of maps should be used: sketches made by the teacher on the blackboard to show the location of different sections of the railway and the relation of the railway to lake and river traffic; second, small sketches to show the influence the railroad has had in the development of different localities; third, large wall maps which show the same things on a larger scale with reference to the whole country.

(*c*) Any sketches drawn by the teacher can afterward be required from the pupils on paper or on the blackboard

(*d*) At the close of the account of the building of the Canadian Pacific Railway, make a careful map of the main line, and indicate the principal branches, especially those in your province (*e*) Good pictures of railway cars, bridges, tunnels, stations and scenery are useful

(*f*) In studying the Canadian Pacific Railway, compare its length and difficulties of construction with those of other lines in Canada and the United States.

(*g*) In teaching a class, follow the outline of topics which forms the basis of the treatment and make each topic clear and full, with reproductions by the children, before passing to the next topic.

(*h*) Have the children drilled upon the names and location of cities and rivers, *e. g.*, Winnipeg, Calgary, Banff, Vancouver, Montreal, South Saskatchewan River, Fraser River.

Outline of Topics

1. The conditions which led to the building of a Canadian transcontinental railway.
2. Plans for the organization of the company and arguments in favor of each.
3. Location of the right of way.
4. Construction of the railroad, and the financial and engineering difficulties.
5. Celebration at the completion.
6. Expansion and additions to the original main line.
7. The part played by the Canadian Pacific Railway in the development of Canada.
8. Summary regarding traffic routes between the east and the west.

CANADIAN PACIFIC RAILWAY

1. The formation of the Dominion of Canada was the beginning of a new nation. At first the Dominion included only the four provinces of Ontario, Quebec, New Brunswick and Nova Scotia. In 1870 Manitoba and the North-West Territories became a part of the Dominion, and a year later British Columbia ceased to be a separate colony and became a province, one of the conditions being that the Dominion of Canada should build a railway to connect the seaboard of British Columbia with the railway systems of the older provinces. Thus Canada stretched from the Atlantic to the Pacific, and from the United States boundary to the Arctic Ocean. A country of such vast extent can not prosper unless

the different sections have interests in common, and such common interests are impossible without proper means of communication and transportation. In 1870, between British Columbia and the eastern provinces the only railroad communication was through the United States. The great prairie districts, as well as the province of Manitoba, could only be reached by water and overland by wagon. It was evident from early days that a railroad across the continent was desirable, for a number of reasons:

First, it would bind together the new Dominion of Canada and give every section speedy communication with every other section. This need for some uniting force explains why it was that the Dominion Government was willing to assume such a great burden when British Columbia insisted on the building of a railway as a condition of its entrance into the Dominion. And it also explains why British Columbia regarded such a railroad as a necessity. The task of building a transcontinental railway seemed impossible to many people. Alexander Mackenzie, who later became premier, declared that the physical and financial difficulties made the idea absurd. Much of the country was unexplored, and none of it had ever been surveyed. North of Lake Superior was a rocky region which was supposed to be absolutely useless for any purpose. The Rocky Mountains were said to be impassable by a railway line. Few people today can realize how little was known of the interior of Canada in 1870. It is true that in the United States railroads were built in sections previously unsettled, but nowhere did there seem so little justification for hopefulness as there was in Canada.

Second, a transcontinental railway was the best method of insuring the development of Canada. It was clear that so long as the interior was inaccessible it would never be settled. No matter where a railroad is located, the great practical problem its owners face is whether or not the country will develop sufficiently to make the enterprise profitable. If Sir John A. Macdonald, Lord Strathcona, Lord Mount Stephen and the other leaders who favored the construction of the road had not felt confident of Canada's future, the Canadian Pacific Railway would not have been built. The government would have been unwilling to risk its newly acquired stability in a doubtful enterprise.

Third, a great transcontinental railway would provide an all-British route from Great Britain to the Orient. In case of a war this route might prove of invaluable aid to the British arms. It was this reason probably more than any other that made the home government anxious to see Canada extend from ocean to ocean and become a strong confederation.

Thus the first reason for building the railroad was political and national in scope. The second reason was economic, the same test that must be applied to any commercial undertaking. The third reason was political, but imperial in scope, for it considered the relation of the colony to the mother country. In the arguments used at the time the first two were most prominent.

2. There were two plans for building and operating the railway: one was that the government itself should build the road and undertake its management; the other was that the government should grant a charter to a company for that purpose. The government, by its contract with British Columbia, having agreed to build the road, it was argued that it should fulfill its obligations. It was urged, on the other hand, that such a task was too great and involved too much risk for the government to assume, and that the hazard, as well as the profit, should be left to private individuals. This question, unfortunately, was not immediately settled upon its merits, but was drawn into politics. The government engineers made the preliminary surveys and laid out the line. Two companies—the Inter-Oceanic Railway Company and the Canada-Pacific Railway Company—had applied for charters to do the construction. The government tried to secure a combination of the companies, but when this proved impossible, it awarded the contract to a new company, the Canadian Pacific Railway Company. When Parliament met in March, 1873, charges of bribery and corruption were made

against the government. There was evidence that one of the promoters of the railway company had given large sums of money for use in the election, but it seems that every form of agreement between the railway and the cabinet was expressly repudiated by Sir John Macdonald. Nevertheless, Parliament and the country at large had lost confidence in the ministry. The Liberal ministry which held office for the next five years made no effective attempts to build a trans-continental railway. Thus it was not until Macdonald returned to power that construction progressed rapidly. The government continued the work of surveying, and started construction in Ontario, Manitoba and British Columbia. Meanwhile, a group of Canadian and American capitalists had made an offer to build the road, and the government decided to turn over all the work to this syndicate. The Canadian Pacific Railway Company was incorporated in February, 1881, the principal stockholders being Mr. George Stephen (now Lord Mount Stephen), Mr. R. B. Angus and Mr. James J. Hill.

LORD MOUNT STEPHEN
First President of the Canadian Pacific Railway

3. On July 20, 1871, the day that British Columbia entered the Dominion, a party of railroad surveyors left Victoria for the mountains. Soon afterward, surveying parties set out from Ottawa to map out a route through the region north of Lake Huron and Lake Superior. Aside from a rough, general

survey, no work was done in the great prairie section during the first year. Sir Sandford Fleming, the engineer-in-chief, preferred to ascertain the practicability of a railway through the hilly and mountainous sections, where the greatest difficulties would have to be met. Working in an uninhabited country, the surveyors were sometimes without food or water. They were often in danger from forest fires in summer and from cold in winter. After three years of hard work by a corps of 800 men, the engineer-in-chief was able to report that there was no longer any doubt of the practicability of construction, and that "the route, taking its entire length, will on the average show lighter work and will require less costly structures, than have been necessary on many of the railways now in operation in the Dominion."

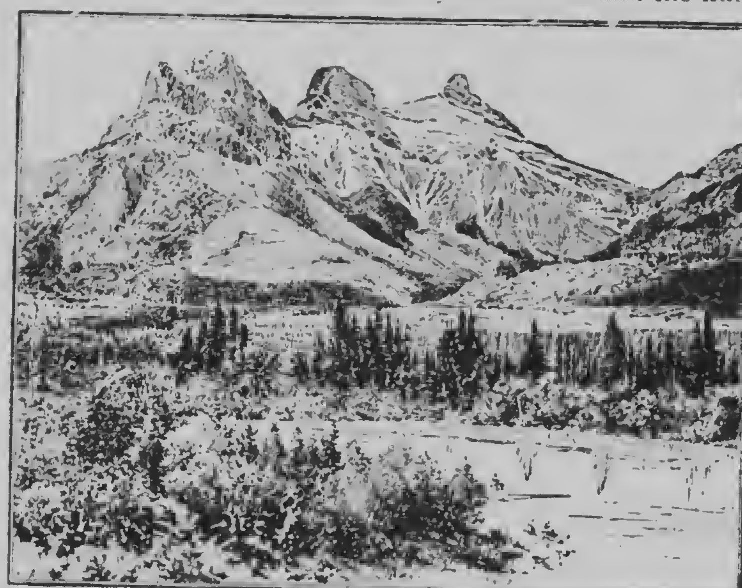
Engineering problems were not the only ones faced in laying out the route. Special investigations were made of climatic conditions, of the character of soil, of the mineral resources and of the water supply, both surface and underground. The chief engineer's report laid special emphasis on the richness of the soil and the ease with which the plains could support a large population. The water supply on the plains was reported inadequate, and steps were immediately taken to increase it. As the supply of water still continues to be a problem in western Canada, the wisdom and foresight of the early engineers was clearly shown. The line, as finally mapped out, was the simplest possible from the engineer's standpoint, while at the same time it ran through regions which in later years would furnish traffic in abundance. When the railroad was turned over to the company in 1881, a few changes were made in the plans, but the line as built followed the general route laid out by the government's engineers.

4. The railroad company was hampered from the start by a serious lack of money. The Canadian government had granted a subsidy of $25,000,000 in money and 25,000,000 acres of land, but this subsidy was not enough to build the entire railway. Two methods were open to the directors: first, to borrow money; second, to develop the country along

the line so that the traffic would constantly increase as the line was being extended. So, without waiting for the completion of the railroad, the company sent its agents throughout eastern Canada and parts of Europe, to induce immigration. The company realized that without a great population to support it, such a vast enterprise could not be profitable. The Canadian Pacific was primarily advertising itself, but it was at the same time advertising the Dominion, a fact which many politicians were slow to realize. This policy of advertisement at first met great resistance from the Grand Trunk Railway and from the political opposition, until it became clear that the government was determined at all hazards to support the company and carry the construction to a successful conclusion.

The problems of building up the country through which they run and of borrowing cash for construction purposes are common to all railroads. The organizers of the Canadian Pacific Railway were themselves wealthy men, they had considerable support from banks, and they had received a large subsidy from the government; nevertheless, there were times when it seemed as if the enterprise must fail from lack of funds. The efforts of the president, Lord Mount Stephen, and his directors were constantly directed to the financial problems. On several occasions the company was forced to borrow large sums of money from the government, sums so large that it is no exaggeration to say that if the railroad had failed the credit of the government would have collapsed. It was not until 1887 that the railroad paid off all its indebtedness to the Dominion.

While the directors of the company were settling the financial problems, the construction was being hastened by Mr. (later Sir) William C Van Horne. By the close of 1881, the first year in which the company was in operation, 163 miles were constructed westward from Winnipeg. In 1882 a farther stretch of 423 miles was completed, and in 1883 the road was finished to Laggan, a distance of 956 miles. Meanwhile, the line eastward from Winnipeg to Port Arthur was completed by the government, in accordance with its contract Thus, in the spring of 1884 the line was open from Port Arthur, on Lake Superior, to the summit of the Rocky Mountains The construction of this section, with the exception of several long bridges over the North and South Saskatchewan, offered no great difficulties, and the gradients averaged only one per cent. The year 1884 was occupied with the construction of the Rocky Mountains and the Lake

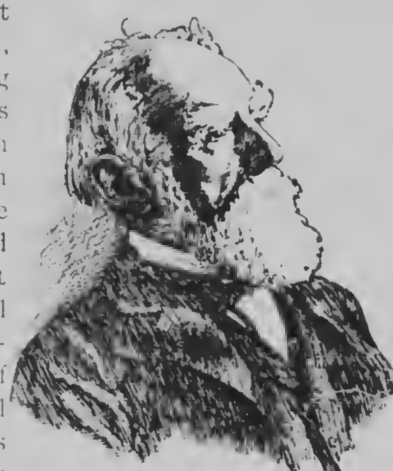


THE THREE SISTERS, NEAR CANMORE, ALBERTA

Superior sections. On the Lake Superior section there were from 10,000 to 12,000 men and from 1,500 to 2,000 teams employed at one time. Twelve steamers were chartered to bring supplies to this army of laborers. This section, through rocky and hilly country, was one of the most difficult along the whole line. In British Columbia the government had already constructed, prior to 1881, the road from Burrard Inlet to Savona's Ferry, a distance of 213 miles. East of that point three mountain ranges had to be crossed—the Gold Range, the Selkirks and the Rockies.

No one who has not traveled over the line can realize the extent and immensity of the difficulties encountered in these section. More than 300 miles were cut through solid rock, and the mountains were pierced by scores of tunnels. Rivers of all sizes were crossed, some by bridges over 1,000 feet long, and no fewer than fourteen streams were diverted from their natural courses by tunneling through solid rock. The magnitude and rapidity of execution were unparalleled in railroad history, and the completion of this enterprise was one of the greatest achievements of human labor.

5. The contract which the Canadian Pacific Railway Company made with the Canadian government called for the completion of the project within ten years. So efficient, however, were the engineering and construction departments that the road was finished in less than half that time. On November 7, 1885, fifty-three months after the company had started construction, the last spike was driven at the small town of Craigellachie, in British Columbia. The choice of Mr. Donald Smith, later Lord Strathcona, to perform this ceremony was a particularly happy one. Long before the backers of the Canadian Pacific Railway had become interested in the Northwest, Lord Strathcona was performing valuable service. In 1869 and 1870, as Commissioner of the Territories, he labored to end the disputes between the settlers and the government. He was influential in building up the industries of the west and in securing the necessary capital from the United States and England. In any work undertaken for the good of the Dominion no man has given more freely of his time and money than Lord Strathcona. In the



LORD STRATHCONA

presence of the Governor-General, the premier and cabinet, high railway officials and many other distinguished citizens, he drove the last spike on the first transcontinental railway in Canada. On the same day, Her Majesty, Queen Victoria, graciously congratulated the people of the Dominion on the completion of the railway, a work which Her Majesty regarded as "of great importance to the whole British Empire."

6. While the main line was being built, construction was begun on several branch lines. In 1881 the branch from Winnipeg to Pembina furnished connection with the United States railroads. The next year several hundred miles of branches were built or bought, and by 1885, when the main line was completed, the company had over 700 miles of branch lines and feeders. The work of extending branch lines has continued, until now the Canadian Pacific reaches nearly every important city or town in southern Canada, from the Atlantic to the Pacific. The company also improved its right of way, lessened grades, substituted steel and concrete bridges for wooden ones, and added rapidly to its rolling stock. It immediately began the construction of grain elevators and docks, and even laid out a new city, Vancouver, in 1885, because its harbor was the best on the Pacific coast. Telegraph lines were constructed and connections were quickly established by cable with all parts of the world. The company also erected the first of its luxurious modern hotels, which rank with the best in the United States and Europe. In 1889 a contract was signed for carrying mail between Vancouver and China and Japan. This was the beginning of the Canadian Pacific's great fleets of ocean steamers, which now cross both the Atlantic and the Pacific. The company also has steamers operating in the Pacific coast service, on the British Columbia lakes and rivers, and on the Great Lakes.

The company's policy has continued to be one of improvement and expansion until it now has a total of over 15,000 miles of road; it stands unrivalled as the largest railway system in Canada and one of the greatest in the world. It has extended its lines into New Brunswick and Nova Scotia and has acquired control of about 4,000 miles of road in the United States. In 1909 it issued new stock to the amount of $30,000,000, the proceeds of which were used in double-tracking the existing lines, enlarging stations, and in general improvements.

7. Until the Canadian Pacific Railway was built, the Dominion was without a railroad from Georgian Bay to the Pacific Ocean, and except for the small settlement at Winnipeg and a few scattered posts of the Hudson's Bay Company, the west was almost unpopulated. For 2,500 miles the railroad was built across trackless prairies and for 500 miles through high mountain ranges. Under such circumstances it would not have been surprising if the company had become bankrupt. The creation of a great volume of traffic, even before the road was completed, was therefore entirely the work of the railroad. The prairies were known to be fertile, but popular opinion, both at home and abroad, had to be educated to appreciate the fact. From the very first the Canadian Pacific carried on a world-wide campaign of advertisement of Canada's resources. Prejudice and opposition of all kinds had to be met with patience and reason. The railway company was thus really opening a new country. It organized immigration bureaus almost before its lines were ready for traffic, and it offered every possible inducement to settlers. By the terms of its contract with the government it became the owner of 25,000,000 acres of land, all of which must find a market. It built elevators to store the grain raised on the rich farm lands, and its trains and steamers carried the farm products to other parts of Canada and to other countries. It has developed an irrigation system for a tract of 3,000,000 acres in southern Alberta, a section which will now support many times the population it could care for without irrigation. The company has prepared "ready-made farms" to sell to farmers on low terms, and it even lends money to settlers. Its strength in the west led to expansion in the east. New branches were built, leased or purchased until the Canadian

Pacific lines now reach every province of the Dominion except Prince Edward Island.

8. The Canadian Pacific is in fact the only transcontinental railroad in America. On no other line may a passenger travel in the same car, by a continuous train and on the same railway, from the steamer in which he has crossed the Atlantic directly to the steamship in which he will cross the Pacific. Even more, he may cross both oceans in ships owned by the railroad whose trains carry him across the continent. Viewed strictly as a Canadian road, the Canadian Pacific possesses this great advantage, which is really greater for freight than

THE CANADIAN PACIFIC SYSTEM

for passenger traffic. East of Quebec it competes with the Intercolonial Railway for through traffic, and by its recent acquisition of the Dominion Atlantic Railway in Nova Scotia it has secured valuable local traffic. In southern Ontario it competes with the Grand Trunk, which is also a competitor for through traffic. In western Canada the railway is the southernmost of the great systems which tap the rich grain sections. The Canadian Pacific and its competitors, the Grand Trunk Pacific and the Canadian Northern, operate in parallel belts from Winnipeg to Edmonton, but the extreme southern sections are served only by the Canadian Pacific. The newer railroads are at a disadvantage in that they are building up the sections through which they pass, just as the Canadian Pacific did thirty years ago. Thus their traffic is not as heavy as that of the older road. The roads have been built so that there is no competition for local traffic, and only at such centers as Winnipeg, Regina, Saskatoon and Edmonton do they meet in competition for through traffic. In British Columbia the Canadian Pacific was for many years the only railway, but the Grand Trunk Pacific and the Canadian Northern will soon complete their lines to the Pacific coast.

Of its total mileage, 4,000 miles, or more than 26 per cent, are in the United States. Nothing is more striking in the development of the Canadian railways than the extent to which they have become factors in transportation in the United States. The Canadian Pacific now controls the Wisconsin Central and the Minneapolis, St. Paul & Sault Ste. Marie railways, which give it entrance to Chicago over its own rails. Thus the company competes for traffic which might go to some of the other lines running to the Pacific coast. The Wisconsin Central also has lines to Duluth, Ashland and Brantwood, which enable it to turn over to the Sault Ste. Marie line and the Canadian Pacific a large amount of traffic for the eastern provinces and Europe. The fleets of steamers are a further advantage which the company possesses for the profitable and growing export trade.

The future of Canadian railways seems bright. Every section of the country to which they run is rich in natural wealth and growing in population. This increase of population is due to immigration, chiefly of desirable classes. The future of the Canadian Pacific, like the other roads, is bound up with the growth of Canada.

References on the Canadian Pacific Railway: *Sir John A. Macdonald.* George R. Parkin. Morang & Co.

The Tercentenary History of Canada. Frank Basil Tracy. The Macmillan Company.

History of the North-West. Alexander Begg. Hunter, Rose & Company.

Annual Reports of the Canadian Pacific Railway Company.

35. Type Study on Voyage from Montreal to Bristol, England

Suggestions as to Method

(*a*) Get from the Canadian Northern Steamships, Ltd. (also known as the Royal Line), a copy of the map of their course which is supplied to each passenger on a voyage. These may be obtained by teachers at the offices of the Canadian Northern Railroad Company

(*b*) Use a map of the British Isles to study more definitely the course up Bristol Channel, and the chief places of interest on both sides.

(*c*) From the steamship company get a large picture of one of the vessels of the Royal Line, and diagrams showing the arrangement of decks, staterooms, dining rooms, etc.

(*d*) If possible, get a map showing various steamship routes for travel and for commercial purposes. (Some geographies have such maps.)

(*e*) Observe on the maps that European countries lie farther north than the settled portions of the eastern part of North America

(*f*) Work out the topics as numbered one at a time and master them.

(*g*) Such a story with the outlines of topics forms a good basis for written language lessons.

Outline of Topics

1. Value of travel.
2. From Toronto to Montreal.
3. The ship and the steamship line.
4. Quebec and the lower Saint Lawrence basin.
5. In the Gulf of Saint Lawrence and on the ocean.
6. Ireland to Bristol.
7. Bristol and Bath.
8. Other routes to Europe: New York via Gibraltar to Naples; New York to Glasgow; New York to Hamburg, Bremen or Cherbourg; Montreal to Liverpool, etc.

A STEAMSHIP VOYAGE FROM MONTREAL TO BRISTOL, ENGLAND

1. One's first steamship voyage across the Atlantic is full of new and interesting sights and experiences. It makes real many of the places and things of which we have previously had very indefinite conceptions. Cities that have been but little round dots on a map become great, busy, commercial

and manufacturing centres. Straight lines marking the banks of rivers become high rocks or wooded hills, or beautiful and fertile farms, villages with many fine churches, tributary rivers and waterfalls, and many other unexpected and interesting sights. Little islands an inch wide on the map take many hours for the steamer to pass and the blank space called the Atlantic Ocean becomes a vast, bounding, rolling body of water that day after day stretches to the sky in all directions as if it would never have a shore. We realize that in some ways map study has given us very inadequate conceptions, if not absolutely incorrect ideas. A type study of a trip by river and sea will give us some concrete knowledge that may help us to make the study of maps and of other peoples and places more realistic.

2. We leave Toronto at night on the train for Kingston, the "limestone city," founded by the great French governor, Frontenac. In the morning we are in Kingston, at the eastern end of Lake Ontario, where the great river Saint Lawrence receives the waters of the Great Lakes and begins its long course to the Atlantic Ocean.

At Kingston we go aboard the river steamer that is to take us to Montreal. All day long we ride on the Saint Lawrence, the queen of rivers, through the celebrated Thousand Islands—really over fourteen hundred—a continuation of the height of land which marks the north shore of Lake Superior, but with no resemblance to those bleak, rugged bluffs. We stay on deck all day to see the beauties of this ever-changing fairyland. On many of the islands we see the magnificent summer homes of wealthy people from the great cities of the United States and the Dominion. At Alexandria Bay the guide points out the fine home in which J. G. Holland, poet, novelist, and editor of the *Century Magazine*, used to live. We think of his line which should inspire all boys and girls to keep on climbing and conquering difficulties:

"We climb by what we have 'neath our feet."

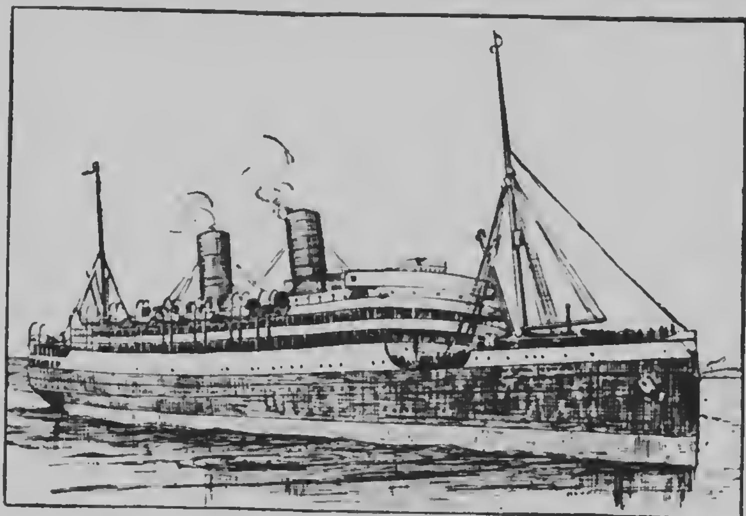
When we get through the expansion of the river called the Lake of the Thousand Islands, we can see Canada and the United States at the same time. The charming town on the left is Brockville. In the distance on the right we see Ogdensburg, and watch it as it grows clearer. A little after noon we gather in the bow of the steamer to watch her plunge and toss for the roaring mile of the Long Sault rapids at Cornwall. On we go, enjoying the scenery, till in the early evening we reach Lachine and take on the pilot who is to guide us over the famous Lachine rapids. We hold our breaths as the steamer leaps the waterfall and makes straight at the giant rock right in front of her. Just as it seems that her destruction is inevitable, she gracefully swings past the rock, and in a few minutes we steam under the great bridge built by Stevenson. Before us lies the city of Montreal, the commercial metropolis of the Dominion, with her splendid docks and fleets of ships from all parts of the world.

While the steamer is being loaded, we have time to drive to the top of Mount Royal, the background of the city, and from its crest we look at the great city below us, bathed in the rays of the setting sun. As we think of the wonderful changes that have been made since Maisonneuve first stood where we are standing and planned to bring his countrymen to the new world, our gaze travels from the city to the Saint Lawrence, a long, thin line stretching up and down for many miles, then away to the southeast to the blue mountains of Vermont, and then slowly back again to the city. Reluctantly we take our last look at the panorama before we drive down again through the city to the docks of the Canadian Northern Railway. Here lies the Royal Edward, named for the King of England, Edward VII, the palatial steamer which is to carry us to England.

3. As our trunks have already been sent on board, we march up the gangplank across the side of the ship and step on deck, where hundreds of passengers and their friends are saying good-bye. If we have taken a first-class passage, our large, comfortable stateroom is soon found, and our hand baggage and our parcels are stowed away. A stateroom, however, is not large as compared with our bedroom at home.

If we prefer a second-class passage, the stateroom will be smaller and somewhat plain.

The size of the ship surprises us. It is 545 feet long, about the length of a city block, and 60 feet wide. Thus a walk around the ship is nearly a quarter of a mile long. The passengers have six decks on which to promenade. A land's-man seldom realizes that these decks are less than half the height of the ship, that the baggage, freight and mail holds, as well as the engine rooms, are all below. The vessel is



THE ROYAL EDWARD

equipped with electric passenger elevators, wireless apparatus, and every possible device for combining safety, comfort and speed. A large ocean liner is a city in itself. Including the crew it usually has a population of 1,000 to 1,500 or even more. To feed this multitude whole carloads of food are necessary. On a single voyage one of these boats uses about fifteen tons of meat, about one ton of ham and bacon, a ton of fish, two tons of poultry, twelve tons of fresh vegetables, 2,000 dozen eggs, six tons of fruit, and over 150 barrels of flour, besides butter, milk, wine, ice and other commodities in great quantity.

4. We wake up early next morning just as the steamer begins to move down the Saint Lawrence, and spend the day going from larboard to starboard as we try to decide which shore is more beautiful. At first we wonder why the homes on the rich farms are so close together, but we learn that when the first settlers divided the land, the farms were laid out in narrow strips running back from the river, so that the people might live near each other and so enjoy the companionship of their neighbors. Scores of villages are passed in which the homes of the villagers cluster around one great building, whose spire and cross proclaim it to be the church. Each little village, when we study it, reveals to us a great deal about the history, the religion, and the customs of the French race that inhabits the beautiful shores of the mighty Saint Lawrence.

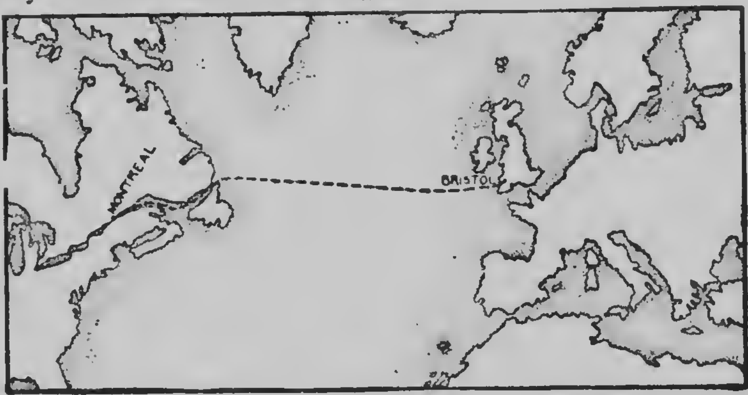
Early in the afternoon the bank on the north shore grows steep and rocky, and as we approach the city of Quebec we see the precipitous pathway up which the hero Wolfe and his brave men climbed the night before the fateful morning when they met the French on the Plains of Abraham and won the battle that gave England possession of the great country discovered and explored by Cartier, Champlain and other Frenchmen. While we stand wondering at the courage which led to the ascent of that almost perpendicular rock and thinking about the battle in which the two brave commanders lost their lives, we have come in sight of the city itself and forget everything else, as we gaze entranced at the citadel on the frowning rock and at the city climbing up the steep streets. Pictures we had seen of Quebec, but the reality was all new and wonderful—a view never to be forgotten.

We are told that the steamship will not leave Quebec for two hours, so we scatter in groups to see the city. First we drive through the old quarter, with its narrow streets and quaint old houses. Then we climb the hill to the terrace on which Chateau Frontenac stands to welcome visitors to Canadian shores and give them a temporary home as fine as the best European hotels. We drive on past several French churches which seem to have been transported from the Old World, past the monuments erected to Canada's illustrious dead, past the legislative buildings, to the Heights of Abraham where Wolfe died and Montcalm was mortally wounded, and then back to the Citadel, where polite soldiers show us the inner secrets of the fort over which the Union Jack has floated for more than one hundred and fifty years. As our steamer leaves the dock we stand at the stern and gaze at the historic city, till a sudden bend in the river shuts it from our view, and we determine to be at the bow on our return to catch the first glimpse of old Quebec when we again come round the bend. We go to the port side of the boat as soon as the city has disappeared from view, and there, past the end of the Isle of Orleans, we see the beautiful falls of Montmorency. The scenery becomes more varied till we pass the Island, where suddenly the river widens to twenty miles from bank to bank, and we finally leave the moonlight charm and witchery and retire to our staterooms.

5. In the morning, when we get on deck, we see only the south shore. We watch the high lines of Cape Gaspé till we lose them at last, and soon see to our left the point of Anticosti as we turn northward through the Gulf of Saint Lawrence. We now know that our route is through the Straits of Belle Isle, and not south of Newfoundland. By the middle of the afternoon we see Newfoundland on our right and Quebec on our left; as we enter the straits the left shore is Labrador. We get through the straits just as several large icebergs slowly float southward, and we admire their wonderful colors as they reflect the setting sun. Before we lose sight of our last iceberg the call, "a whale," is passed from the side of the vessel, and every available glass is turned to a dark object that becomes visible every few minutes a quarter of a mile away. We know by his spouting farewell that we have really seen a whale.

We are startled into a realization of a little-known geographical fact, when one of the officers informs us that we are then less than a day's ride from Greenland. We can scarcely believe as we look at our watches in the twilight that it was nearly eleven o'clock. As we admire the afterglow, we know now that we must be far north.

The next four days pass quickly. We learn to go to bed an hour earlier than usual, because each night the clock is set forward nearly an hour. The ship is speeding all day and all night eastward toward the sun, so that we meet him earlier than if we had waited for him. At first we think we are growing old too fast because our days are shortened, but we are comforted when we remember that on our return trip the clocks will be set back each night at twelve, and our days will each be an hour longer.



STEAMSHIP ROUTE FROM MONTREAL TO BRISTOL

The days are too short for us. The sea is too smooth to justify any appearance of seasickness. Every one smiles at his fellow-passengers. Old friendships are renewed, and new ones formed. Occasionally a ship is met or passed, or a school of porpoises or dolphins play leap frog for our amusement, or we watch the gulls and Mother Carey's chickens flying beside us even in midocean. We sometimes wonder how they get back home.

6. Four days after we lose sight of Newfoundland we watch eagerly for the first sight of land on the eastern horizon. Nobody tells why he is looking through his glasses toward the gray sky, but everybody knows the reason. Each one

SCENE IN BRISTOL, ENGLAND

is anxious to be the first to shout that he has seen the shores of Ireland. Soon some one calls, "There it is," and the word passes quickly around the decks and through the parlors and smoking-rooms that the "dear green isle" is only a short distance ahead. In an hour we are sailing along the south coast, less than a mile away, and we find it so different from the little line on the map. How we admire its rocks, and little islands, and its green farms and villages.

It seems almost wicked to think of dinner that evening. We watch the sun set over the "Emerald Isle." We watch the lights on the shore, each one representing a family and a home. We watch the stars come out. We are sure that there is something of romance and of history in the air. We begin to feel that on the morrow we will set foot in England, "Merrie England"—the England we have read so much about and dreamed so much about. As we ride up the Bristol Channel in the morning, with England on our right and Wales on our left, we appreciate the fact that we have seen three of the four parts of the British Isles—the centre of the greatest empire the world has ever known, the empire of which Canada is proud to form a part.

7. Too quickly we sweep past the rolling fields, the superb homes and the splendid watering places of Somersetshire, till at length we land at Avonmouth. Here we at once board the waiting train, and arrive in Bristol in a few minutes, minutes filled with hedgerows, flowers, gardens, meadows and downs, all the beautiful surroundings of a city rich with evidences of a glorious past and thrilled with the buoyancy of a new hope in a more glorious future.

In Bristol we visit the spot from which the Cabots sailed away to the west on their first voyage of discovery, to share honors with the French and Spanish explorers. We climb to the top of the grand hill on which stands the "Cabot Tower," in commemoration of the work of Bristol's brave sailors, and after roaming over Clifton Downs we walk down the hillside through the squares laid out in the time of George III, when Bristol and Bath, twelve miles away, were the merry meeting places of kings and aristocracy in the holiday seasons. We visit St. Mary Redcliffe church the finest parish church in all England, where Chatterton said he found the manuscripts of the Rowley poems.

In Bath we see the old Roman baths, and learn from them a good deal of the splendor of the life of the Roman people about the time of the birth of Christ. Their magnificent marble bathing houses indicate an advanced material civilization. We leave Bristol and Bath as we dream of their early glory, when King John had his fish ponds there (one part of Bristol is still called Fishponds), of the centuries when royalty and the finest types of England's aristocracy made merry in these two charming cities, of the Cabots, Chatterton, Dickens and Pickwick. Ere our dreams are finished we see high up on our right Windsor Castle, with Eton lying at the foot of the hill. Now we know that we are nearing London, the centre of our Empire.

REFERENCES. Advertisements of steamship companies.

Baedeker's Guides to England, Germany and other European countries.

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36. Type Study on Rocky Mountains Park

Suggestions as to Method

(*a*) This is a topic which requires great variety of pictorial illustration, including scenes in color. The books and advertisements of this region of wonders are well supplied with beautiful views. Stereographic views and lantern slides, if obtainable, are the best of illustrating materials.

(*b*) Good maps of the Rocky Mountains Park are found in many books and tourist guides. Each child should make a good map of the park and locate the striking features.

(*c*) The policy of governmental ownership and supervision of this and other park regions is worthy of special note. The government here sets a standard for tourist behaviour and etiquette which is worthy of imitation.

(*d*) The comparisons with other interesting parks will help to bring out more clearly the special features of this region and other regions like it. Locate definitely other scenic regions.

(*e*) This topic is strongly scientific and makes a strong appeal to the imagination in a number of ways. Some interesting problems are brought to light and are reasonably sure to arouse the curious inquiries of children as to the causes of sulphur springs and the history of strata in the earth's crust.

(*f*) The mountains as centers for tourist travel are becoming yearly more important. This topic is the best possible illustration in the Dominion.

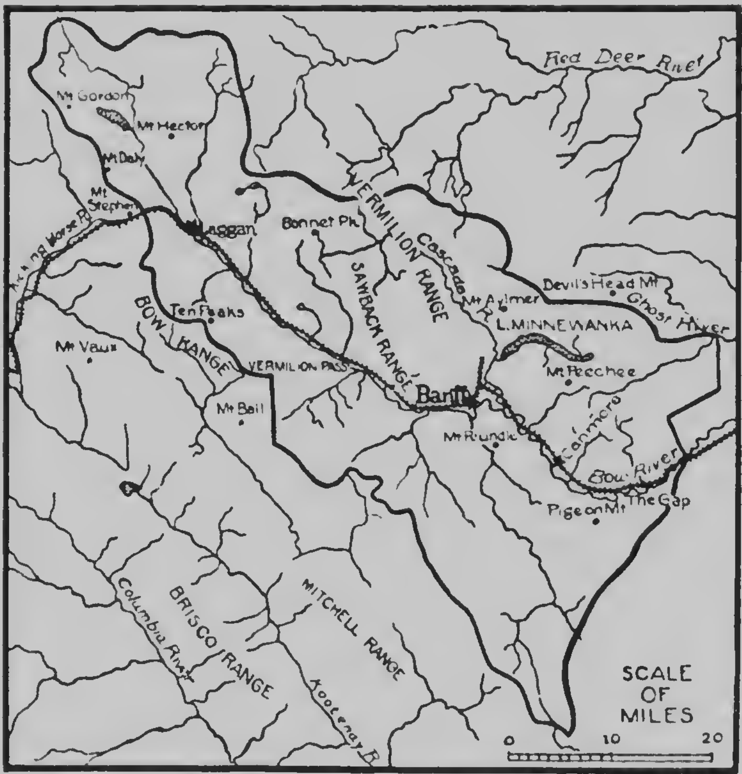
Outline of Topics

1. Location and general physical features.
2. Vicinity of Banff.
3. The hot springs.
4. Lake Minnewanka and Ghost River Valley.
5. The mountains.
6. The buffalo herd.
7. Policing the park.
8. Tourists in the park.
9. Other parks in Canada.
10. National parks in the United States.

THE ROCKY MOUNTAINS PARK OF CANADA

1. Rocky Mountains Park is a region in the Rocky Mountains about the sources of the Bow, Red Deer and other rivers. It is in the form of an irregular triangle, having an area of 1620 square miles, the size having been reduced and other changes made by the Dominion Forest Reserves and Parks Act of 1911. Its western limit is the boundary between Alberta and British Columbia, which is also the watershed of the main chain of the Rockies; along this it extends about 90 miles in a northwesterly direction, this line forming the base of the triangle whose apex lies on the Ghost River about 25 miles east of Banff.

The original object in setting aside the park was the protection of the sources of the rivers and the establishment of a Forest Reserve as well as the creation of a public park, but the underlying idea of the newer Act was to establish a Forest Reserve and also public parks or pleasure grounds, some of them lying within the larger Forest Reserve, such pleasure grounds to be subject to definite regulations and to be handled as a distinct branch of the Government service known as the Parks Branch. The Rocky Mountains Forest Reserve, established in 1911 along the eastern slope of the Rocky Mountains, and since carefully surveyed, has forest preservation and conservation as its main object, and is controlled by the Forestry Branch of the Government service.



ROCKY MOUNTAINS PARK AND VICINITY

The irregular heavy line marks the limits of the park

It has an area of 18,213 square miles, or 11,656,320 acres, and, besides the Rocky Mountains Park, it includes Jasper Park and the Kootenay or Waterton Lakes Park. It extends from the international boundary on the south to the 50° 17′ parallel of latitude, a distance of approximately 500 miles. In shape, it is an irregular strip from ten to fifty miles wide lying between the Alberta-British Columbia boundary on the West and the foothills on the East. Surveys were made for the special purpose of determining where the boundary should be placed to the best advantage. All strictly agricultural land was excluded and the line separating true forests from farm lands was usually found at an elevation of 4,100 feet. The surface of the Reserve varies from foothills to the Rocky Mountains proper. Among the rivers, the Elbow, Highwood, Oldman and Belly have their sources well up in the mountains; the sources of the North Saskatchewan and the Athabasca also lie within the reserve.

The forests are chiefly of spruce, Douglas fir, lodgepole pine and balsam poplar. Spruce is found mostly on northern exposures and in moist valley bottoms, whereas the firs and poplars are more numerous on southern slopes. Lodgepole pine is found on all sites and exposures, and is most abundant and widely distributed, chiefly because it invariably follows forest fires. The forests have suffered much from fire and lumbering, and their protection has not come a moment too soon; it is estimated that 90 per cent of the eastern slope has been burned off in the last 75 years.

The variety of game is noteworthy. Fish abound in all the lakes and streams. Pike, grayling, bull trout and several other species are found. Big game is especially plentiful in the north. Moose, deer, mountain goat and prairie chicken; but elk are practically extinct. Among the fur-bearing animals who make this section their home are the mink, lynx, bear, beaver and wolf. With its vast extent and varied surface and climatic conditions this reserve should in time become the greatest game reserve in the world.

2. The whole region is one of great beauty. Especially noteworthy is the vicinity of Banff, a section rivalled only by the Yosemite Valley in California in its grandeur and variety of scenery. The general surface is mountainous; in or about the park are several minor mountain ranges, some of whose almost inaccessible peaks exceed 10,000 feet in altitude and are covered with snow during the whole year.

Thousands of feet below the peaks tumble the Bow and the Spray, two rapid streams whose sources are glaciers. From a look-out near the Banff Springs Hotel a splendid view may be obtained of the confluence of these rivers. The most magnificent view is obtained, however, from the summit of Tunnel Mountain, which may be ascended by a bridle-path. From lower altitudes the park is not seen to best advantage, as the beauties of the valleys are lost. The meadows are carpeted with white and yellow marguerites, asters, fireweed, goldenrod, bluebells and other wild flowers. The Bow and the Spray are silver streaks in a field of color. The Bow, coming from the northwest, passes through Banff, and after forcing a passage through the mountains, flows east to the plains. Southward for many miles lies the valley of the Spray, a solid mass of forest enclosed by mountains, one of which, Mount Rundle, is nearly 10,000 feet high. A few miles to the northeast is the end of Lake Minnewanka, the largest lake in the park, and some 30 miles west of Banff is Lake Louise, high in the mountains, justly famed for its exquisite beauty.

3. There are many natural beauties and curiosities in the park. Among the most conspicuous of these are the hot springs on the slope of the Sulphur Mountains. The water is boiling, and contains sulphate of lime, soda and magnesia. It is considered helpful in curing rheumatism and various skin and blood diseases. A large bath house and an open-air swimming pool are provided for visitors. Because of the sulphur fumes the outdoor bathing is usually preferred.

The Cave is a grotto in a limestone formation, really the cone of an inactive geyser. It was discovered by a hole at the top of the mound, and the present opening at the side was made by man. In the Cave is a spring of hot, sulphurous water, and the atmosphere is full of vapor or steam. The roof of the Cave has several peculiar rock formations which are said to resemble certain famous British statesmen. These sulphur springs are like the hot springs in the Yellowstone National Park in the United States. In the Yellowstone Park

LAKE LOUISE, LOOKING TOWARD THE GLACIER

is a great limestone terrace which has been formed by such a spring. Its sides are snow white and have been described as staircases of Carrara marble. The hot underground waters, forcing their way through the limestone, dissolve some of the lime, which is carried in solution to the surface. This lime deposit is again solidified by evaporation and left in thin layers on the surface. It is said that a foot of lime will be deposited in about two years if the spring is an open-air one.

The Cave, it has already been explained, is the cone of a geyser. Active geysers are found in Iceland, New Zealand and the United States; they result from the contact of subterranean water with hot rocks. In the Yellowstone National Park, where the greatest geysers are found, there are so many geysers that the air often has a distinctly sulphurous odor. Columns of boiling water and steam are thrown 200 feet into the air, returning to the basin in millions of prismatic drops. Such a geyser once burst forth from the Cave.

4. About four miles east of Banff is Lake Minnewanka, or Devil's Lake. This is a beautiful little lake, eleven miles long and averaging from one-half to one mile in width, lying among great mountain ranges. Its clear, cold waters have a depth of 300 feet, and are well stocked with fish, especially trout, some of which weigh as much as thirty pounds. Along the north shore runs an Indian trail, which finally leads to valley of the Ghost River. This is a strange valley in which no rivers flow. Waterfalls and torrents dash down the walls of the canyon, only to disappear when they reach the bottom. It is supposed to have been the ancient valley of the Bow, whose former course is now marked only by Minnewanka and several smaller lakes. A few miles farther east the mountains end abruptly, and the Devil's Gap affords a wide view of the plains

5. The Canadian Rockies have no single peaks or groups of mountains equal to the Jungfrau or Mont Blanc. Their wild, unsettled valleys offer no striking contrasts between the grandeur of nature and the artificial beauty created by man. There are no herds or flocks, no little farm houses and chalets

in these mountains. They rise up as great piles of stone, here and there covered with trees, or higher up, with snow and ice. The Canadian Rockies, though not as high above the sea as the mountains of many other countries, are more imposing because of their greater height above the valleys from which they rise. And there is another feature of the Canadian Rockies which is lacking in Switzerland and most parts of the United States. The mountaineer, standing on the summit of some peak, commands a view, not of a small circle of mountains, but of an interminable sea of peaks and ranges extending in every direction as far as the eye can see. It must be remembered that there are great peaks in the Rockies. Mount Assiniboine, Mount Stephen, Cathedral Peak, and such mountains as Victoria and Temple, are snow-capped giants. The ascent of any of these is a difficult task, worthy the skill of the hardiest mountaineer.

6. One of the features of the park is the animal paddock, where about 100 animals are kept. These include a small herd of buffalo, along with the typical mountain animals. The bison, or American buffalo, was rapidly becoming extinct by the end of the nineteenth century. There were several large herds in the United States, but none in the Dominion. In Montana was a large herd, owned by a rancher named Pablo, who was trying to sell it to the United States government. While the United States was hesitating about the price, the Canadian government bought the herd at $250 a head. Thus the Dominion became the owner of 700 head of buffalo. Having bought the animals, the next step was to secure them. They were then running wild on the plains, and before they were captured there took place one of the most exciting hunts of modern times. In May and September, 1906, Pablo and his cowboys managed to corral several hundred buffaloes and ship them to Banff, and in the next spring about 150 more were captured and sent to their new home, from which they have since been transferred to Buffalo Park, at Wainwright, Alberta, leaving only about 25 head at Banff. Here at Wainwright they live under practically

natural conditions and prosper and multiply. There is now no danger that these noble animals, the monarchs of the plains, will become extinct.

7. The park, being the property of the Dominion government, is under the control of the Parks Branch of the Department of the Interior. Order is maintained by the Royal Northwest Mounted Police, who have a station at Banff; but it is the prestige of the force rather than its number which preserves law and order, for there are only six men at the station. The park game guardians also act as

BUFFALOES IN THE PARK AT BANFF

fire wardens, and their efforts are reinforced by special rangers during the dry season. A strict watch is kept on campers to see that no fires are left burning. Considerable work is constantly being done in repairing old roads and trails and opening up new ones. This feature of the work is especially important, since the tourist is largely dependent on these roads and trails for his enjoyment, and since it is clear that the greater the enjoyment of the tourists the greater the fame of the park. Automobiles are now allowed in the park as far as Banff, on payment of a nominal registration fee and on compliance with certain rules.

8. The park is a favorite resort for tourists, who usually begin their stay at Banff. Here is the large and comfortable Banff Springs Hotel, which offers accommodations equal to those of a large city hotel. The time that most tourists visit the park is during June, July, August and September. During the remainder of the year there are few people except the storekeepers and park guards. The snowfall in the neighborhood of Banff is normally one to two feet; on the heights and in the passes it is much deeper. The temperature

ONE OF THE BIG TREES IN STANLEY PARK, VANCOUVER

at times falls as low as 50 degrees below zero, but the sulphur springs keep bubbling on.

There are other national parks in Canada, but none having such magnificent scenery. In Alberta are Jasper Park, further north, and Kootenay or Waterton Lakes Park and Buffalo Park; in British Columbia, Yoho Park and Glacier Park. To these must be added the twelve islands in the St. Lawrence River, between Brockville and Gananoque, known as the St. Lawrence Islands Park. Besides these, there are

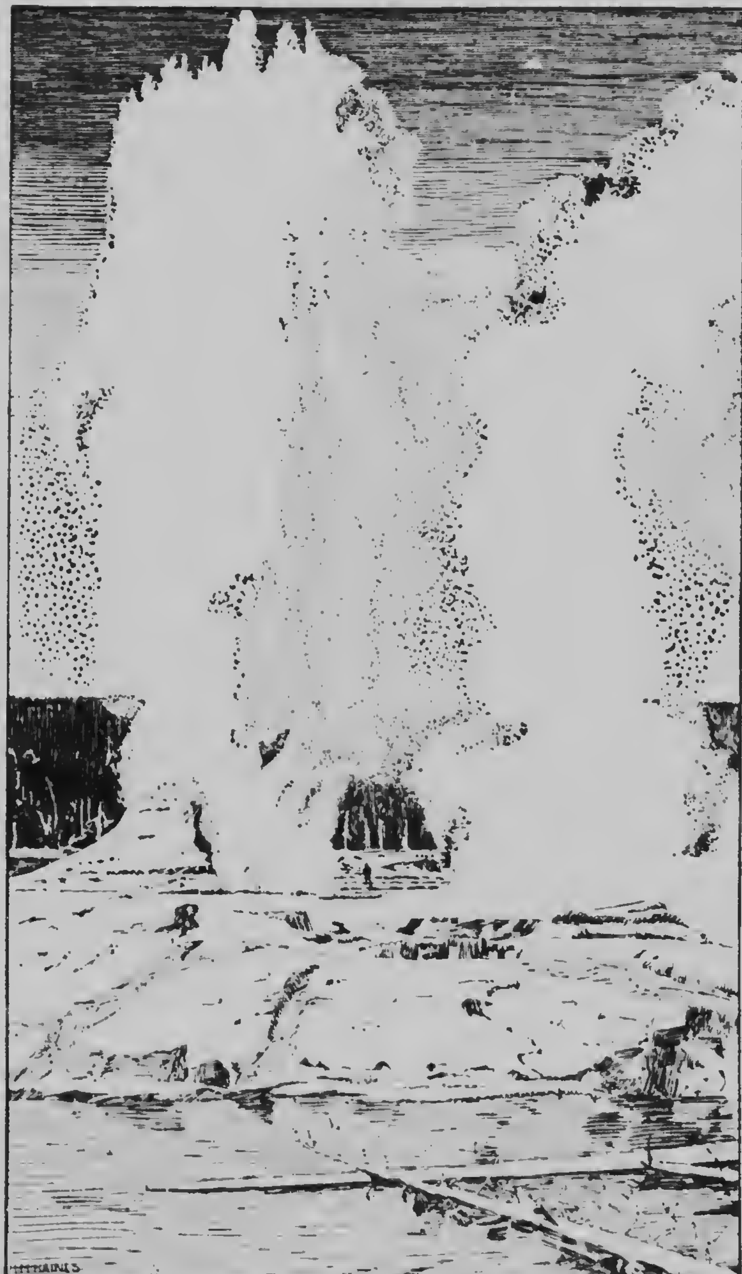
THE THREE SISTERS

a number of Forest Reserves, about 20 in number, a total area reserved for forest purposes of 16,128,000 acres. There are also a number of provincial reservations, notably the Algonquin Park in Ontario, the Laurentides Park in Quebec, and Stanley Park at Vancouver in British Columbia. None of these parks possesses the variety of topography and grandeur of the Rocky Mountains Park, and only a few of them can even be compared in size.

10. Like Canada, the United States has a number of large parks. The Glacier National Park, containing about 400,000 acres, was established in 1911 in the Rocky Mountains just south of the international boundary. It aims to do in the United States what the adjoining Rocky Mountains Forest Reserve does for Canada. Another great park is the Yosemite Valley in central California. It is a narrow valley about six miles long and half a mile wide, hardly surpassed in beauty by any mountain valley in the world. It has the famous Yosemite Falls, Bridal Veil Falls, and hundreds of giant redwoods. In the eastern part of the United States are sections in the Adirondack and Catskill Mountains set aside as forest and game preserves. None of these preserves, however, are comparable to our own Rocky Mountains Forest Reserve in extent or to the Rocky Mountains Park in natural grandeur.

The best known of all the parks in the United States is Yellowstone National Park. This is a region in the Rocky Mountains, in Wyoming. It is 55 miles wide and 65 miles long. Its general surface is a high plateau, averaging about 8,500 feet in height, surrounded by lofty, almost inaccessible mountains from 10,000 to 12,000 feet high, covered with snow during the whole year. On the north and east sides is the Absaroka Range; across the southwest extends the Continental Divide of the Rocky Mountains, and along the northwest is the Gallatin Range.

The whole region is full of natural curiosities. Ages ago there were a number of active volcanoes in this region which poured forth great floods of lava for innumerable decades,



GIANT GEYSER IN YELLOWSTONE PARK

filling in the lower parts, and making the central part of the park the high plateau as it now exists. Although these volcanoes have become extinct, and their burning craters have been displaced in many places by sparkling lakes, the volcanic force still shows itself in various other forms.

About the first of these to attract the traveller's attention is the Mammoth Hot Springs Terrace. This is a small mountain, covering 200 acres, which for centuries has been slowly built up by the action of the water. Its lower terraces are dead springs, but near the top of the hill there is a pool of hot water at the top of each terrace. The rims of the pools have the appearance of delicate lace, but are firm as marble. The water flows softly over the edges of these pools and trickles down the sides of the terraces. In many places the coloring is marvelously beautiful. The rays of the sun shining on the rocks are reflected, some places in streaks of richest orange and red, or of dainty pink or creamy yellow. The different colors are due to the mineral deposits left by the evaporating water.

The geysers are among the most interesting features of the park. One of these—"Old Faithful"—is in a great basin near Firehole River. When not in action, Old Faithful seems to be merely a crater—a hole about six feet in diameter, but at intervals of seventy minutes out of this crater, with a short preliminary roar, bursts a stream of water and steam to a height of 180 feet. This dazzling pillar of rising and falling water lasts for about seven minutes, when it seems to sink back into the earth and all is quiet as before the eruption. It is estimated that in one eruption as much as 1,500,000 gallons of water is thrown into the air, and in one day over 33,000,000 gallons from Old Faithful alone. This geyser gets its name from the regularity of its eruptions, which occur almost precisely at intervals of seventy minutes, most of the other geysers in the park being irregular. So with a little patience the tourist can wait and see this glorious sight without disappointment, while at others he might wait for hours and then not see the eruption.

In the park are several clusters of shafts, some small and others ten or fifteen feet high. These shafts are the trunks of trees which have been petrified. They are now solid agate, but on examination the markings of the bark, the rings of growth and even the worm holes can be easily traced. These forests are supposed to have been submerged in a strong mineral solution which caused the wood to turn to stone. Excavations in the vicinity have disclosed layers of such shafts, separated by cushions of lava. Think of the time, perhaps more than a century, that it took for a tree trunk to reach the size of one of these shafts, then to be covered with lava, this lava to be decomposed, fitting it for the growth of vegetation, and other great trees to grow on this new soil, until eleven such layers were formed.

Besides its volcanic features, the park is noted for its beautiful scenery. One of the most beautiful features is Yellowstone Lake; it is the largest lake in the park, its area being 139 square miles, and is one of the highest lakes in the world. It is so far above sea level that it is said that if Mount Assiniboine, nearly 12,000 feet high, could be placed in the lake at sea level, only a small hill would remain above the surface of the water. The shore of the lake is made up of many pine-covered promontories, and its surface is dotted with scores of beautiful islands. There is a large steamboat on the lake for the use of tourists. It was brought in sections to the lake, and at some places on the road the cliffs had to be blasted in order to get it through.

Following the outlet of this lake—the Yellowstone River—for about twenty miles down its course, we come to the Grand Canyon of the Yellowstone. The region hereabout is an old geyser basin in which most of the geysers have become extinct, and the river for about thirty miles has cut a gorge through this volcanic rock and hot springs deposit, from 1,000 to 1,200 feet deep and 1,000 to 2,000 feet wide. There is a granite bluff at the upper part of the basin which has resisted the erosion, and over this the water falls to the bottom of the gorge below. It is one of the most beautiful waterfalls in the world. It has been described as appearing like a "clasp of emerald from which descends a spotless robe of ermine," and the bottom is hidden in clouds of mist. The Yellowstone Falls are one hundred feet higher than Niagara Falls, and although much narrower, are far more beautiful because of the beautiful mountain scenery which surrounds them.

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37. Type Study on Geography

BY MARY BELLOWS

Of the Seattle (Wash.) Public Schools

To illustrate the correlation of geography and biography, let us select a subject for our geography lessons for one week. Let this subject be:

The Italian people are famous for their achievements in the field of painting, sculpture and music.

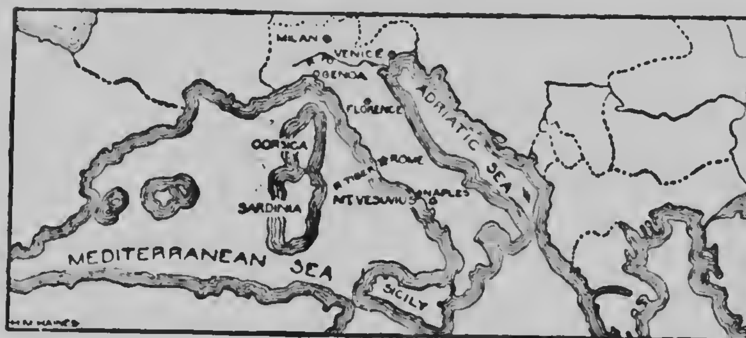
Place the above statement on the blackboard, and underneath it write the following names, in order to have a type of each art.

1. Raphael: great Italian painter, 1483–1520.
2. Michelangelo: great Italian sculptor, 1474–1563.
3. Paganini: great Italian violinist, 1784–1840.
4. Verdi: great Italian composer, 1814–1901.

In another place on the board the teacher may write the following for the study of locations. This work should precede intensive study of the outline already on the board.

Locate: Mediterranean Sea, Adriatic Sea, Apennines, Mount Vesuvius, Rome, Naples, Florence, Genoa, Milan, Venice, Po, Tiber, Corsica, Sardinia, Sicily.

Now when the children can locate the above it is often wise and is most interesting to the class to give them an outline map of the country. If the outline is simple, as it is in this case, it may be drawn by the children and they may write in these locations as the teacher dictates. This may be used as a test of their ability and it makes an attractive page for the notebook.



MAP OF ITALY

The topical outline on the board may be managed as follows, if the teacher is dealing with an unusual subject in geography where the children can secure little material, or at least will secure little until their interest on the subject is aroused: When the teacher has once aroused their interest she will find that her boys and girls are desirous of reading good things in connection with this most interesting form of geography. Let the second lesson be merely one in which the teacher tells her class about Raphael, or perhaps about his most famous picture. For instance, tell the story of the *Sistine Madonna* as it was told by John C. Van Dyke. This picture is a suitable one because it is perhaps the most popular and is least understood. Tell the children how the Black Monks engaged Raphael when he was thirty-six years old to paint an altar piece. Explain that an altar piece was a picture placed directly back of the altar and forming a part of it just as much as a mirror forms a part of the dressing table. This picture was the one thing that the kneeling people looked at as they said their prayers or heard mass. During the services the curtains that protected the picture from dust were looped back.

We would understand the intention of this wonderful piece of art better if we were back in the sixteenth century when we could see the darkened church and the kneeling body of worshipers and hear the music and the chanted prayers. It seemed when the curtains were drawn that the glorious Madonna with the Christ Child appeared walking down on the clouds to meet the kneeling people.

Tell the children that the picture is ten feet high and seven feet wide, and that there are six figures in it. (A good copy may be easily secured to show the class.) Speak of the significant positions of Santa Barbara and San Sisto, and describe the throng of angels' faces in the original, which are seldom reproduced. Van Dyke carefully describes the robes of all the figures. There is a charm of color in the picture aside from the sense of form and movement.

Now tell the class how after two centuries the Black Monks sold the *Sistine Madonna* for $40,000. The children seem to comprehend the different setting this wonderful picture has when placed in a bare room at Dresden. They see how the meaning is destroyed when the Madonna instead of seeming to come down on the clouds to meet the kneeling public meets a group of alleged critics, and sometimes unbelieving mobs of over-sea tourists.

In just this way we may study Michelangelo's *David;* may tell of Paganini's queer life—how at the age of seven he wrote music which he could not play until he was ten, and how he won fame by playing on the G-string.

The study period may be used for notebook work, such as the copying of the outline or the drawing of the skeleton map in which the child has written the locations of the places studied.

The main point in such work as this is not the supplying of many details but the giving of a few facts which will be retained.

CHAPTER FOUR

CONSTRUCTION WORK

REED MATS AND BASKETS

1. Introduction. The chief problems to be considered in the introduction of industrial arts into the public schools are the ability of the teacher to do the work, the equipment with which the school can be provided, and the material to be used. It is the purpose of the following exercises to show how these problems can be solved.

First, the teacher can learn to do the work by doing it as directed in the exercises here given. Before attempting to introduce even the simplest of these exercises into the school, she should construct the object to be made; and if she encounters difficulties, she should repeat the exercise until she acquires the skill necessary to enable her to teach the class. Second, the problem of equipment is easily solved by the selection of such exercises as require few or no tools, like those given on the following pages. The solution of the third problem is found in the material employed in the constructions given. The expression of thought through wood necessitates a more or less elaborate equipment of tools, and children in the lower grades are usually denied this material. There are, however, mediums through which thought may be expressed by younger children that require almost no tools, and work with them may be carried on in the regular classroom, without disturbing the pupils at work in the various rooms, or in other branches in the same room.

Each set of exercises is entirely separate from the others, and can be taken up without any reference to them. While basketry is given first, it does not necessarily follow that the teacher should begin her work with the construction of baskets. She may begin with the raffia work, or with the paper and cardboard work, if conditions are such as to make the selection of either of these sets more advisable. In general, it is wise to begin with those exercises with which you feel you will succeed the best, and which the conditions and the time seem to make most suitable. This lends interest to the work, and also enables the pupils to see that they are working for a definite purpose.

2. Materials. The most familiar materials used in basketry are rattan, tilo and raffia. *Rattan* is a stout cane which comes to us from China, India and Japan. It reaches this country in the crude state and is then cut up into caning, pith and rattan. The polished outer surface is removed in flat strips, and is called *caning*. This is used in weaving chair seats. The remainder of the cane is cut into flat and oval lengths having an unpolished surface. The part used for basketry, and commonly called *reed*, is the oval part. This reed is sold by the pound and is designated by numbers beginning with No. 0. No. 0 is very fine, and No. 8 is very coarse. No. 1 and No. 4 are best for school use. The price varies according to number, No. 1 costing about 75 cents per pound; No. 2, 60 cents; No. 3, 55 cents; and No. 4, 45 cents.

The material should be soaked for about ten minutes before using. Too much soaking is bad for the reed. It not only discolors it, but also causes it to become very brittle.

Tilo strands are the shavings from a fir tree. These are a Japanese product. The trunk and large branches of the fir tree are steamed, and then, by using a kind of plane, these clever natives cut the wood into long, straight shavings. *Tilo matting* is a soft, pliable material made of the tilo strands. It may be used in a variety of ways, and is as easily worked as cross-stitch canvas. It is a very absorbent material, taking color as freely as any fabric.

Raffia is the outer covering of the palm leaf. It grows in Madagascar, where the natives dry it and twist it into coils, or make large braids of it. It is then baled and sent to this country in large quantities. It is often mistaken for a kind of grass. Nurserymen find it useful for protecting shrubs and young trees from cold.

All of these materials may be purchased of the George M. Hendry Company, 215 Victoria Street, Toronto, and most other general school supply houses.

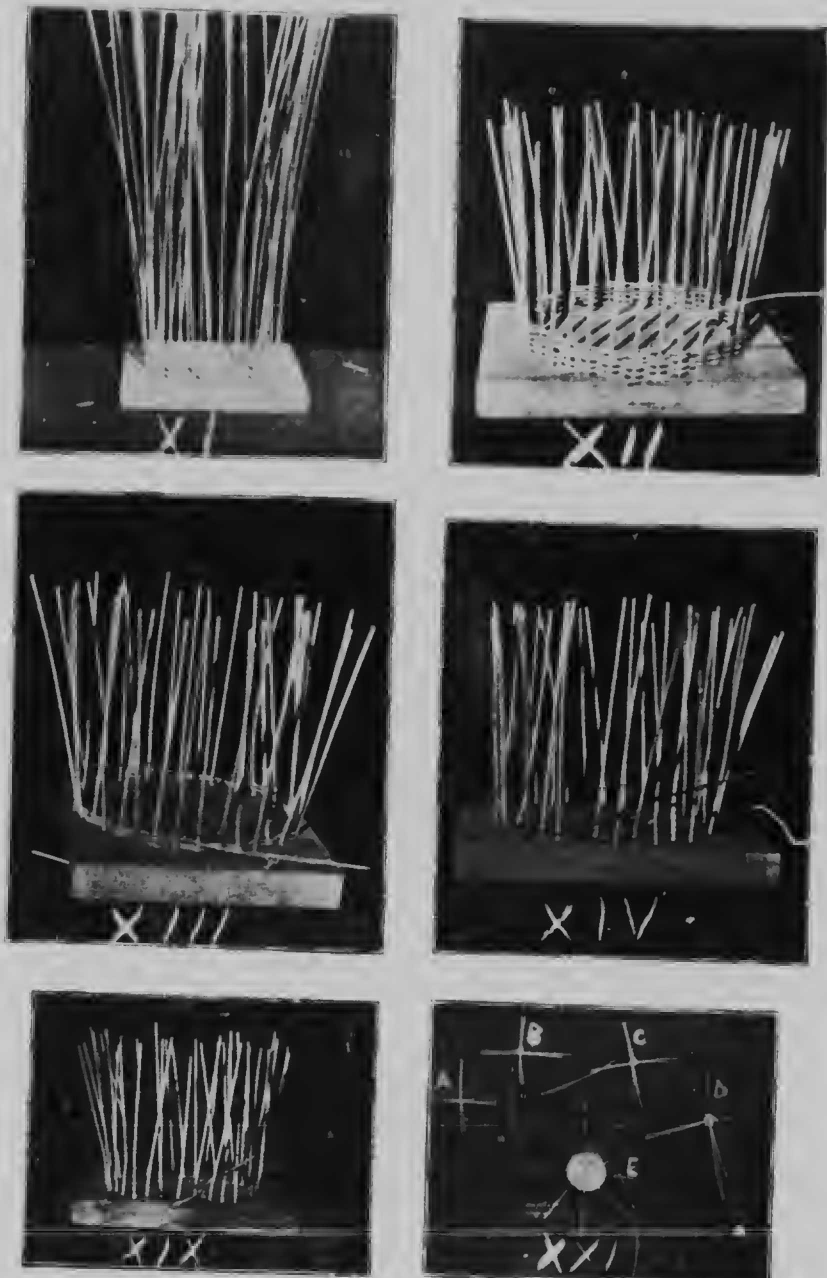
3. Preliminary Steps. Basketry should rank high in the industrial arts of the schoolroom. It requires practically no tools, and admits of great variety as to form and color. In the weaving of baskets and mats there are unlimited possibilities in design. Much has been done spasmodically in the way of basketry. The results on the whole have been poor, which is due largely to poor teaching. No pupil should be allowed to take up a second step in weaving until he thoroughly understands the first. He must understand that no basket can be firmly made unless its foundation is right. As far as possible, each child should be so guided in his work that he can answer his own questions after experimenting.

The material used in basketry consists of the uprights, called *stakes*, and the strands woven around the stakes; these strands are called *weavers*. One who has woven understands that in order to weave continuously with a single weaver, there must be an uneven number of stakes. The child does not know this.

To assist the child to answer many questions concerning the number of stakes, the kind of weave, etc., take a small board, any size and thickness, and draw on it a circle not less than 3 inches in diameter; divide the circumference of this circle into spaces $\frac{7}{8}$ of an inch apart, and bore holes large enough to receive pieces of No. 4 or No. 5 reed. Slender twigs of willow adapt themselves to basketry, and may be used just as successfully as reed, as shown in Fig. XI.[1] This is not a basket, but it is used to illustrate to the pupils the different weaves, and how the weaving is done. The spaces in the circle should not be equal, as one hole is to hold a peg, which may be taken out in order to get an odd or an even number of uprights.

This arrangement makes it possible for a pupil to answer

[1] The figures in this and the following sections refer to corresponding numbers in the halftone plates.



BASKETRY

such questi ..s the following: Why must there be an uneven numbe stakes in simple, continuous weaving? Why does an even . urber give the striped effect in double weaving, when one weaver is colored? How is the Indian weave with an even number of stakes brought about? The same arrangement also makes it possible for the child to make many discoveries in weaving.

4. The Different Weaves. (a) Single Weave. Fig. XII shows the single weave, using an odd number of stakes. Fig. XIII shows the single weave, with an even number of stakes. Fig. XIV shows the Indian way of using a single weaver on an even number of stakes. When the weaver gets around to where it started, it passes behind two stakes, and the weaving is continued as before. The next time around, when the weaver reaches the starting place, it passes behind two stakes again. This is true each time around. To make the illustration more easily understood, different colors have been used in order that the course of one weaver may be more easily followed. The reed is easily colored with vegetable or with aniline dyes, using directions as given under *Dye Stuffs* (Sections 21 and 22). Fig. XV shows what may be done in the way of decorations, by using a single weaver and an even number of stakes. At the point marked "2", is shown the way to change from one course to another. Several rows may be woven before changing courses. A band of this style of weaving may be used as the decorative feature of the basket.

(b) Double Weave. Fig. XVI shows the handling of two reeds as weavers. In using two or more weavers, the one at the left hand is known as the *rear* weaver, and the right hand one as the *forward* weaver. Weaving is always done from left to right, except in cases of special design. This will be explained later. In the double weave, two weavers are put behind two consecutive stakes, and project forward to the right. The rear one goes over the forward one and in front one stake, then behind one stake and out between the next pair of stakes, to the right of the forward weaver.

Fig. XVI shows the effect of a double weaving when one weaver is colored, and an even number of stakes are used.

The end of a new weaver is inserted behind and beside the end of the one already woven in. The weaving is then continued. When the basket is finished, these ends may all be cut off flush with either the inside or the outside of the basket, as the case may be. New weaves are introduced in the triple and quadruple weaving in the same manner.

(c) Triple Weave. Fig. XIX shows the beginning of the triple weave. The weavers are arranged behind three consecutive stakes and project toward the right. The rear one goes over the other two and in front of two stakes behind one stake, and out between the next pair of stakes, to the right of the forward weaver. The one that was the middle weaver now becomes the rear one, and it, in turn, is treated as the rear one was. Always be sure to take the rear weaver and bring it out between the pair of stakes, to the right of the forward weaver. Very effective results are produced in the triple weave when the number of stakes is exactly divisible by three, when the number of stakes is divisible by three with a remainder of one, and when the number of stakes is divisible by three with a remainder of two. Ample opportunity for experiment should be given.

(d) Quadruple Weave. The quadruple weave is done the same as the triple weave, only four reeds are inserted. Very interesting results are obtained by weaving one, two or three colored weavers.

Fig. XX shows finished baskets.

5. Mats. To put into actual practice what has already been given, plan to make a mat, as this embodies all the constructive features found in the bottom of a basket. Soak a No. 4 and a No. 2 reed until both are pliable. From the No. 4 reed cut four 12-inch spokes and one 7-inch spoke. With a darning needle split three of the 12-inch spokes in the center. This is done by boring the needle through the reed and then pulling it so it splits the reed. These incisions must be long enough to allow the remaining number of

MATS WOVEN FROM REEDS

(a) Simple weave [illegible] Indian weave [illegible] weave with border (d) triple weave [illegible] weave with colored bands

[illegible] material that can be [illegible] [illegible] easily [illegible]

spokes (three) to pass through them. Push half the length of the remaining two 12-inch spokes through the three incisions, as shown in Fig. XXI (a). The four spokes, now in groups of two, are lying at the right angles to each other, forming upper, lower, right hand and left hand groups.

Place the 7-inch spoke between two of the 12-inch spokes, pushing it just through the incisions, as shown in Fig. XXI (b). This gives the odd number of spokes necessary for plain weaving. The end of the weaver of the No. 2 reed is pushed through the incision, as shown in Fig. XXI (b). The weaver is then brought to the right, in front of the vertical group, back and down behind the horizontal group, thereby binding its own end to the spokes. It then comes to the left, across the vertical group, back and down behind the horizontal group to the left, back to the place from which it started. It follows the same course once more, until it has been around the group twice, as shown in (c). The next time, instead of coming down across the group of horizontal spokes to the right, it breaks back, or is reversed, over the horizontal group to the left, and follows the opposite course around twice. The next time around the spokes are separated and the under and over weaving commences, as shown in (d). If one weaver is too short to bring the weaving to the desired size, join the weavers as shown in (e), and continue the weaving as though the weaver were continuous. Be careful to keep the weaving close together, with the left hand, each time it goes over and under the spoke.

Fig. XXII shows the way the mat is held with the left hand in the beginning of the work, while the right hand does the weaving. Be sure to hold the spokes out straight. The weaver must adjust itself to the spokes, and not the spokes to the weaver. When the spokes are all the same distance apart, and approximately in the same horizontal plane, the weaving is placed on the flat surface. The spokes are held down with the left hand, and the weaving is done with the right. When the weaving is completed, the edge of the mat is overcast. To do this, first cut off the weaver long enough to go a little more than once around the circumference. Begin overcasting, as shown in the illustration, by bringing the weaver from behind one spoke, over the next spoke to the right, and through the last row of weaving just before it gets to the following spoke. Continue this process until once around, then cut off the weaver back of the last spoke.

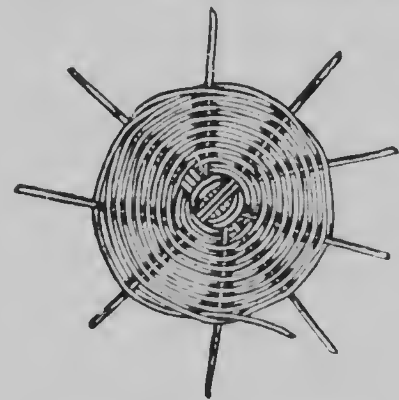
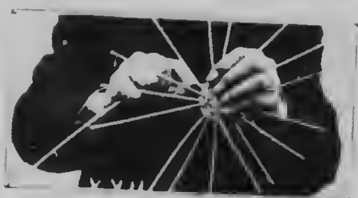


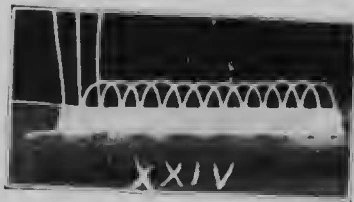
ILLUSTRATION OF OVERCASTING

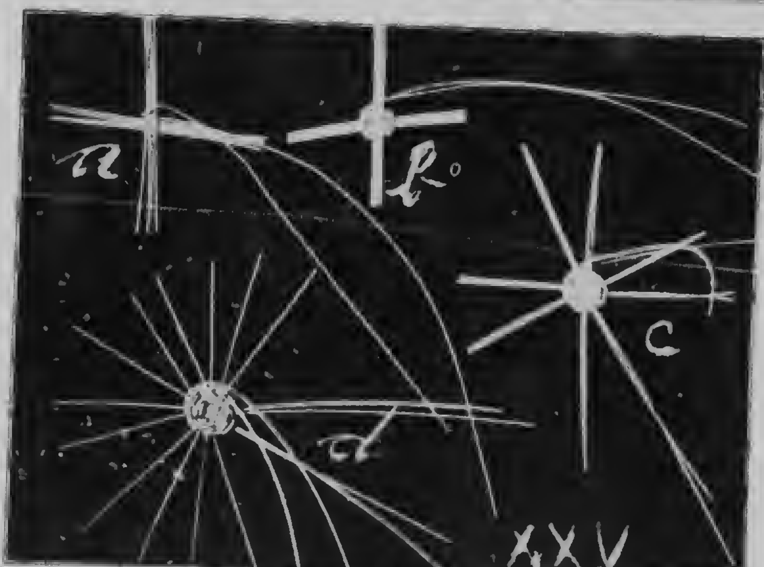
The mat is now to be finished with an open border, as shown in Fig. XXIII (a).

Fig. XXIV shows a very simple way of illustrating to a class how open borders are made. Looking from right to left, we find in the illustration that one spoke goes in front of the next, and inserts just before it gets to the third. If the spokes are about one inch apart, it will require about 2¾ inches, outside of the overcasting, to finish the border. A very effective border is made where the first spoke goes in front of the second, and inserts just before it gets to the fourth. This requires about 4½ inches outside of the overcasting. A third finish allows the first spoke to go in front of the third, and insert just before it gets to the fifth, and requires from 6 to 7 inches beyond the overcasting. In each case the end must be sharpened and inserted 1 to 1½ inches.

Fig. XXV shows the method of starting a center with the pairing weave. Half the reeds are split, and the other half are pushed through these incisions to form a perpendicular cross, as shown in Fig. XXV (a). The weaver is pushed through the incision, so that one-half is to the right of the vertical group, and the other to the left. The split pieces are held vertically, and the weaver, doubled in the







BASKETRY

middle, is started around the vertical group (a), and under the horizontal group. The rear weaver is brought over the same horizontal group.

The whole group of spokes revolves in the hand from right to left, until the horizontal group becomes the upper vertical group. The weaving is continued first with one weaver and then the other, always allowing one to pass under the group, and the other over, as shown in (b). After going around several times in this way, begin to separate the spokes into pairs, weaving first with one weaver and then with the other. After the spokes are spread apart, as at (c), single spoke weaving may be commenced by weaving first with one weaver and then with the other, as in (d). Single weaving may now be started by weaving once around with one weaver, until coming to the other weaver. The other weaver is then woven around until it comes to the same position as the first. In this way, first one and then the other, each as a single weaver, is used until the mat, or bottom of the basket, is finished.

To make a mat, decide first upon the size. Cut the spokes equal in length to the diameter of the mat, plus the length required to give any one of the above named finishes. To make a basket, decide first upon the size of the bottom and depth of the basket. Cut spokes equal in length to the diameter of the basket, plus the depth of the basket, plus the length required to give the desired finish.

Fig. XXIII (b) shows a mat of Indian weave and open border; (c) shows an Indian weave with a band of color; (d) shows a mat with triple weave, two strands of natural reed and one of color, with an odd number of spokes; observe the close finish; (e) shows the triple weave, with a band of color in single weave.

6. Baskets. If a basket is to be made, the spokes are turned upward after a thorough soaking, as shown in Fig. XXVI. In weaving the first time around, the stakes do not stand erect, as shown in (a). After weaving around several times, the stakes take a more erect position **(b)**.

The spokes, which now become stakes, are turned so that the weaving may be continued from left to right.

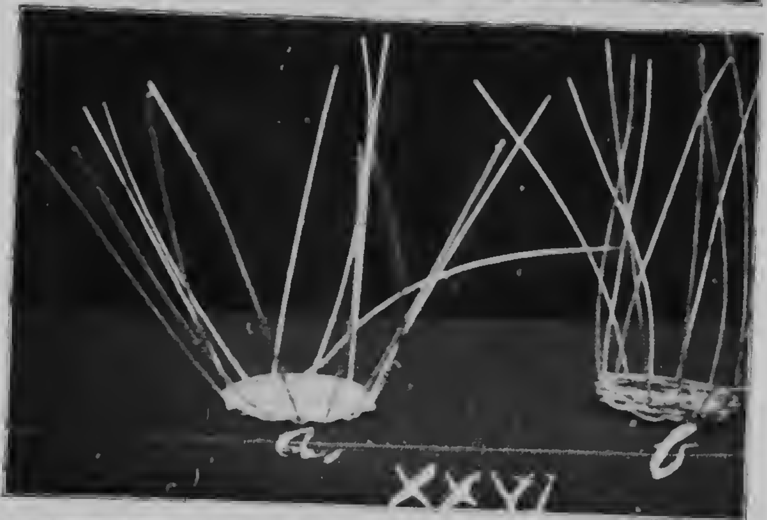
Fig. XX shows the various ways in which the upper edge of a basket or mat may be finished, after being overcast. The weaving of this close finish is started on the side nearest to you, and continued from left to right, as shown in Fig. XXVII. The starting spoke is pushed behind the one to the right and out; No. 2 is pushed behind No. 3 and out, and so on around the top, the last spoke going behind the first, and out of the loop left by it in going behind No. 2. Pull all ends tightly, as shown in the left-hand part of Fig. XXVII. For the second row, start with any spoke, put it in front of the next to the right, and through the loop, into the inside of the basket, as shown in the right-hand view in Fig. XXVII. The ends are cut off just inside of the border and close to it.

Another way to finish the top is to allow each spoke to go to the right, behind two, and out. In the next row, in front of two and through to the inside. A third way is to allow each spoke to go behind one and out, and then in front of two to the inside.

The way to begin a sixteen-spoke center is to let four pieces cross four pieces, and two rows of pairing are woven around the groups of four's before starting in two's. Weave around two's twice, and then separate into single spokes. The way to begin a center having twenty spokes is to let five cross five. Three rows of pairings are woven around the groups of fives. Each group of five is divided into two's and one, making eight pairs and four single spokes. These are woven around twice and then separated into singles.

EXERCISES IN KNOTTING

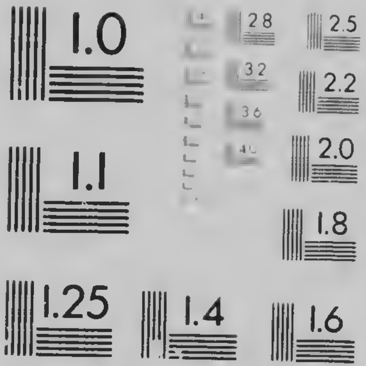
7. Twine Holder. Select eighteen long, smooth strands of raffia. Place the ends of one strand together, thus making a loop at the center. Hold a pencil, or round stick, horizontally in the left hand; bring the loop over the top of the pencil from the back, and pass the two ends up through



BASKETRY

MICROCOPY RESOLUTION TEST CHART

ANSI and ISO TEST CHART No. 2



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the loop, pulling them down until the loop is held close to the pencil. (Fig. I, a.) In this manner loop the remaining strands on to the pencil. The knotting is done working from left to right. Leaving one strand on the left edge, knot the second and third strands. Hold the two strands together. Bring the two ends up and around to the back, across the back of the two strands and through the loop to the front. Pull the ends down into place, leaving the knot one-half inch from the pencil. Continue in this manner, knotting the fourth and fifth, the sixth and seventh. One strand will be left on the right side, corresponding to the one on the left side. In knotting the second row, two strands are left on each side. Tie until the knots assume a V shape (b).

The pencil is now slipped out, and a braid of raffia is run through the loops. This finishes the top of the twine holder. The first two loose strands at the top are knotted together; then the two pairs which follow, and so on until the loose strands are all knotted. Gather up the bottom of the holder, tying it with a strand of raffia. Cut the ends of the strands a uniform length. (c) shows the finished twine holder.

8. Shopping Bag. Draw and cut from light weight straw board an oblong 10 inches by 8 inches. On each 8-inch edge, close to the upper 10-inch edge, cut notches. Use two braids of raffia for draw strings. Place one braid around the oblong, tying in the left-hand notch; place the other braid around the oblong, tying in the right-hand notch. On each side of the oblong, and over both braids, loop 20 strands of raffia, as directed in the exercise for the twine holder. We will handle these strands of raffia in pairs (See Fig. II). The two outer strands will be knotted around the two inner strands. Hold the two inner strands in the left hand (Fig. III, a); place the right hand strand over the two inner strands (b); bring the left hand strand down over the part of the right hand strand which lies on the left of the two inner strands (c). Now the left hand strand is passed along to the right, under the two inner strands, and up through the loop formed by the right hand strand (d). Pull the right and left ends outward. This completes the first half of the knot (e). To begin another knot, the left hand strand is placed across the two inner strands, as in (f). The right hand strand is brought

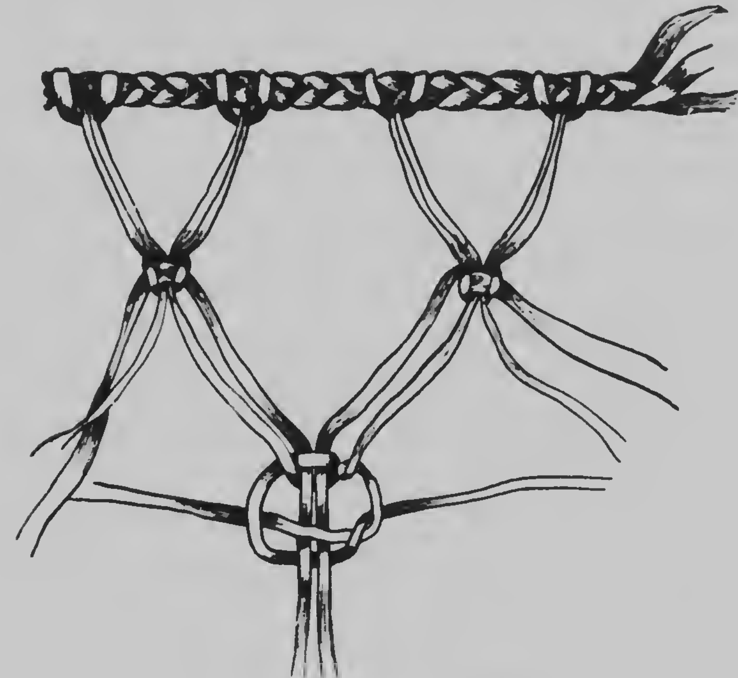
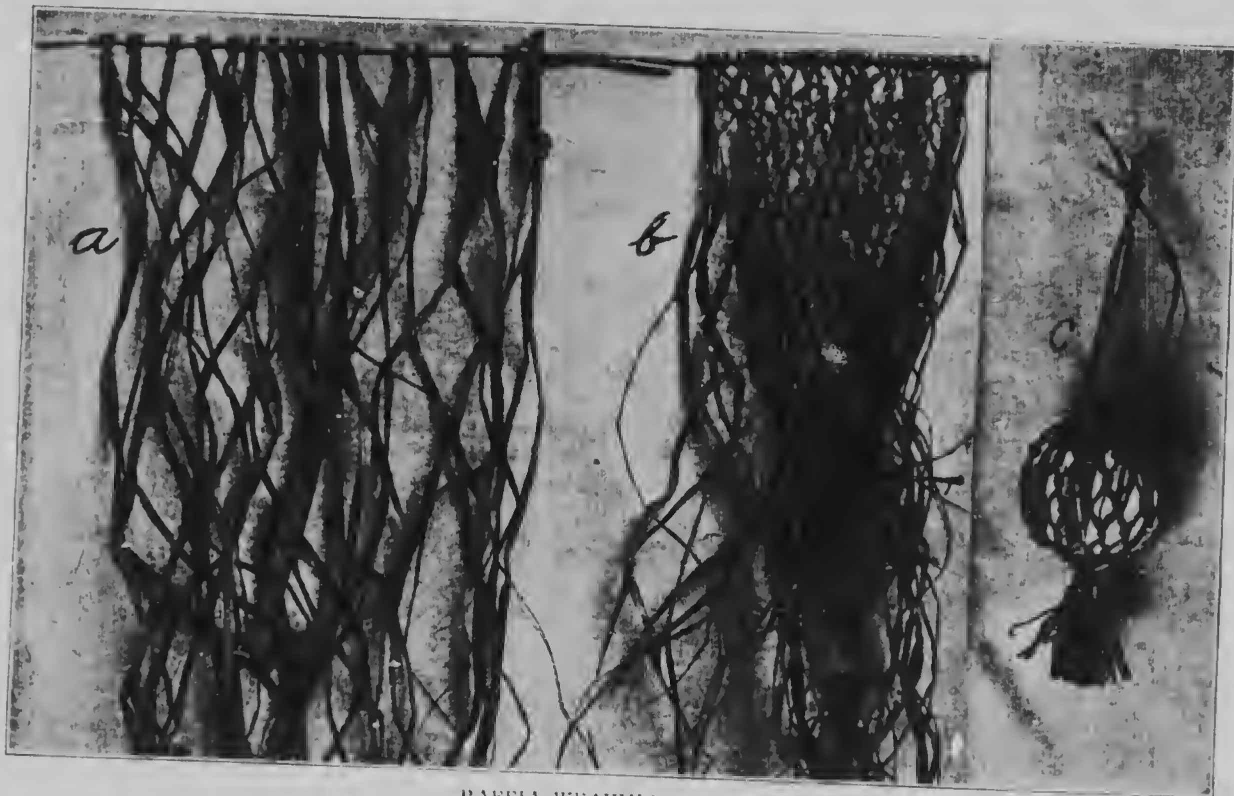


FIG. II. SOLOMON'S KNOT

down over the part of the left hand strand which lies to the right of the two inner strands (g). Now the right hand strand is passed under the two inner strands, and up through the loop formed by the left hand strand (h). Pull the ends outward, one to the left, one to the right, and you will have a finished flat knot (Fig. II), called *Solomon's Knot*. Continue in this manner, handling the next two pairs, and so on, until the first row of knots, going across both sides of the oblong, is completed. In the second row the right hand strand of one knot, and the left hand strand of the next knot, are



RAFFIA WEAVING FIG 1

held together, and the knot is tied with the two strands on either side of them (Fig. II).

Care must be taken to keep the meshes even. When the bottom of the oblong is reached, the two sides are joined

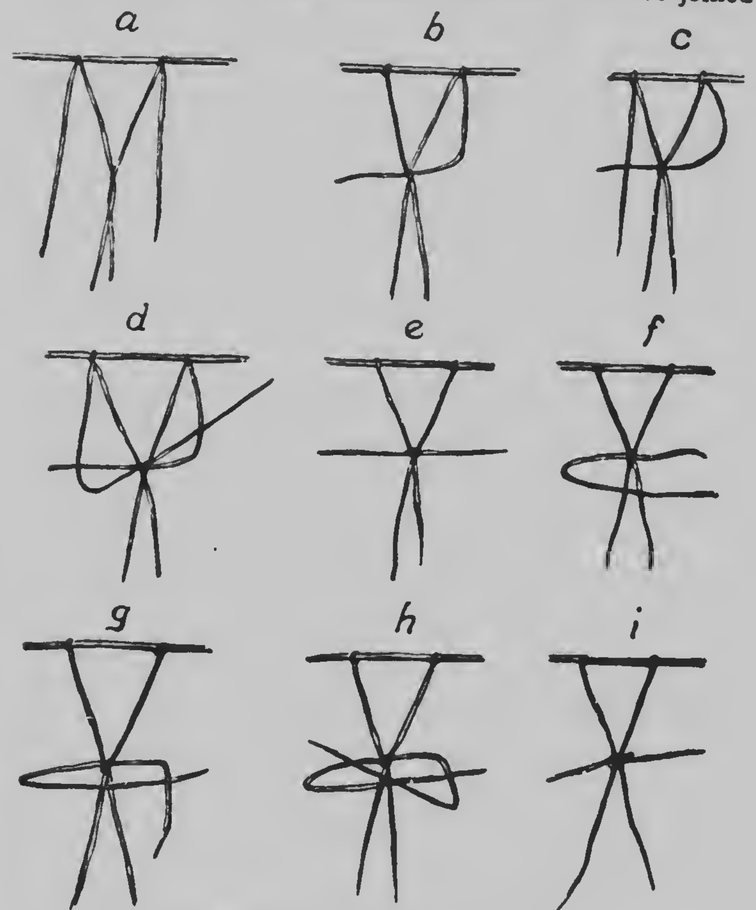


FIG. III. METHOD OF TYING A SOLOMON'S KNOT

at the bottom by placing the meshes and knots evenly together, and tying together a knot from the front and a knot from the back, with two of their outside strands. Cut the ends of the raffia a uniform length to make a good finish. A pretty twine holder may be made in this manner by splitting the strands of raffia and making smaller meshes.

9. Knotted Work Bags. Secure a small brass ring. Into it loop eight long, red strands of raffia, as described in Section 7; or, loop seven strands on one, as shown in Fig. IV (a), and tie the ends of the foundation so as to form a ring in the center. The tied ends are dropped, making the eighth pair (b). We will call those strands *leaders*. The knot in this bag is tied as described in Section 8. On every two red leaders knot six strands of natural colored raffia in the following way: Place a strand under the two leaders, at right angles to them. Then proceed to tie the knot (Solomon's knot). Every knot must be pressed close to the brass ring, thus forming a symmetrical center for the bottom of the bag (See Fig. V). Between every two pairs of leaders we have twelve strands of natural colored raffia—six strands pointing to the left and six strands pointing to the right. Gather the twelve strands into one hand and tie together, using the first leader to the right and the first leader to the left for tying the Solomon knot (Fig. V). Treat the other leaders in this manner (Fig. IV, c).

The next step is an important one, for upon it depend the shaping of the bag. The two leaders, between two knots, naturally lie toward each other. They are tied together in an ordinary hard knot. To make the bottom of the bag flat, the leaders are tied so as to allow the work to lie flat. To make the bottom rounded, and later to draw the sides into shape, the leaders are drawn closer together. Tie all the leaders in this manner. Now the first half of the figure is finished (Fig. V, a).

Hold the leader which points to the right, in the right hand, over the bunch of strands. Take six strands from the knot on the right, and in their order, tie them in a hard knot, on to the leader held in the right hand, letting each strand come under the leader (d) (e). Take the other leader, which points to the left, and hold it in the left hand. Take six strands from the knot on the left, and in their order tie them in hard knots, on to the leader held in the left hand (c) (d). Tie once around in this manner. The two leaders

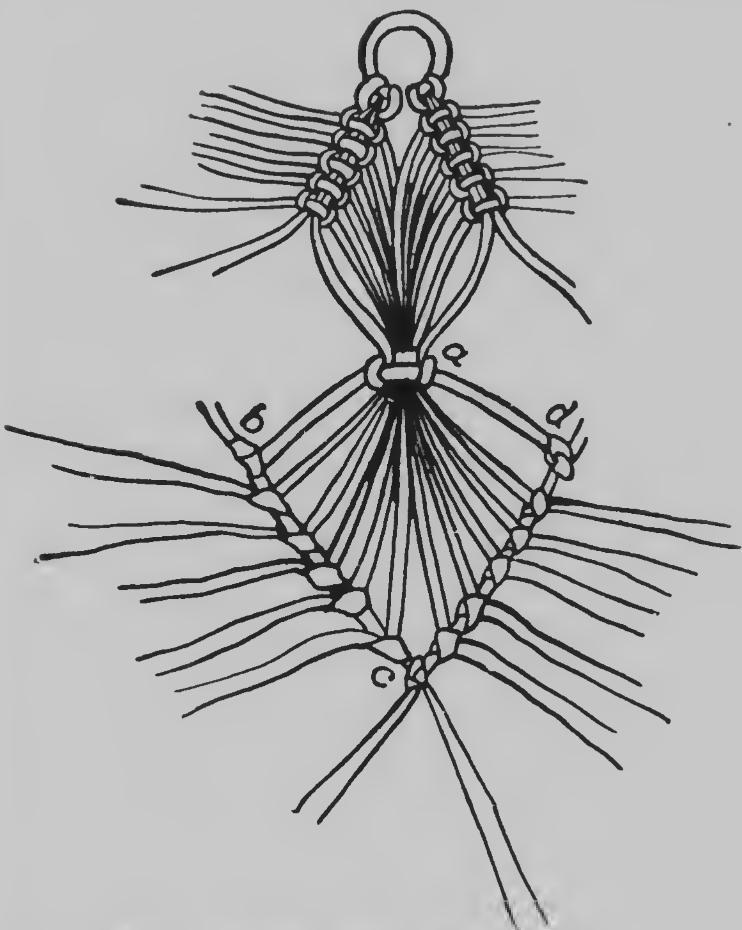


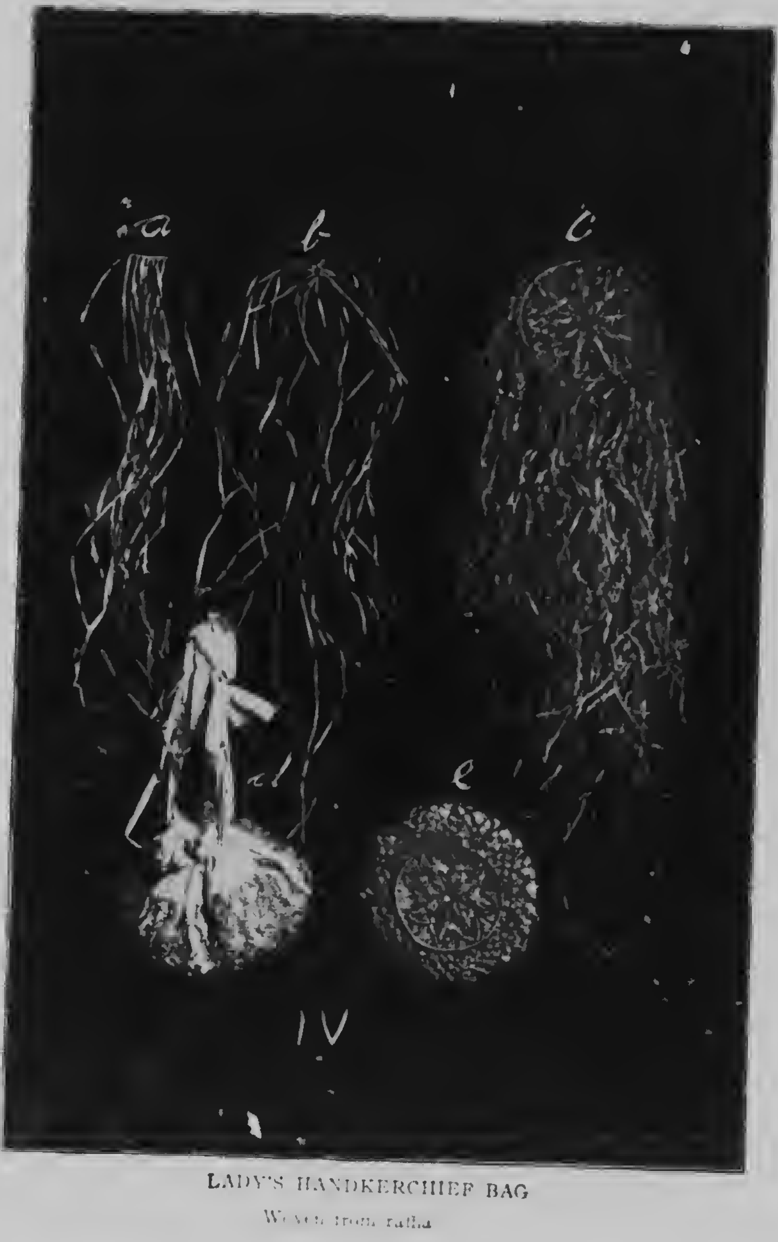
FIG. V. KNOTTED DESIGN FOR SEWING BAG

fall together at the bottom of this figure (c). The figure is now complete. Repeat the exercise until the desired shape and size are attained.

The bag may be finished in several ways: (1) The ends of the raffia may be braided and looped over to the inside, where they are fastened. (2) The ends along the edges of each scallop may be run each way from the upper point, passing through all the knots, and being cut off at the lower point of the scallop. (3) The ends may be run each way, through all the knots, to the upper point of the scallop, and tied in a small tassel (4). The edge, if finished without the tassel, may be bound by sewing over and over with narrow ribbon or raffia. Use a braided handle. A pretty lining adds to the beauty of the bag.

10. Handkerchief or Work Bag. Fig. IV (c) shows the bottom of a very attractive handkerchief or work bag. The exercise is begun as in (a) and (b). After the first row of points is completed, the ends are all tied to a piece of No. 3 reed, bent circular, as shown in Fig. IV (c). This is done by first tying the reed to the ends of the points of the leader (c). Each strand of raffia is tied with a double knot around the reed, drawing it from below just as the strands were knotted around the leader in Fig. IV. After the strands have all been knotted around the reed, begin to make Solomon knots a i continue until the bag is as large as desired. The top may be finished by making rows of Solomon knots. Bend outward and fasten, making loops around the top. Cord or ribbon is drawn through the loops to close the bag, or the lining may be allowed to form a heading and the draw strings run through it, as in Fig. IV (d). Fig. IV (e) shows the bottom of the bag. By making the knots close together near the bottom, the lower part of the bag will have a more solid appearance than the upper portion, producing a pleasing effect.

11. Continuous Coil Basket. The material required is reeds and raffia. Soak a No. 2, 3, 4 or 5 reed in hot water until pliable. Dampened raffia makes the work more even and smoother. Thread a darning needle with the large end of the raffia. Scrape the reed flat, with a knife, 1½ inches from the end. Hold the reed in the left hand, and wind the



LADY'S HANDKERCHIEF BAG

Woven from raffia

thread, carefully, around the scraped portion. Wind toward the point. Shape the covered end into a round coil and sew firmly through the center until the coil is securely fastened. See that the coil is well covered with raffia (Fig. VI). This

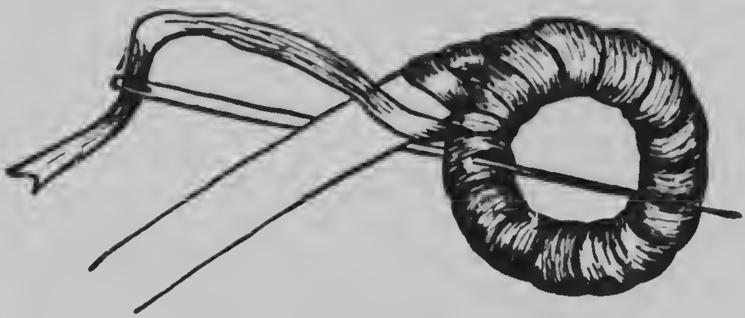


FIG. VI. COVERING A REED

is simply stitching over and over the one coil. Introduce a new thread by placing it along the reed, and working over it until the end is securely fastened. Thread the new strand into the middle and work the end of the old one until it is securely fastened.

To introduce color, proceed in the same manner as in introducing new threads. Do not cut the threads in changing from one color to another, but carry them along with the reed, and work over them. In filling out designs, stitches are not counted as would naturally be supposed. The design must be filled in solid, and may take more or less stitches, according to the size of the thread. A pattern of the design to be used may be cut from paper, and laid on the basket as the work progresses.

After the bottom of the basket has been made the desired size, begin shaping the side by holding the reed directly over the last coil, if straight sides are desired. If the basket is to flare, hold the reed and raffia to the outside of the last coil. If the basket is to grow smaller, hold the bunch of reeds and raffia to the inner edge of the last coil.

To splice the reed, scrape the ends to be spliced two inches from the points, and place them together, lapping one over the other, so that the size of one reed may be kept. Continue weaving, holding the ends together until they are securely fastened.

Finish the basket by scraping the reed to a point and finishing the coil off gradually. This basket may be made with a rope of raffia or an ordinary clothes line rope for the foundation.

12. Navajo Weave. (a) ROUND BASKETS. To commence a round basket, proceed as in Fig. VI. Bring the thread back between the coil and reed, and over the reed to the front, and back between the coil and reed. Bring the needle through to the front under the coil. The stitch is now complete (Fig. VIII). As the coil progresses, each stitch

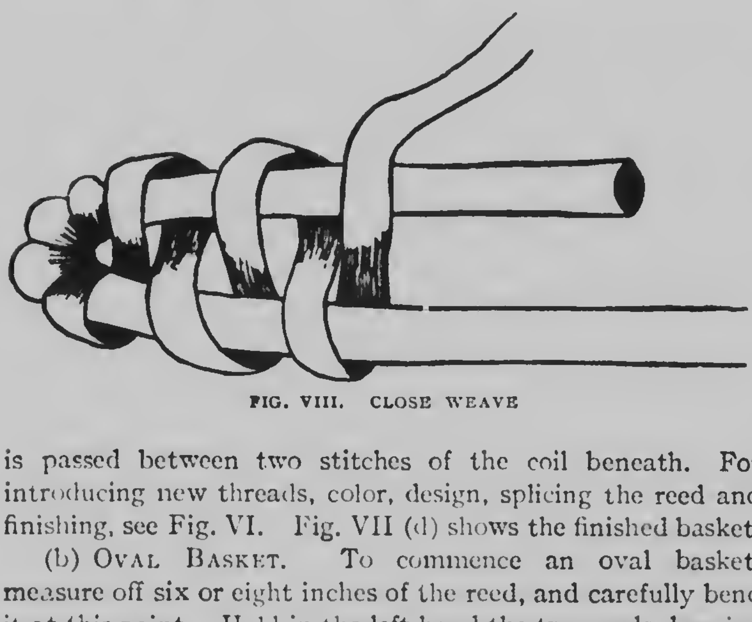


FIG. VIII. CLOSE WEAVE

is passed between two stitches of the coil beneath. For introducing new threads, color, design, splicing the reed and finishing, see Fig. VI. Fig. VII (d) shows the finished basket.

(b) OVAL BASKET. To commence an oval basket, measure off six or eight inches of the reed, and carefully bend it at this point. Hold in the left hand the two reeds, keeping the short end underneath the long one, and the bent end to the right. Commence weaving by wrapping the raffia several times around the bent end. Use the Navajo stitch. Draw the thread firmly, and do not let the reeds spread apart.

(c) Needle Basket. This attractive and useful article may be made by weaving over a No. 1 reed a small Navajo basket. Make a small cushion to fit the basket. Fasten the cushion in place with threads of raffia.

13. Mariposa Weave. To commence an oval basket, follow the instructions in Fig. VI. After the bent end is smoothly covered, bring the thread over the long reed from the back down between the two reeds, around the short reed, and down between the two reeds again. Bring the thread

FIG. IX. MARIPOSA WEAVE

up between the two reeds at the right of the stitch, and down between the two reeds at the left of the stitch. This completes the stitch. Both reeds (Fig. IX) are wound toward you. This is sometimes called the *open work stitch.* For introducing new threads, color, design, splicing the reed and finishing, see Fig. VI.

Fig. VII (b) shows the completed basket.

14. Lazy Squaw Weave. (a) Small Coil. To commence a round basket follow the instructions given in Fig. VI. This is a long and a short stitch. Hold the coil in the left hand. Wrap the raffia toward you and around the reed, then over the reed again and down through the center of the coil. This gives the long stitch, while wrapping the reed once gives the short stitch (Fig. X). In the Lazy Squaw weave the thread is wound toward you, just the opposite of the winding in the Navajo weave. For introducing new threads, color, design, splicing the reeds and finishing, see Fig. VI. Fig. VII (e) shows the finished basket.

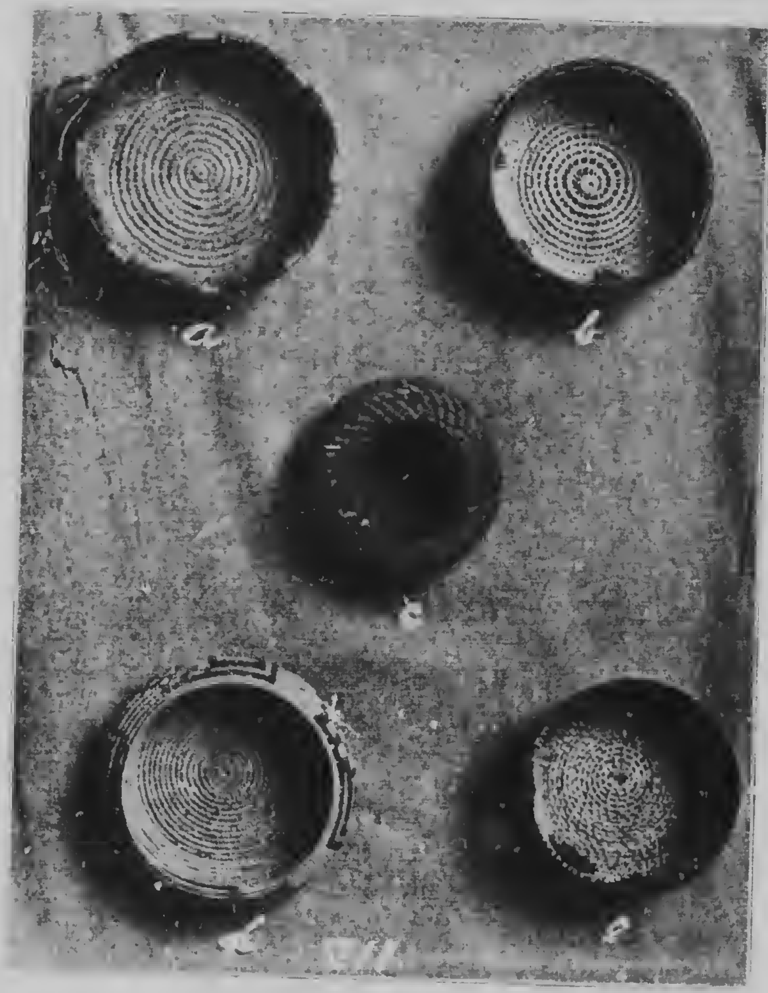
(b) LARGE COIL. To commence the basket, follow the instructions given in Fig. VI, using a No. 2 reed. Gradually introduce three more No. 2 reeds and eight or ten strands of

FIG. X. LONG AND SHORT STITCH

raffia. Wind the coil three or four times in making the short stitch, then down through the coil once, for the long stitch. Keep the coil a uniform size by introducing new reeds and strands of raffia. This basket is often made with coil of raffia without the reed. For introducing new threads, color, design, splicing the reeds and finishing, see Fig. VI.

(c) CROCHET STITCH. To commence this basket, follow the directions given in Section 7, using a No. 2 reed. The coil is divided into eight equal parts by the long stitch of the Lazy Squaw weave. In the second round, the long stitch falls directly upon the long stitch of the first round. Working from you, as in the Lazy Squaw weave, split the long stitch in the first coil. The ribs formed by these split stitches must radiate evenly from the center of the basket. To keep the basket firm, long stitches, forming new ribs, are introduced as the basket progresses. To introduce new threads, color, design, splicing the reed and finishing, see Fig. VI.

15. Pomo Bam Tush. Soak a No. 1 reed until pliable. Cut eight lengths. Take four of these reeds and lay them



INDIAN BASKETRY

[illegible]

parallel to each other. With a strand of raffia, weave over and under through the centers of the reeds, until you have a square of weaving. Make two of these sets of weaving. Place the two sets together, crossing them at right angles, and having the ends of the two weavers come together. Commence weaving around the center, using both threads, one thread passing over the reed while the other passes under the same reed. After weaving around four or five times, insert two extra reeds in each corner. Now begin radiating the reeds, making a complete circle. The weaving must be firm and close. To introduce new threads, weave the new threads along with the old ones for several inches. Then push the old thread on the inside of the basket. The ends of the threads are cut off after the basket is completed.

This basket is shaped over a form—a medium sized bowl is convenient. The bottom of the basket must be woven as large as the bottom of the bowl. Place the bowl on the woven bottom, and fasten securely by tying over the top of the bowl with extra threads of raffia. The weaving may now be continued, pressing the reeds close to the bowl. Two or more colors are attractive in this weave.

When the weaving is finished, cut the ends of the spokes a uniform length, about three inches, leaving the ends sharpened. Soak in warm water until very pliable. Carefully bend the end of the first spoke and push it down beside the second spoke. Bend the end of the second spoke and push it down beside the third. Continue in this manner until all the spokes are fastened.

PAPER AND CARDBOARD.

16. Value. Paper and cardboard afford an excellent means of working out or making practical much of the number work used in the intermediate and grammar grades. Some objection is occasionally made to this material because it is not substantial. This is not a serious objection. The first exercises are simply a preparation for more advanced problems later. Every child is able to use this material because it is cheap. The paper comes in every shade of color and in various textures, and the choosing of these shades is in itself an excellent art training. Every model requires a drawing and the care and neatness necessary in this drawing afford a good means of discipline. The geometric figures require the most accurate drawing and construction. The decoration on these exercises is an important part of the problem, and forms the beginning of an art training that will be very valuable in the more advanced work in weaving, leather work, basketry and metal. This work, when proprely taught, affords excellent mental training and discipline.

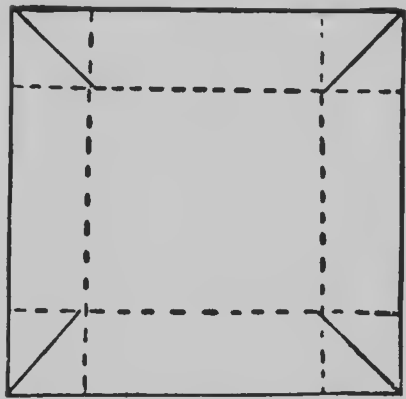


FIG. I (a) PLAN FOR CHRISTMAS BASKET

17. Baskets. The following are suggestions for Christmas, May or Easter baskets.

FIGURE I. Material: Light weight bristol board, drawing paper, or Prang special construction paper.

Draw a 5-inch square. Draw lines one inch from and parallel to the edges of the square, as shown in the figure. Draw the diagonals of the squares found in the corners of the pattern drawing. Cut all continuous lines. Score all dotted lines. To do this, place the ruler along all lines to be creased, and draw the back edge of one of the blades of the

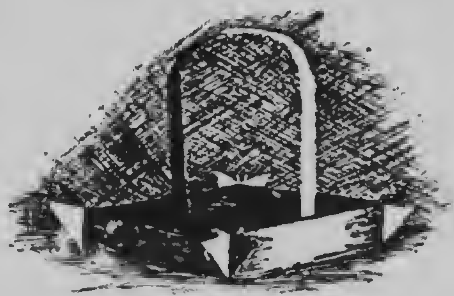


FIG. I (b) COMPLETED BASKET

scissors over these lines. Do not press hard enough to cut the paper. Before doing this scoring, compare your drawings with the figure to see that it is correct. Turn the triangles in the corners outward, and tie the corners with twine or narrow ribbon. Cut a handle $7 \times \frac{1}{2}$ inches.

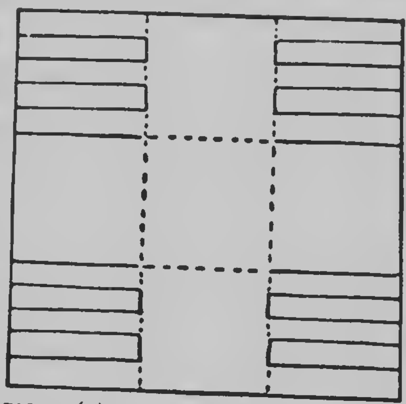


FIG. II (a) PLAN FOR EASTER BASKET

FIGURE II. Material: Drawing paper, light weight bristol board, or Prang special construction paper.

Draw a 6-inch square. Divide this into two-inch squares. Divide the squares in the corners in five parts. Study the figure before making these divisions. With young children this may be done free-hand. Cut all continuous lines, and score all dotted lines. Paste as shown in the finished basket. The center squares on the right and left sides turn upward and the strips formed by cutting the corner squares are pasted to these center squares.

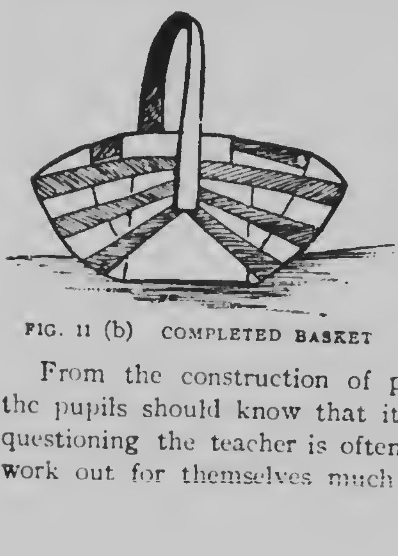


FIG. II (b) COMPLETED BASKET

FIGURE III. Material. The same material may be used as for the previous exercises.

Present a completed basket. What is the first drawing to be made in making the pattern drawing for this basket?

From the construction of previous baskets and boxes, the pupils should know that it is a rectangle. By careful questioning the teacher is often able to get the pupils to work out for themselves much that is ordinarily dictated, thus giving the pupils no opportunity to think for themselves. Draw a rectangle 5¾ by 4¼ inches. Draw other lines within this rectangle 1¼ inches from and parallel to the edges of the rectangle. There is now a 1¼ inch square in each corner.

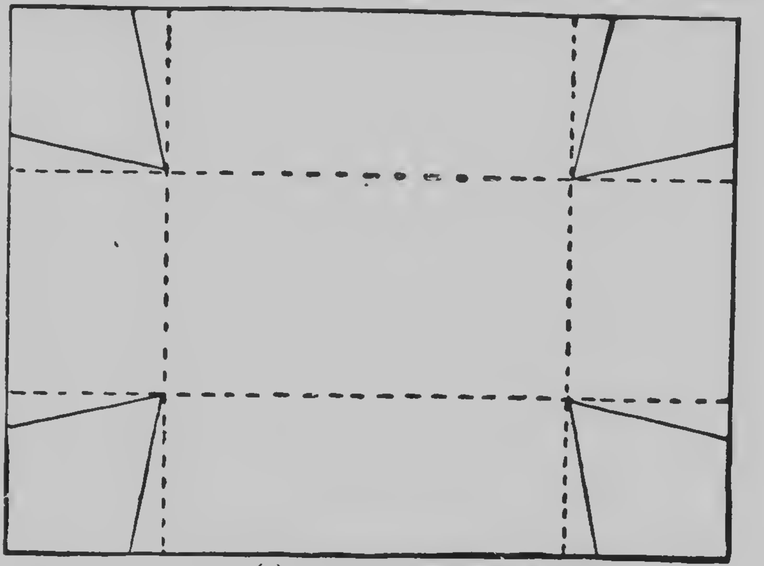


FIG. III (a) PLAN FOR FLOWER BASKET

The slanting straight lines within these small squares are ¼ inch from the outside corners. Study the figure. Cut all continuous lines and score dotted lines, which form the bottom of the basket.

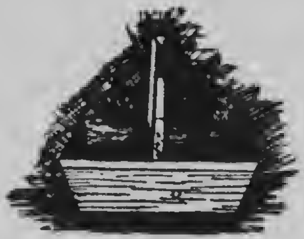


FIG. III (b) COMPLETED BASKET

Cut a strip 12 inches long and ½ inch wide. This strip is pasted around the top to hold the upper edge of the basket together. Before beginning to paste the strip, mark it off into four parts, as this will tell exactly the part of the strip which is to be used along each edge. Begin to paste the strip at the middle of one side or end. By doing this, the seam will not come at a corner. Cut a handle 6 by ½ inches.

FIGURE IV. Material: Light weight bristol board, drawing paper, or Prang special construction paper.

Draw a 6-inch circle. (This means a circle measuring 3 inches from the center to the circumference.) Bisect the circumference of the circle vertically and horizontally by placing dots in the circumference. With each of these points as a center, draw a 2-inch circle (one inch from center to circumference). These circles cut the large one. Use these points of intersection as centers, and draw other 2-inch circles, as shown in the figure. Cut all continuous lines and fold into shape as shown in the completed basket. Tie at the corners with twine or ribbon.

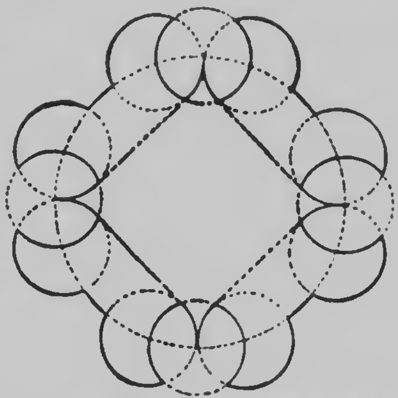


FIG. IV (a). PLAN FOR MAY BASKET

FIGURE V. This exercise is almost the same as Figure IV, only it is cut differently. The square drawn in the center is made by placing the ruler across the points where the middle circle bisects each of the others, or by connecting *a* and *b*, *c* and *d*, *e* and *f*, *g* and *h*. Study the figure carefully before making the drawing. Cut all continuous lines and fold into shape. See the drawing of the completed basket. Tie the corners.

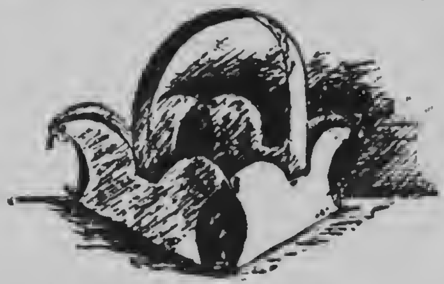


FIG. IV (b). COMPLETED BASKET

18. Boxes. Since so many uses for boxes may be found in the primary and intermediate grades, directions for making a few of the more simple ones are given. There are boxes for colored crayons, seed boxes, boxes for colored shoe-pegs and toothpicks, candy and valentine boxes.

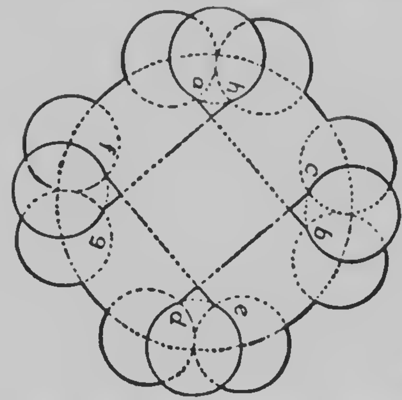


FIG. V (a) PLAN FOR MAY BASKET

SQUARE BOX. Material: The same as in the previous exercises. Figure VI shows the pattern and completed drawings for a 3-inch square box with cover attached. Draw a rectangle 9 by 5 inches. Draw lines within the rectangle 1 inch from and parallel to the edges of the rectangle. Draw parallel lines across the center, 1 inch apart, as shown in the drawing. Cut all continuous lines. Score the dotted lines. Turn the sides upward, and paste. Study the figure.

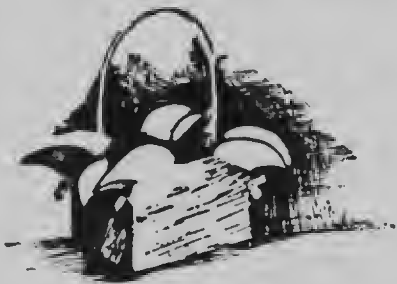


FIG. V (b) COMPLETED BASKET

RECTANGULAR BOX. Material: The same as in previous exercises. See figure VII. Draw a rectangle 9 by 7 inches. Draw lines parallel to and 1 inch from the edges of the rectangle. Draw parallel lines through the center, 1 inch apart, as in Fig. VI. Cut all continuous lines. Score all dotted lines. Turn upward and paste.

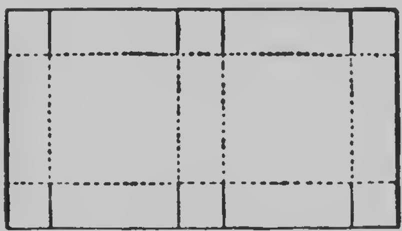


FIG. VI (a) PLAN FOR SQUARE BOX

TRIANGULAR BOX. Figure VIII. Material: The same as in the previous exercise. Draw a 7-inch square. Draw lines 1 inch from and parallel to the edges of the square. Draw straight lines ¼ inch from the edges of the small squares in front, left and back, right corners, as shown in the figure. Connect with the ruler the points where the lines just drawn touch the inner lines, and draw diagonal lines as shown in the pattern.

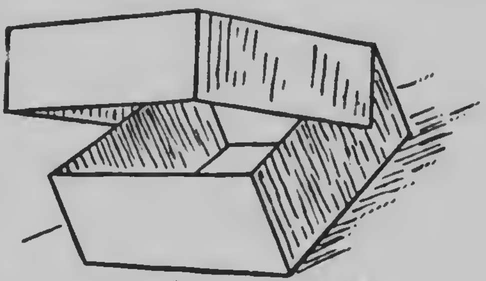


FIG. VI (b) COMPLETED BOX

Cut all continuous lines. Score all dotted lines; fold and paste.

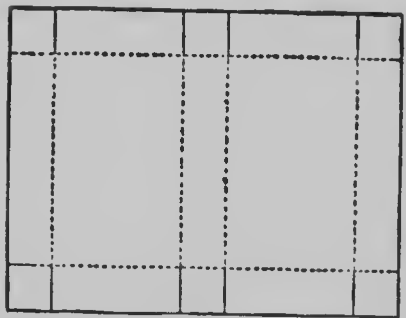


FIG. VII (a) PLAN FOR RECTANGULAR BOX

HEXAGONAL BOX. Figure IX shows a pattern drawing for a hexagonal box, with cover attached. Draw a 3-inch circle within a 5-inch circle, using the same center. With 1½ inches on the circle maker, mark off six points in the circumference of the small circle. Connect these points with straight lines. From each point draw a straight line perpendicular to the edges of the hexagon. With *a* and *b* as centers, and a distance equal to *ab* on the circle maker, draw two arcs which intersect at *c*. With *c* as a center, draw two other circles the same size as the ones just drawn. Proceed to construct the cover on the same plan as the box. When cut and pasted, the result is a hexagonal box with cover attached.

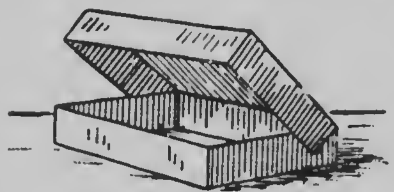


FIG. VII (b) COMPLETED BOX

19. Envelope Folio. Material: Heavy cover paper. Draw a rectangle 17¾ x 11½ inches. Place the long edge of the rectangle parallel with the front edge of the desk. Draw a line parallel to and 5 inches from the left edge of the rectangle. Draw a line parallel to and 4½ inches from the right edge. Draw other lines parallel to and 2 inches from front and back edges. Draw slanting lines as shown in the pattern, Fig. X, from points on outside edges. 1 inch from corners, to inside corners. Draw a tongue, as shown, at right. On the opposite side cut slits into which the tongue may be drawn. This makes a very interesting folio, in which language papers or drawings may be kept.

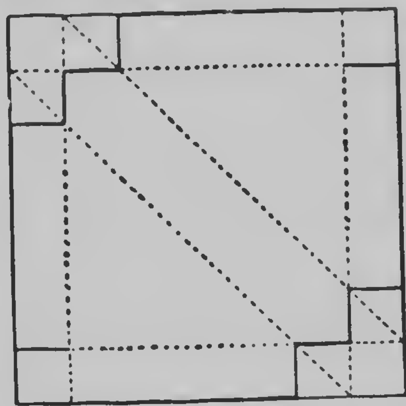


FIG. VIII (a) PLAN FOR TRIANGULAR BOX

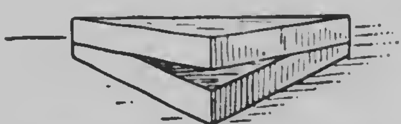


FIG. VIII (b) COMPLETED BOX

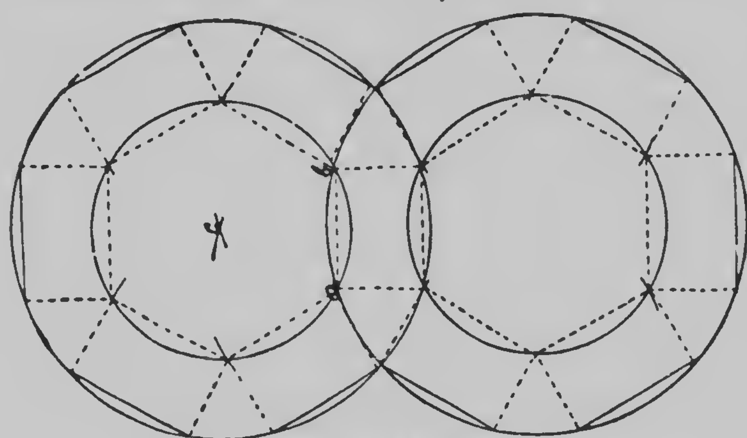


FIG. IX. PLAN FOR HEXAGONAL BOX

20. Lantern. Figures XI and XII show drawings for a lantern. Material: Jute or straw board.

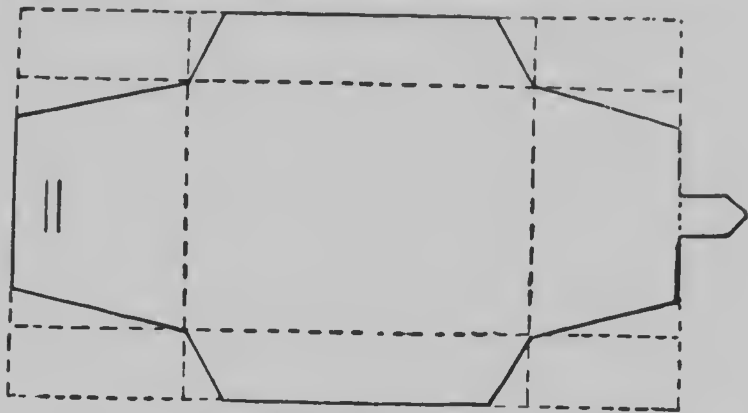


FIG. X. ENVELOPE

Draw a rectangle 6 x 5 inches Place the short edge parallel with the front edge of the desk. Draw slanting lines from points 1 inch from the front corners to the back corners, as shown in Fig. XI. Bisect the back edge, and $2\frac{1}{4}$ inches from this point of bisection place a dot at the point marked "a". Connect the back corners by slanting lines to this point.

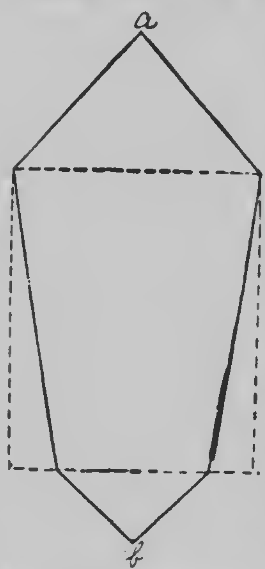


FIG. XI. DRAWING FOR LANTERN

C-IV-16

Bisect the front edge of the rectangle and place a point at "b", $1\frac{1}{2}$ inches from the point of bisection. Connect "b" with slanting lines drawn within the rectangle.

We now have a pattern for one side of the lantern. This when placed or repeated, as shown in Fig. XII, gives the complete drawing for the lantern.

By use of the shoemaker's punch, holes are placed as shown in the drawing. Lace back and forth with a colored twine, and we have the finished electric lantern, as shown in Fig. XIII.

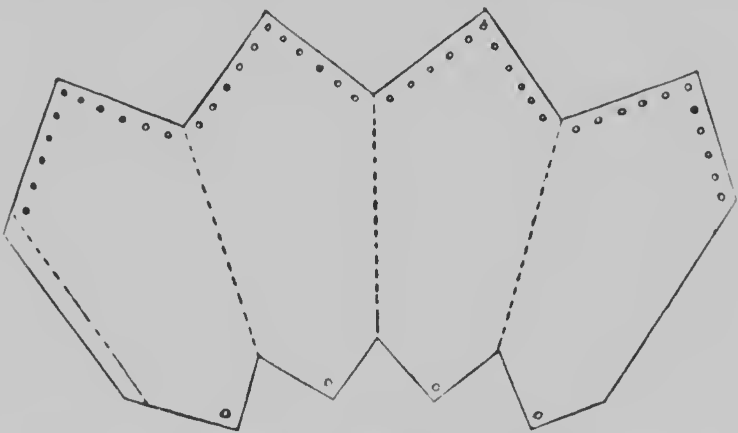


FIG. XII. PATTERN FOR LANTERN

A design is cut in each side and colored tissue paper is placed on the inside. Fig. XIII shows the design.

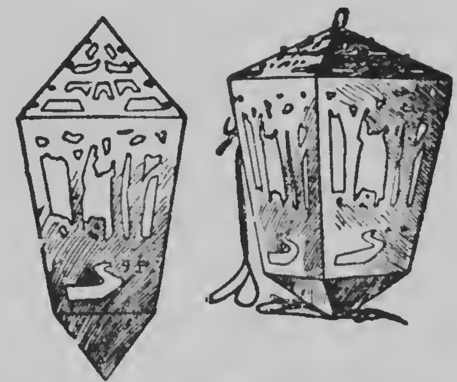


FIG. XIII. COMPLETED LANTERN

DYE STUFFS

21. Vegetable Dyes. (a) INDIAN DYES. When we come to the coloring of baskets or the materials of which they are made, we enter another field that has been only partially explored. We must form our tastes from good models, and nothing better is known to art than the olden hues used in baskets made by the Indian tribes of the southwestern United States.

A visit to any museum where there is a collection of these Indian baskets will enable one to recognize the soft, rich, quiet Indian colors.

True Indian colors, used in basketry are few in number, red, green, black, cream, yellow, brown and occasionally blue; but there are many soft gradations of self-coloring—soft yellows, browns, greens, that are more harmonious than brighter colorings would be.

It is true that the "Indian dyes may be duller, that they do not run through such a lengthy, diverse and brilliant chromatic gamut as the white man's dyes, but the Indian dyes are permanent and they are so softened by the mellowing touch of time, as to gain with age an exquisite combination of color values, altogether inimitable."

Vegetable dyeing is a fascinating part of basketry. When one is interested he is led to make many new discoveries.

It is surprising how many beautiful dyes may be found in the fruits and blossoms of many plants.

The faded flowers of the purple iris are full of the purple liquid.

The Indian method of dyeing is as different from ours as is their choice of materials.

Sometimes they bury spruce root and other woody fibres in certain mineral springs or mud pools for weeks and months, and thus gain a beautiful chocolate color. In another tribe a pit is made, the material is smeared with charcoal paste, sprinkled with two inches of willow ashes, and the whole covered with loose, damp earth, and allowed to remain three or four days. Experience has taught the Indian that if it is left too long, the lye will eat the fibre and render it useless, and if taken out too soon the color will be brown instead of the desired glossy black.

Squaw grass, used by the Klickitas in their exquisite basketry, is naturally white, but is turned to yellow by being soaked a certain length of time in cold water, while a rich brown is obtained by using hot water.

Boiling mud from sulphur springs that abound on some of the reservations is used to color splints black.

Some berries are used for red, and the seed-case of the sunflower yields a dark rich purple.

These Indian methods of dyeing are crude and laborious, but the results are exquisitely beautiful and fadeless. So long as we seek by means of vegetable and mineral dyes rich, soft and enduring hues, it is perfectly legitimate to shorten and simplify the process and to employ any labor-saving device.

(b) Recipes for Dyeing Raffia and Rattan. (1) *Mordant.* A useful mordant for most vegetable dyes is made from three ounces of alum dissolved in one quart of water. Soak the raffia, rattan or grass, etc., in the mordant over night and drain before putting the material into the dye proper. All material must be thoroughly cleaned before dyeing.

(2) *Blue.* Indigo is a pure and enduring dark blue, but demands so much attention and labor that it is not a favorite with amateur dyers. An indigo dye-pot, once started, may be used almost indefinitely by adding more dye as the old is used.

Take eight parts of indigo (paste), three and one-half parts of bran, and twelve parts of potash or lye, with sufficient water. Keep this solution at about 95 degrees for a week to ferment. If it is slippery it needs more bran and lye. Use the latter, one part saturated solution to nine parts of water. This bath will have a greenish color, not at all like indigo.

The material to be dyed is placed in the warm dye, allowed to remain from one to several hours, according to its absorbent capacity, is then hung in the air, in a breeze if possible, is again put into the dye and the process repeated until desired shade of dark blue is obtained.

No alum or mordant is used with indigo. Get the indigo paste at some dye house.

(3) *Yellow.* (a) Soak raffia or rattan in alum mordant over night.

Soak fustic chips over night; in the morning boil for ten or fifteen minutes in the same water. Strain. Place the material in the strained solution, letting it remain until the desired shade is obtained. If the chips are boiled too long a dull olive color is obtained. It is for this reason the chips are removed after boiling ten or fifteen minutes.

(b) Make a solution with green peach leaves. No mordant is used.

(c) Make a solution with bark from the white oak tree. No mordant is used.

(d) A common weed, in temperate climes growing in fence corners, and much abhorred by farmers for its disastrous effects upon stock when it gets mingled with hay, is the sneeze-weed. This, as well as many yellow composite blossoms, will give a pure fadeless yellow, when made into a strong tea. Use an alum mordant.

(4) *Scarlet.* Mordant the material with six parts of stannous chloride crystals to four parts of cream of tartar. Dye with cochineal which has been boiled and strained, until the desired color is obtained.

(5) *Red Orange.* Cochineal added to the fustic solution for yellow gives a dull red orange.

(6) *Orange from Annatto.* A bright orange is made from annatto. A short time before it is required for use it is dissolved by boiling

it with a solution of carbonate of soda (washing soda) for twenty minutes. Mordant the material with stannous chloride (or tin crystals), which dissolve in a small quantity of water, and dye.

A bright red orange is obtained by using broom sedge dye first. Drain and dry, then color with madder root.

(7) *Red.* Wash the material and soak in an alum mordant over night. Make a solution with hypernic chips. Boil for ten or fifteen minutes the following morning and strain. Place the material to be dyed in the strained solution, leaving it until the desired shade is obtained.

(8) *Indian Red.* A fine Indian red may be obtained by using extract of sumac.

Use an alum mordant.

(9) *Black.* A good black may be obtained by boiling logwood chips in sufficient water to cover them, for fifteen or twenty minutes. Add sufficien water to cover the material to be dyed. After boiling fifteen min es, drop in a few lumps of copperas. When the desired black is obtained remove the material.

Sometimes the raffia is soaked in a solution composed of fifty parts of logwood and ten parts of fustic for one-half hour. The raffia is then removed and four parts of copperas added. The material is again returned and allowed to remain for fifteen minutes. This gives a good black.

(10) *Purple.* Soak the material in an alum mordant. Place in an extract of logwood, which is obtained by boiling the chips.

If a bluer purple is desired, add a little ammonia, baking soda or baking powder.

(11) *Green.* To color green use three parts of yellow and eight parts of blue.

Experience will show the worker that many gradations of color may be obtained by allowing the material to remain a longer or shorter time in the dye-bath.

Different shades of green may be obtained by changing the proportions above mentioned.

(12) *Brown.* The shucks of the butternut are used in dyeing a beautiful shade of brown.

Soak the shucks several days and then boil them for about twenty minutes. Strain, add sufficient water to cover the material. Remove the material when the desired shade is obtained. No mordant is necessary.

(13) *Brown from Walnut.* Treat the shucks of the walnut the same as those of the butternut.

A very good brown may be obtained from the bark of the walnut root. No mordant is necessary.

(14) *Brown from Logwood.* Cover the logwood chips with water

and boil ten or fifteen minutes. Strain, add sufficient water to cover material and boil for another twenty minutes. No mordant is necessary.

(15) *Brown from Hypernic.* A seal brown may be obtained from the chips of hypernic, the process being the same as in the use of the logwood. No mordant is necessary.

(16) *Olive.* To obtain a soft olive, dye first with the brown sedge, wash, drain, and then dye in indigo until the desired shade is obtained. Use an alum mordant.

Another olive may be obtained by mixing a pale purple with green.

(17) *Red.* The bark of the red oak makes a very fine red in coloring raffia, tilo and reed. A lump of lime about the size of a base-ball, dissolved in about five gallons of water, makes a very good mordant. The material is first dipped in the lime water and then placed in the oak solution. To extract all the color from the bark, boil thoroughly for about twenty minutes before placing the material to be dyed in the solution.

(18) *Yellow.* A very good yellow may be had from the blossoms of the golden-rod.

(19) *Green.* Tomato leaves and nasturtium leaves make a good green.

(c) General Suggestions. There are many other simple recipes for dyeing, but those given will be found sufficient for the beginner. Experimenting will teach the dyer that different materials take the dye in different times; thus, raffia requires only one-half the time that must be given to rattan.

To gain a certain hue, the material must be frequently lifted with two sticks and examined. It must be turned over and over, so all parts may be evenly submerged in the dye.

All materials must be thoroughly rinsed after being removed from the dye, and slowly dried in the open air.

The soap-weed or yucca, which is so invaluable to the basket-maker of California and the Southwest, yields four distinct hues that again merge into each other, forming most exquisite transitions of color. There is the ivory white of the heart of the plant, running to the dark olive green of the outer circle of the mature leaves. The Indian woman carefully separates these colors when she strips the leaves and hangs each color bunch by itself from the rafters of her house. Yucca is frequently colored red or brown. Sometimes plants are bleached to obtain white.

In some plants the two sides of the leaf will yield different colors.

Using undyed materials, the amerind produces a black effect with the ripe peeled pods of the martynia, a dark brown with the stems of the maiden-hair fern, and a bright red with the roots of the yucca.

The teacher of rural schools will find this problem of vegetable dyes a very interesting one.

22. Aniline Dyes. The market is full of aniline dyes of various brands. Most of them are good, but perhaps the one most conveniently used is the brand called the Easy Dye. It comes in tubes and may be used with cold water. The Easy Dye is furnished by the School Arts Supply Company, Lockport, Illinois. A little booklet is furnished free of charge, giving full directions as to its use.

TEST QUESTIONS

1. Make five statements in favor of paper and cardboard construction.
2. Give the commercial names of three different papers or cardboards suitable for construction.
3. What is reed? Where does it come from?
4. Give the names of two Indian baskets, and make drawings to illustrate stitches used.
5. What is meant by vegetable dyes? Name five local vegetable dyes.
6. Name four imported vegetable dyes.
7. How did the Indians secure their colored materials for basketry?
8. Make a drawing to show the way a reed basket is begun.
9. In making a small reed work-basket, state the size of reed you would use. Name three different weaves.
10. What is tilo? Where does it come from?

CHAPTER FIVE

DRAWING

INTRODUCTION

1. Aim of the Course. The aim of the following lessons in drawing is to inculcate a larger appreciation of the beautiful in nature and art, to develop the power to see beauty in commonplace things, to assist in bringing about an era of better taste in the selection of the objects which surround us, and to develop skill of hand in transforming raw materials into objects of use and beauty.

It is hoped, through a course in public school art, ultimately to improve the environment of the school and home, and eventually to bring about a greater interest in civic beauty, thereby increasing the pleasure of living.

2. Arrangement of Plan. The plan here given is by months, covering the work for the intermediate and grammar grades, from fourth to eighth, inclusive.

If the course is being used in an ungraded school, type lessons may be chosen which will carry out the spirit of the plan. A general outline of the subjects treated during the year is given under the heading *Plan of Work.*

3. Materials; Use and Care. The work, to be carried out most effectively, is dependent upon the selection and proper use of both nature and art materials. The nature materials will be considered under *Nature Study and Expression.*

The art materials consist of paper, pencils, crayons, outfit for water color work, rulers and paste.

(a) PAPER. The paper used for work in drawing and painting is an inexpensive manila, cut any size, but usually sold in two sizes, 6 x 9 and 9 x 12 inches.

Cream-tinted paper is preferred to white paper for work in water color, as the white dries too rapidly and because the white tone is too cold to obtain good color effects. The white paper is the best for pencil work, but the inexpensive, cream-tinted paper may be used very effectively for both pencil and color.

Colored paper for mounting and construction work, in neutral tones of brown, green and gray, lends an additional interest to the work; but an inexpensive substitute may be had in bogus paper, of heavier weight than manila, and of a warm gray tone.

Rice paper, a thin, transparent paper for use in copying work, is a delightful medium, but it is, in a way, a luxury rather than a necessity.

Squared paper, a manila paper with lines printed to form half-inch or quarter-inch squares, is used in design work; but pupils can draw lines with a ruler and thereby save this expense.

Mounting cards, covered with gray bogus paper, of good weight for use in mounting exhibits of work, should be included in a list of supplies.

(b) Pencils. A soft pencil is necessary for use in free-hand drawing, SS grade is a very good one. Any of the standard pencil manufacturers make good pencils for use in drawing—Dixon, Eagle or Prang.

Care of Pencils. The pencil should be sharpened to a blunt point and rubbed down on paper to make the best point for drawing. The drawing pencil should not be used for writing, but kept in cases made for the purpose, or by the children at their seats, in cases made for all their art materials. If pencils are kept by the teacher, each pencil should be marked with the owner's name, and should always be used exclusively by the owner, for sanitary reasons.

(c) Crayons. Colored crayons have become almost as universal a medium as the pencil, and, in the absence of water color, are a substitute for that medium. If but one medium can be obtained, a box of colored crayons is recommended as the best medium to purchase. A box containing eight colors—red, orange, yellow, green, blue, violet, brown and black—is manufactured by several reliable firms, whose addresses are given under the heading *Supply Houses*.

(d) WATER COLORS. The use of color in connection with art study is indispensable. Surrounded by a world of beauty in color, one can only inadequately express form without the use of color. The three-color box, containing red, yellow and blue, with black added, is the most acceptable for school use. The colors may be purchased separately at three cents per cake.

(e) BRUSHES. A No. 3 sable brush, costing seven cents, has been found the most practical for general use in school work. A Japanese brush for line work is very convenient and inexpensive, but the sable can be substituted.

(f) WATER COLOR PAN. This may be purchased at slight expense. It is a small, black, japanned tin, with enamel lining. Tops of tin cans or fruit jars may be made to serve as substitutes.

(g) GENERAL CARE OF MATERIALS. Most of the materials needed in art lessons can be cared for by the individual pupil by placing in his desk, in a box or cloth case made especially for the purpose, everything belonging to one child. Materials furnished by the school, such as paper, should be passed out at each recitation.

4. Supplies and Supply Houses. The art materials enumerated, as well as many others, including drawing textbooks for pupils' use, and teachers' manuals, may be obtained at the following supply houses:

Prang Educational Company, D. C. Heath & Co., and Scott, Foresman & Co., all of 378 Wabash Avenue, Chicago; Atkinson, Mentzer & Grover, 223 Washington Street, Chicago; Milton Bradley & Co., Springfield, Mass.; W. T. Gage & Co., 84 Spadina Avenue, Toronto; Copp, Clark & Co., 64 Front Street, Toronto; and the George M. Hendry Company, 215 Victoria Street, Toronto.

It is suggested that teachers send to these firms for catalogues of materials and price lists.

PLAN OF WORK

5. Introductory. The work is so planned that the portion for each month is arranged and explained in detail under its proper heading. The work can be adapted to the needs of either intermediate or higher grades by selecting simpler or more complex subjects, and this selection will depend quite largely upon their previous training. In schools where drawing has not previously been taught, the teacher will need to begin with simple subjects in all grades.

In order that each teacher may understand clearly all the principles explained in these lessons, it is absolutely necessary that she perform, herself, all the work indicated. She should work out with great care each direction given, for if she does not understand each step to be taken in making a drawing, she will be unable to give the clear, specific directions to children which will enable them to make correct drawings. After completing each lesson, practice drawing many simple objects based upon the principles discussed in the text. If the first results are not satisfactory, do not be discouraged. The old adage that "practice makes perfect" is doubly true in drawing. Practice persistently, and, after completing a drawing, examine it to see wherein it could be improved. Occasionally compare the work with an illustration of some similar study given in the text. Then try again. By working this way, one will surely succeed.

After completing the lesson for each month, prepare the work required in the *Test*, as an evidence of your progress. The drawings should all be made on regular drawing paper.

6. September. The work for September includes the study of various nature materials—grasses, weeds and flowers—in different mediums. If the work is being adapted to the needs of the intermediate grades, or to children in the higher grades who have had little or no experience, care should be exercised in choosing the simpler subjects, such as the common foxtail, timothy, millet or cat-tail, in the grass family; among the weeds, the milkweed, jimson weed, etc., would make large, simple subjects, while among the flowers the black-eyed Susan, cosmos, sunflower and other single flowers would be the ones to select.

The more complex forms—oats, wheat and rye, among the grains, and the thistle and field flowers—could be chosen for the grammar grades.

7. October. In October the various grades might be assigned the study of a few trees for special consideration, again choosing the simpler ones for lower grades, as maple, poplar, elm, oak, apple, evergreen, beech, sycamore, birch, locust, in the order named.

The October landscape may be made as simple or as complex as the ability of pupils suggests. The range may extend from flat washes, to represent sky, ground and distant trees, to a special study of clouds and fields, and trees in the foreground with their wealth of color.

8. November. The work in November includes the study of seed pods, vegetables and landscapes, which may be adapted to the ability of any grade. Choose the larger forms in seed caskets and vegetables, and a single bare tree in the landscape, for the younger pupils; more complex forms, such as a branch of oak, with acorns and a chestnut burr, may be assigned the older pupils. The study of the November landscape may include a group of trees, or trees and a house, with a road or path in perspective. Use the landscape, with some appropriate nature quotation, in the upper grades. The text appropriate for Thanksgiving is a good upper grade problem, while the "Mayflower" would be simple enough for the intermediate grades.

9. December. The construction work in December should be planned with reference to the ability of the children. Box making, with simple decorations, would be a good problem for fourth and fifth years, while basket making would be better adapted to the grammar years.

If the school is ungraded, the teacher may give box making to all grades, varying the problem by allowing the upper grades to make the larger box, where the decoration becomes a more important feature.

The exercises on Christmas cards, or texts, may be made simple or elaborate, as the teacher plans.

10. January. If the pupils are familiar with the principles of cylindrical perspective, they can carry their work in object drawing to more difficult objects, which have handles, spouts, etc. The studies may include the grouping of several objects, or a still life object and some fruit or vegetables grouped together.

The effects of dark and light may be expressed in pencil painting, in upper grades, while the crayon work will be better adapted to the lower grades.

11. February. The work in rectangular perspective, in February, may be made simple enough if it is introduced by giving observation lessons, having the pupils express what they see, without too much discussion of principles. Use single boxes and books in the lower grades; the group of objects can be used for more complex problems for the upper grades.

12. March. The outline for March provides for the continuation of object drawing for grades sufficiently advanced in the work to make it interesting, and at this point the study of the figure is introduced. Animal and nature work may be continued for the whole month.

13. April. The nature subjects in April will include plants, birds and insects, chosen with due regard to the ability of the children to express them, and also with regard to the choice of the medium used in expression. Colored crayons, for instance, are an easier medium to use than water colors, and the study of the form only, expressed in outline with the pencil, is the simplest of all.

14. May. Nature studies are to be continued. Landscapes in simple wash effects may be introduced into the intermediate grades, and the higher grades can adapt the landscape or flower forms to decorative purposes, illustrating nature booklets and other articles to which the designs can be appropriately applied.

15. June. The closing work of the year should include a further application of the problems of decoration from nature motifs, and from the various suggestions given throughout the year. Suitable problems may be chosen to meet the needs of any of the several grades, by allowing the lower grades to use the simplest nature subjects in their designs.

16. Summary.[1] The work of the year is planned to use the interesting material of each season, and the teacher should at all times look for the many opportunities to correlate the drawing with all the other school subjects. Drawing should become an illuminating means of making all other thought more easily comprehended, appealing to the sense of sight, through which much of our knowledge comes.

NATURE STUDY AND EXPRESSION

17. An Appreciation of Nature. Do you know the best way to interest children in nature and to create a love for representing nature's forms? Have you ever tried the plan of going on a nature tramp with the children, and enjoying with them the beauties of nature? The trophies you will find on such a walk will serve as interesting material for both nature and art study for several lessons. The different varieties of grasses, including the grains, the wild flowers, the pretty weeds, including the thistle, jimson weed, teasel, curly dock and others; the trees, the panorama of sky and ground, and the insect world are all marvelously interesting when we become intimately acquainted with them

SEPTEMBER[2]

September waves her golden-rod
Along the lanes and hollows,
And saunters down the sunny fields
A-playing with the swallows.

18. First Week. (a) ARRANGING FLOWERS IN VASES. The nature material which you have gathered will serve admirably to decorate the schoolroom, and will, at the same

[1] The work as outlined in Sections 6-15 is the regular course given to the students in the Western State Normal School, Kalamazoo, Michigan, and most of the illustrations in this chapter have been made by students in regular class work. The course in general has also been given to the children in the Training School

[2] Consult Section 6, page 263.

time, afford a valuable lesson in flower arrangement. Ask the children to bring from home some common crocks, fruit jars, and large-necked bottles to use as vases, and then assist the children in choosing the nature material most suitable for the different receptacles, or ask the children to assist you. Do not arrange a great variety together; this gives a confused mass of forms and colors. If the flowers are large, like the sunflowers, golden glow, or field lilies, arrange those of only one kind together. Do not strip the leaves from them, but arrange them to give the most natural effect possible. Sometimes two kinds of flowers may be massed together so as to give a most pleasing effect, through contrast of form or color. The golden-rod with white or purple asters would be effective, or field lilies with white asters; but the golden-rod with the field lilies would not form a desirable group, because the color combination would not be so pleasing.

We may profit by the advice of John Ruskin, the eminent English art critic, who said, Let us have nothing in our homes which we do not know to be useful, or believe to be beautiful." This will apply equally well to our school home.

After the children have beautified the schoolroom with these large and showy bouquets, it will stimulate their love for the beautiful to allow them to have on their desks a bottle containing grasses or a pretty flower. This will also do much toward cultivating an appreciation of beauty in nature.

(b) Flower Arrangement on Desks. Procure small sprays of flowers or pretty grasses. Provide each pupil with a sheet of drawing paper 6 x 9 inches in size.

Have the pupils arrange their flowers or grasses on the paper so that they will make a pretty study for use in drawing. Place one spray so it will look well (natural) in the space. Try placing it centrally, but not stiffly in the exact center. Do not place it slanting from corner to corner. If the stem grows erect, show the direction by placing it in this position. Then try placing two sprays together. Is greater beauty obtained by placing one a little higher in the space than the other? Make the sprays look as if they were good friends; do not have them cross each other. In this way variety and unity, two essentials in a good work of art, may be obtained. After two sprays have been satisfactorily arranged, try placing three together. Arrange them to suggest the way nature arranged them while growing. Allow some of the children to show the arrangement they have made by drawing lines to represent the stems in an oblong space on the blackboard. Others may draw on a piece of drawing paper at their desks.

During the progress of this work, notice what difficulties the children have in handling their materials. Observe also the position of body, hands, arms and limbs while drawing. It is very essential that good habits of work be established at the beginning; therefore, a drill lesson should precede any definite work in drawing.

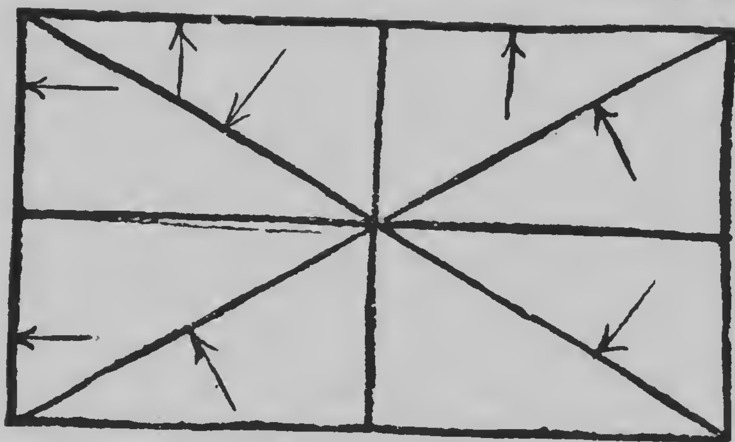
(c) Lesson on Proper Position. Supply each pupil with manila paper 6 x 9 inches, and a drawing pencil.

Previous to the lesson the pencils should have been sharpened, exposing a piece of lead between ¼ and $\frac{3}{16}$ of an inch in length. Do not use a pencil sharpener. A knife should be used to cut away the wood, and the lead should then be rubbed on a piece of manila paper or emery paper, making a rounded point. The lead should be so shaped that it will make a broad, soft line.

(1) *Holding the Pencil.* Take the pencil lightly between the thumb and first and second fingers, grasping it at about the center. The pencil should be held at right angles to the line to be drawn, as shown in the illustration. The arrow lines show the position of the pencil, and the heavy lines show those to be drawn. Move the pencil lightly across the paper from left to right. In drawing a horizontal line, the pencil should make a smaller angle with the paper than for other lines. Count for movement, "Over, back; over, back; over, ready, draw." See that the pupils follow directions. For vertical and oblique lines, the directions may be, "Down,

back; down, back; down, ready, draw." Do not change the direction of the pencil while making the movement.

(2) *Exercises.* Draw a page of horizontal lines about one inch apart, then draw vertical lines, making squares.



POSITION OF PENCIL

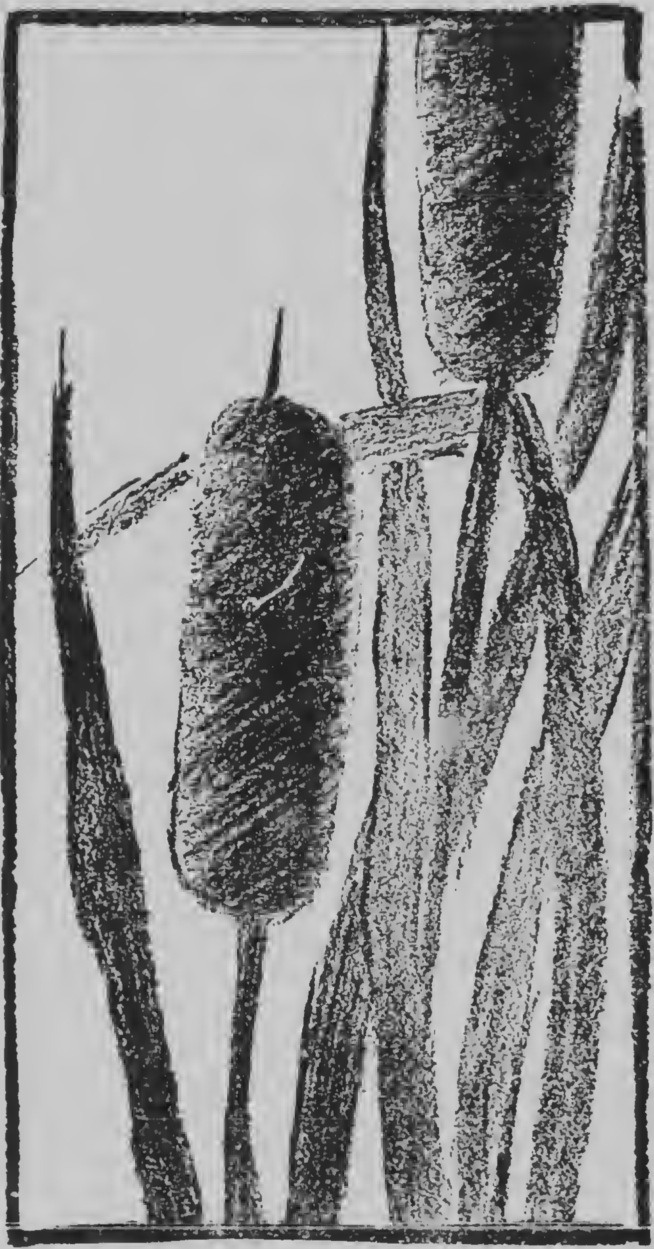
Turn the paper over and make oblique lines from corner to corner, and lines parallel to them, one inch apart.

In all exercises, see that the pencil is held in a position that makes a right angle with the line drawn. The line should be a broad, soft gray line of uniform width. (See illustration.)

In every lesson allow some children to draw at the board. The crayon should be short, from 1 to 1½ inches in length, and should be held between the thumb and first and second fingers, with the broad side to the board. The pupils should stand as far away from the board as possible, and work at arm's length. The position of the crayon should be the same as that of the pencil—at right angles to the line drawn.

(d) DEFINITIONS. Write all new terms on the board, and define them: horizontal, vertical, oblique, oblong, diameter, diagonal.

A *horizontal* line is a level line.



CAT-TAILS

A *vertical* line is an upright line.

An *oblique* line is a slanting line.

An *oblong* is a four-sided figure, longer than it is wide, and having its opposite sides equal and parallel.

A *diameter* is the length of a straight line through the center of an object, from side to side.

A *diagonal* is a line drawn from two corners not adjacent, and passing through the center of the object.

19. Second Week. GRASSES. Supply the pupils with pencils and paper 6 x 9.

If you have enough grasses, put a few on each child's desk, and ask each one to make a pleasing arrangement, as in the previous lesson. There are numerous grasses that may serve well for this lesson, as the common foxtail, that grows on every roadside; millet, wheat, rye and barley also make interesting studies.

Direct the children to draw marginal lines on the paper which they have, making a good framing space for the picture. At the beginning of the exercise review the position at the desk, and manner of holding the pencil. Have the pupils sketch lightly to show the position of the stems in the space allowed for the picture, and then after studying the structure of a head of grass, have them try to show its appearance in their drawing.

Vary the work during the week by having different varieties of grasses. Use the grains, if possible. Cat-tails make a strong, simple subject. These may be fastened to a cardboard at the front of the room, where all the children can see them, or they may be left in a jar on the teacher's desk. Allow the children to make their own arrangement on the paper.

Colored crayons are a good medium to use in this study. Select the brown and green crayons that match the head and leaves, and use them as you do pencils. The long, slender heads and stems will suggest a long, panel-shaped paper, and the pupils should fold a 9 x 12 sheet so as to make a narrow panel.

If colored crayons cannot be provided, the pencil shading may show dark for the color of the brown head, and lighter strokes for stem and leaves. Make the strokes lengthwise through the leaves, to suggest the parallel-veined growth. The heads may be shown with slanting, or vertical strokes. Notice the difference in the light and shade side of the brown heads. Half close your eyes to simplify this effect. Arrange to have the light fall on the study from one side only. If there are cross lights, draw the shades at one side or back of the room. Have each pupil hold the study he has drawn as far away from him as possible, and compare the drawing with the subject, with half-closed eyes, and judge the general effect. If any of the studies are lighter than the subject, the pupil should go over the lines again, making them a little darker. See illustrations of grasses in pencil.

STUDY IN GRASSES

20. Third Week.

(a) Water Colors. Each pupil should have manila paper, a paint box, a brush, a small dish of water, and a soft cloth. Place the painting materials at the upper right corner of the desk. Open the paint box, placing the cover toward you, for use as a palette. If the children have not used water colors before, ask them to look at and name the colors—red, yellow, blue, and possibly black. These three first-named colors are called *primary* colors, because from them other colors may be produced. Ask the children to experiment and see what colors they can make. Give the following directions:

(1) With your brush full of water, put a few drops on each cake of color to soften it.

(2) Put a few brushfuls of water in one of the little divisions in the cover.

(3) Make a green wash. First rub the brush lightly across the yellow cake, and mix the yellow in the water. Now add some blue, and watch the transformation; it produces green; adding more blue makes a darker, or bluer green. To lighten the color, add more water; more yellow added makes a yellow-green.

(4) Try on your paper the green wash you have made.[1] Fill the brush with the green wash. Commence at the top of the paper and sweep across the top from left to right. Then continue filling the brush, and with short, vertical strokes from left to right, cover the surface as rapidly as possible, insuring, by so doing, a smooth surface.

If a graded wash is desired, add a little more water to the wash, making it lighter as it comes to the bottom of the paper. Make about two green backgrounds, adding a touch of red in the second one, which will make a gray-green color, and make a graded wash. Allow these to dry and save them for the next lesson where a tinted background is needed.

(b) WEEDS OR GRASSES. Tinted backgrounds and some pretty colored weeds, or grasses, that you have in your nature bouquets, form the materials for these studies.

[1] Be sure to use manila paper for all work in water color, instead of white drawing paper, which gives a cold background and dries too rapidly, due to the amount of lime used in bleaching it.

Have you noticed that some of the weeds and grasses are already turning to brown or red autumnal colors? The curly dock or pigweed will make a pretty study. The studies may be fastened on pasteboard easels, made by folding a long piece of cardboard and resting it like an easel. Place these on boards between the front desks. Pin the studies against some of the tinted backgrounds to study the effects. If the children do not have water colors, use the crayons to make a tinted background.


STUDY IN GRASSES

Use the color that matches the color of the weeds, making a light tone for the background. Draw the stem lines first, and notice any peculiarity of growth of the seed heads. Try to show the exact formation of the stem and fruit.

(c) Flower Painting. Any large single flower will be suitable for this exercise. Small sunflowers, the brown-eyed Susan, or the field lily are suggested. Express the study in water colors on manila paper.

Before trying to express the beauty of the flower in water color, give a short lesson on handling the brush and color. Let the pupils try making the green you see in the leaves, mixing the colors in the brush by taking first a little yellow, then a little blue and a touch of red, to make the green less vivid. Each pupil should try the color he has made in his box top or palette. If the color is too dark, he should take another brushful of water, or touch the yellow cake, to make it more yellow. Now have the pupils touch their brushes to the paper to see if the color matches the leaves. The next step is painting the stems. The pupils should hold the brush in an upright position, and with the point make some firm, slender strokes to suggest stems. Then they should try pressing down on the brush gradually, to widen the stroke, making the stem wider. To make the leaves, fill the brush with color, hold it upright, and, commencing at the apex of the leaf, gradually press down on the brush, making a stroke as wide as the leaf. If this is not possible, make another stroke beside the first one, and continue

STUDY IN GRASSES

the strokes until the width and shape of the leaf are obtained.

After practicing to obtain the shape of stems and leaves, clean the brush on the cloth (not in the water), and mix the color for the flower. If the flower is orange color, use yellow and red together; if violet, use red and blue mixed. Experiment until the right color is obtained.

If the flower has separate petals, like the sunflower or the black-eyed Susan, try making a petal with one stroke of the brush. Arrange the petals around the center, and notice that those projecting forward look fore-shortened; that is, shorter than those at the sides. Now paint the flower on another piece of paper. If your brush is full of the color of the flower, paint the flower first; or the stem may be painted in first, and leaves and flower added. Try to show the arrangement of the leaves on the stem. Are they alternate, opposite or in whorls? Also show the shape of the leaf, if it is turned, or foreshortened. If the leaves are slightly brownish, add more red to your yellow and blue.

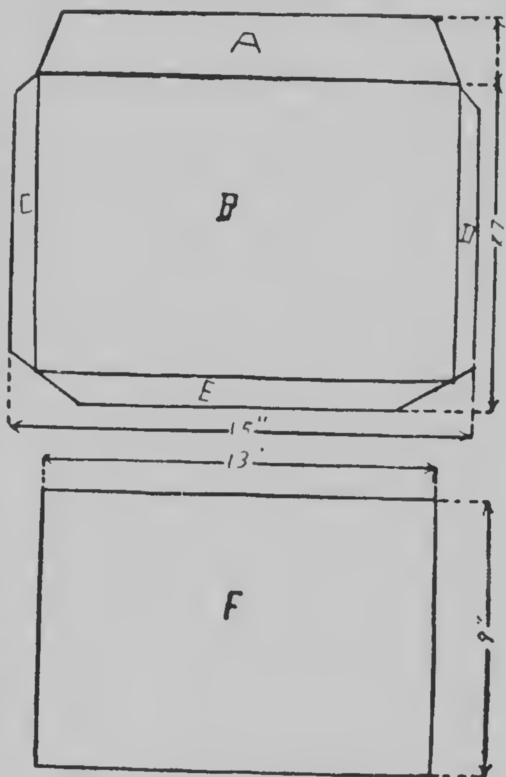
Cautions. (1) Be sure to have the pupils clean their brushes on the cloth whenever they mix a new color for the flower.

(2) Keep the water in the pans as clean as possible.

(3) Be careful not to mix mediums. Do all the work with water colors, not using a pencil to outline the forms first. Work directly in the flat mass effects with the brush and color. If pencil is used, try to show the contrast of color in the flower and leaves by pencil shading. See illustrations in pencil painting.

If the pupils have no water colors, colored crayon or pencil may be substituted, and the flower represented in either of these mediums.

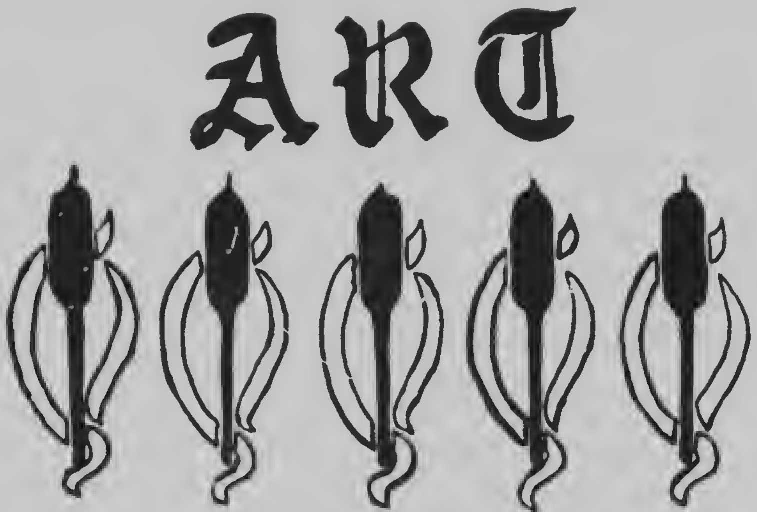
21. Fourth Week. (a) ENVELOPE FOR DRAWINGS. The children should make envelopes in which to place their drawings. Use bogus paper for this problem in construction, or, if this cannot be obtained, use any tough wrapping paper, such as is found at the butcher shops or grocery stores. When completed, the envelope should be 10 x 13 inches in size. This will allow sheets of 9 x 12 drawing paper to slip in and out easily. The full size of the sheet from which this may be cut should be 14 x 23 inches, or it may be made from two smaller pieces, one being 9 x 13, the other 14 x 15 inches. The larger piece allows for one-inch laps on three sides, and a three-inch lap on one side. Fold the larger piece (C, D and E) down to B; apply the paste to these laps, and paste the left, right and lower edges of F down on B. Fold the flap A after the envelope is pasted, and put under a weight to dry.



DRAWING FOR ENVELOPE

The envelopes may be decorated with some nature unit that the pupils have studied during the month. Some simple flower or leaf motif, or the cat-tail, will serve well for this purpose. If a flower form is chosen, select some simple flower, like the black-eyed Susan, and with free brush strokes paint the center and the petals arranged around it. Work by opposites in representing the petals, placing one at the top, then one at the bottom, then at the left and the right sides, and filling in as many between as there is room for.

This design may be carried out in water colors, or colored crayons. The units may be arranged in a border at the bottom of the envelope, at the top and bottom, or on all four sides. (See illustration with cat-tail design.) Divide the space to be filled with the design into equal spaces, by drawing lightly with the pencil. Place the unit in the center



DESIGN FOR ART ENVELOPE

of these spaces, thus making a border around the envelope. The child's name may be printed on the envelope with the same color as is used in the design. If there are no water colors, colored crayons or ink may be used. Be careful not to use strong, gaudy colors in the design. Do not use the primary colors (red, blue or yellow), but the secondary colors, green or violet, may be used; or, best of all, mix all three colors together, making a brown.

(b) Tertiary Colors. Colors obtained by mixing all three colors are called *tertiary*. They are olive, citrine and russet. Citrine has more yellow than red and blue; olive has more blue than red and yellow; and russet has more red than blue and yellow.

(c) Mounting Drawings. Supply the pupils with 9 x 12 manila paper, scissors and paste.

Show the children how drawings and paintings can often be improved by cutting down the surplus background, putting a dark line at the edge of the study (paper), and mounting it on larger paper. If you have no scissors, the children may fold and crease their papers firmly and tear them, instead of cutting. If library paste is not at hand, make flour paste and use just a drop under each of the four corners of the study. Do not spread paste all over the back of the study.

(d) Exhibits. Make an exhibit of the best work done during the month. There is nothing which encourages children so much as to see their work on exhibition in comparison with that of others. Every schoolroom should have a bulletin board, or a space covered with burlap, where children's work may be exhibited. If nothing better can be devised, a piece of black mosquito netting can be hung and the drawings pinned on that. A more permanent exhibit may be made by pasting drawings on mounts of large gray cardboard. Mounts on tag-board may also be used. Do not paste too many drawings on each mount. Not more than three sheets of 9 x 12, or six sheets of 6 x 9 should be placed on a cardboard mount 22 x 28 inches. Fasten the mounts together, three deep, if arranged vertically, and four deep, if fastened horizontally, by tying them together with a twine or tape to match the cardboard. Punch holes with punch or nail, through which the cord is passed. These rows of mounts can be hung on the wall from the moulding.

(e) Illustrating Written Lessons. Some of the art work done during September may be used to illustrate nature compositions. Have the pupils write compositions on the subjects connected with your nature tramps, and illustrate them with their nature drawings and paintings. The composition and drawings may be fastened together, and enclosed within a cover of drawing paper, bogus paper or wrapping paper. Fasten the booklets together with paper fasteners, or tie them together at the back with a cord that matches the cover.

Test. Make two pencil drawings of grasses from nature.

Make a design for an art envelope, using a nature form, but, in this instance, do not use cat-tails. Use ink or black water color.

OCTOBER

The world puts on its robes of glory now,
The very flowers are tinged with deeper dyes,
The waves are bluer, and the angels pitch
Their shining tents along the sunset skies.

—*Albert Leighton.*

22. Subjects for the Month. The beautiful month of October has long been a favorite theme for poet's pen and artist's brush. Whittier, Longfellow, Tennyson, Alfred Austin, Alice Cary, Helen Hunt Jackson, Lucy Larcom, and a host of others have voiced in song the beauties of October.

The French artists Rousseau and Diaz, and in America George Inness and the Hoosier group of artists have immortalized on canvas her glorious color. There are such riches from which to choose in nature, literature and art, that one has but to open his eyes and behold them on all sides. There should be daily observations of nature, and the written exercises in various branches should be freely illustrated with brush, crayon and pencil, in order most completely to reveal the beauties of this queen of months.

Some of the interesting themes for study and enjoyment are An Autumn Walk, An October Landscape, Trees in October, Flowers of Autumn, Fall Fruits, A Nutting Party, Harvest Time, Mother Nature's Treasure Caskets. Consult Section 7, page 264.

23. First Week. (a) TREES. Use manila paper and water colors.

Choose one of the trees the pupils have studied on their walks. Ask them to compare the shape and color of the maple, the oak and the elm, and note the points of difference. Which is the tall, graceful tree; the strong, sturdy one, and the symmetrical one? What colors are in the foliage? Have the class paint the trees in their proper colors. Mix the color in the brush, and mass in the shape of the tree,

TREE STUDY

commencing in the center and working out to the edges, showing where the widest part is, also showing whether it is regular or irregular at the edges. After painting the foliage, the trunk should be added by mixing all three colors for the gray color of the trunk. If branches are visible here and there, add a touch of this color to represent them. If you have no water colors, use pencil or crayon to represent the tree.

(b) October Landscape. Water colors and 6 x 9 manila paper are the best materials for this exercise.

Study the color of the sky, the ground and the distant trees. Put a water wash over the surface of the paper. Represent October's bright blue weather in making the sky blue, bringing the color over the whole paper. What colors are seen in the fields now? Represent the ground space by mixing all three colors, to obtain the golden-brown or the gray-green. If the trees have changed color, try massing the color along the horizon to represent the distant trees.

Pencil work in landscape study may be used in place of color. If the pencil is used, represent the ground with pencil strokes drawn close together, to show the darker mass compared with the sky, and then the trees may be represented in a still darker mass, using slanting strokes.

24. Second Week. Autumn Flowers, Vines or Weeds. Use the same materials a were required in the last exercise.

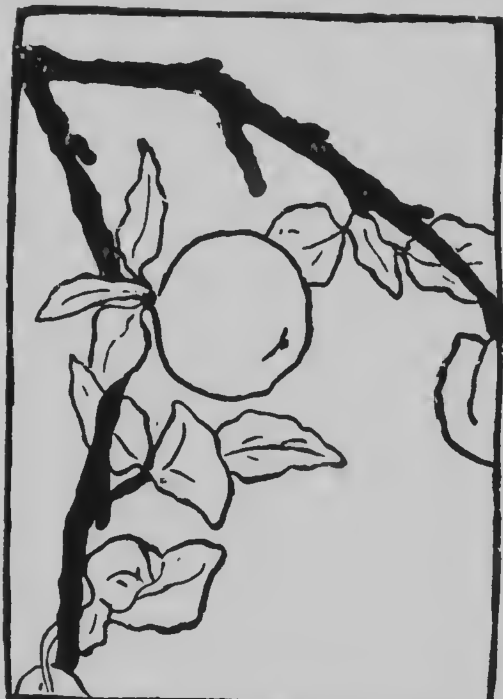
If the flowers still remain, use a simple arrangement of asters or golden-rod, and try massing in the color to show the form of the mass of flowers, leaves and stem. When flowers grow small and in bunches, the color may be applied in mass. Do not try to show too much detail.

Water color is the most suitable medium for flowers, while the weeds may be shown nicely in colored crayons. See illustrations. Try making a study of the curly dock or the teasel burr with the brown crayons. You should arrange the studies so that all th children may see them. To give an idea of the proportionate size of the subject, it is well to fasten the studies upon paper of the same size as that which the pupils are using. If the pencil is used, try to show the shape of the parts, and then by shading show the value of the color. The *value* of the color is its degree of light or dark. If the color is light or dark, represent it by light or dark shading in pencil.

AN OPEN SEED VESSEL

25. Third Week. BRANCHES. Branches of fruit, as the apple or pear, a branch of oak with acorns, or a tomato vine with its fruit, are suitable subjects for study. Use 6 x 9 manila paper and pencil.

Draw an enclosed space, or margin, about one inch from the edge of the paper. Study the arrangement of leaves and fruit on the branch, and sketch the stem to represent its position and character. Sketch the leaves lightly so as to show the arrangement, but do not try to represent them all, if there are many. Show the shape and size and arrangement of the fruit. Make a good outline drawing in this first lesson.



BRANCH OF AN APPLE TREE

Continue the study of the branch with pencil painting or water colors. If water colors are used, paint a gray-green background first, and, after that is dry, represent the color of leaves, stem and fruit. A perfectly flat wash may be used to represent this study without showing the effect of light and shade, and the study can be finished by painting a strong black line at the outline of each part when the color is dry, thus making a decorative study of it. See illustration of apple on branch.

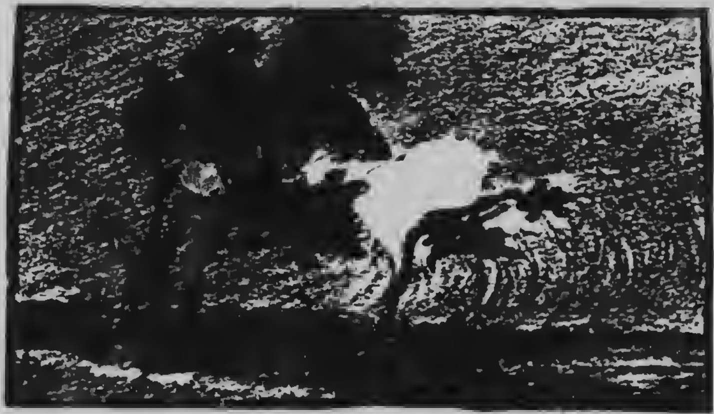
If there is time, a pencil painting may be made of the same study, even if color has been used. If the pencil is used, make a light outline first, and then, with slanting

PLATE ONE

strokes massed close together, show the depth, or value, of the color of the study.

26. Fourth Week. (a) OCTOBER LANDSCAPES WITH TREES. Use water colors and 6 x 9 paper.

In our previous landscape study we represented the trees in the distance as massed in, in simple silhouette effect. In this lesson we wish to show the tree in the foreground; consequently, it will appear much larger and in brighter color. Paint the sky and ground as directed in the previous lesson



OCTOBER LANDSCAPE

on landscape. While this paper is drying, paint the tree you wish to represent on a dry piece of paper, representing the bright red and yellow of the maple, or birch, the russet color of the oak, or the dark green of the apple or elm. Try painting the tree on the original paper before it is quite dry, as this gives a softer effect to the edges, which suggests the haze of the atmosphere over everything. This is very important. See Color Plate One.

(b) ILLUSTRATING POEMS. Another lesson might be given by reading a descriptive poem to the children, and asking them to illustrate it with color. The water color is preferred for landscape work. Here is an appropriate quotation:

OCTOBER

THE MORNS ARE GAYER THAN THEY WERE,
THE NUTS ARE GETTING BROWN;
THE BERRY'S CHEEK IS PLUMPER,
THE ROSE IS OUT OF TOWN.
THE MAPLE WEARS A GAYER SCARF,
THE FIELD A SCARLET GOWN:
LEST I SHOULD BE OLDFASHIONED
I'LL PUT A TRINKET ON!

It was late in mild October,
And the long autumnal rain
Had left the summer harvest fields
All green with grass again;
The first sharp frosts had fallen,
Leaving all the woodlands gay,
Like the hues of summer's rainbow
Or the meadow flowers of May.

—*Whittier.*

Ask the children to close their eyes and try to see the picture in imagination; then let each child paint the picture as he sees it. The older pupils may grasp the picture from a single reading, but the younger ones should have an opportunity to study the stanza before attempting to illustrate it. See the illustration of October landscape, Color Plate One.

(c) AUTUMN LEAVES. A branch of oak or maple leaves makes a delightful study. Use them when the color is at its best. Try painting them in, without drawing, in what is called the free brush work. Do not have too many leaves on the branch—two or three will give a pleasing effect. See illustration with the poem on October, page 286.

(d) MOUNTING. Have a mounting lesson again to complete the month's work, and make an exhibit of the best work. See Section 21 (c), page 279.

Test. Make a drawing of a tree from nature. Use the pencil.

If you have water colors, paint a simple October landscape. If you have no colors illustrate in pencil a simple poem.

Draw a fruit branch, in pencil.

NOVEMBER

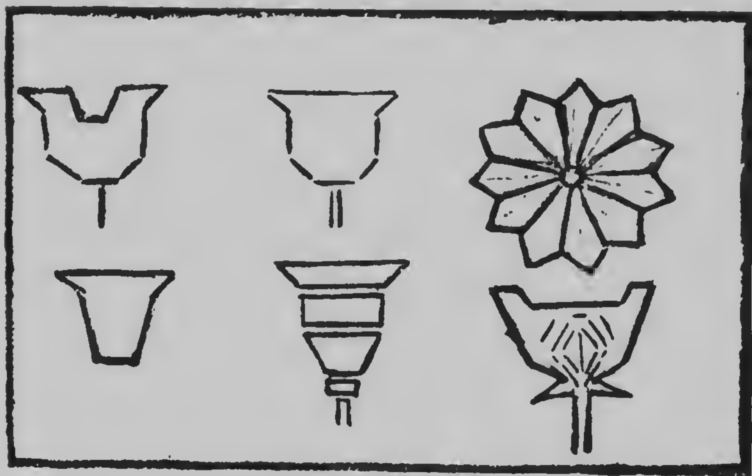
Pleasant summer over,
And all the summer flowers;
The red fire blazes,
The gay smoke towers;
Sing a song of seasons,
Something bright in all;
Flowers in the summer,
Fires in the fall.

27. Nature in November. In this month Nature presents a changed aspect from gayly-robed October, but November has beauties all its own. Notice that the trees that were so recently painted with gorgeous dyes are showing now their characteristic lines in trunks, limbs and branches. The underlying structure of the trees may now be more fully studied and enjoyed than before. Can you tell the different trees when the leaves are gone? How many of your pupils can tell them? Choose a half dozen trees, and make a special study of them with the class. The sturdy oak, the graceful elm, the knotted apple tree, the symmetrical maple, the delicate birch, are as beautiful to the appreciative eyes of the nature lover, when the bare branches form delicate traceries against the sky, as when clothed with nature's most gorgeous raiment. Let the class express in pencil, crayon and water color the varied beauties of November.

STUDY IN SEED VESSELS

So many of the interests of November circle around the home that we may well give them special thought for this month. The preparations for winter made by plants, insects, animals and man serve as suggestive motives to be incorporated into the art work.

From the morning talks develop interest in the following subjects: Pictures comparing nature in October and November (the trees, the skies, the ground); collecting nature's stores for use in winter (fruits and vegetables, nuts and grains); Nature's treasure caskets (seeds and seed pods). Ask the children to collect and bring to school the various



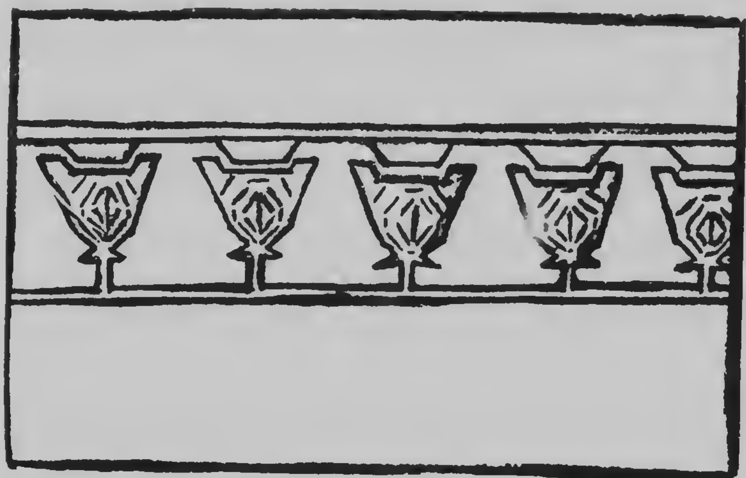
DESIGN FROM INDIAN MALLOW

weeds having seed pods—the milkweed, the teasel, the Jamestown or jimson weed, the cat-tail, the thistle and the Indian mallow. Consult Section 8, page 264.

28. First Week. SEED PODS ON BRANCHES. Use manila paper 9 x 12, pencil or crayons.

Place the nature material where all the pupils can see it. The class should study the general direction of stems, the angles between the branches, the character and form of the pod, how the pod is attached to the stem, and other distinguishing features of the study. Draw marginal lines on the paper to give an idea of the proper space in which to draw the study. If the branch is long and slender, draw a panel shape, that is, a long oblong, folding the paper to indicate the required shape. The pupils should sketch in lightly at first, to show the stems and the shape of the pods. If the surface of the pod is rough or smooth, try to show that effect in the shading of the pod. If the pencil is used in the first expression, try the colored crayons in a second lesson.

Save these drawings to use for design work in December. Save also some of the seed pods for use again. In the meantime they will make beautiful winter bouquets.



DESIGN FROM INDIAN MALLOW

29. Second Week. AUTUMN BERRIES. The rose hip or berry, the bittersweet, the green brier, the Judas berry and the poke berry are included under this title. Manila paper and colored crayons or water colors are good material for these studies.

If the colored crayons are used, see that the pupils match the colors as nearly as possible. They should also try to show the effect of light and shade in the berries, by adding some blue and brown on the shade side, even of the red berries, allowing the light paper to show through for the effect of light and high lights. If water color is used, it is a good plan to make a light wash of blue to show the shape of berries, and to drop in the bright color while the first light blue wash is still wet. Be sure that the brush is held upright in making the slender stems and leaves.

PLATE TWO

Save these drawings and the nature material for use later in design work. See illustrations for suggestive treatment.

ROSE BERRY AND UNITS OF DESIGN

30. Third Week. FRUITS AND VEGETABLES. Use colored crayons or water colors. Ask the children to bring to school a pumpkin, a squash, potatoes, onions, apples, pears, or ears of corn in the husk. If the children have had only a little of this work, select for use the larger, simpler forms, in the order given in the list. Water color is the easier medium to use in representing the pumpkin or squash; but the colored crayons can be used. See Color Plate Two.

Place the object on your desk or on a chair placed on the desk, so it will be plainly visible to all. Study the general shape of the object. Is it round, or longer than wide, as illustrated in the pumpkin and the squash?

If working in water color, take the brush full of the proper color, and, starting in the center, make the mass the shape to represent the object. *Do not outline* the object and then fill it in, for there is no outline to be seen, and the color should show the shape of the object. Add a little of all

STUDY IN VEGETABLES

these colors to represent the dark side of the object. If colored crayons are used, try taking a piece of crayon about an inch long and putting it flat on the paper; mass it in as you do in blackboard work. See illustration of the squash in color. Let the pupils try representing the large vegetables on the blackboard.

If the study of the corn is used, hang one or two ears from a nail, fastening them by some of the husks. This study is the most difficult of any of the vegetables enumerated, and should be used by upper grades only.

The study of the corn can be expressed in pencil, colored crayons or water color. If pencil is used, make a careful outline drawing first, then show details of the ear, and shade with slanting strokes. If colored crayon is the medium employed, mass in with the proper color, and then use darker brown to show the dark effects between the rows of kernels. Do not try to show all the marks between the kernels, but try to express the effect obtained by looking at the ears with eyes half closed. This shuts out all the small details, and gives the essentials which are necessary. When the drawings are completed, have the pupils hold them off at some distance and compare them with the study.

If potatoes or onions constitute the studies, the best medium to use is the pencil or black crayon. These are also good subjects for brush and ink work. See illustrations of vegetable studies.

31. Fourth Week. (a) OUTDOOR STUDIES. Collect pictures that suggest November and the Thanksgiving season. First secure those that suggest November landscapes. If someone has a camera, pictures of the surrounding neighborhood can be taken. But work from the window scenes can be done successfully. Ask the pupils to notice the different pictures they see in looking from the different windows. Sometimes a view from one pane of glass in a window will give a beautiful motif for a composition. A bare tree, carefully studied and drawn, makes an attractive study. Notice whether the tree sends a trunk through its entire length, or subdivides into many branches. The former is called the *excurrent* type, while the latter is the *deliquescent*. (See drawing of the elm, page 281.) Ask the pupils to name the trees they can think of that are like each of these types. The Lombardy poplar, the trees of the evergreen family, the beech, the sycamore, and some oaks are excurrent in type, while the greater variety of forest and cultivated trees, including fruit trees, maples, most oaks, the elm, the cottonwood and some others, are deliquescent in type. Next observe the arrangement of the branches. Are they opposite or alternate? Notice the angle which the branches form with the trunk. Show the irregularity of the little branches and twigs.

(b) CALENDAR. Plan a November calendar as suggested by Color Plate Three. Perhaps you can suggest some squirrels in the trees. Plan the spaces for the illustration, the poem and the calendar, to produce a pleasing arrange-

STUDY IN INDIAN CORN

ment. The pencil or water colors may be used appropriately in making the November calendar. If possible, give space on the blackboard for a calendar with suggestive illustration for each month.

(c) THANKSGIVING TEXT. While the fifth and sixth grades are making an illustrated calendar, the upper grammar grades can plan, and make a beautful illumined text. For plan, see Color Plate Six.

Choose some text in harmony with the thought of the season, and on paper lined in small squares plan the words of the text in plain letters. Use simple block letters, or, if you prefer, a more ornamental type, such as the Old English or Gothic style, may be used. The titles of books and magazines will furnish good examples of printing. Ask the children to look in newspapers for plain block letters.

The design will be more attractive if some of the fall nature studies are used to decorate the text. The berries, seed pods, or the Thanksgiving flower—the chrysanthemum—could be used. To make the nature study suitable for such a decoration, draw it carefully and apply the color in a flat wash on flower and leaves; then, when that is quite dry, outline each part with a strong black line, using black water color.

(d) CORRELATIONS. If the children are studying colonial history, it would be interesting for them to make a sketch of the "Mayflower" in a decorative treatment, to use as a cover for their written exercises in this branch.

(e) MOUNTING. Give the pupils an opportunity to mount their drawings and paintings on large size manila paper, 9 x 12, and make an exhibit of the work done in November.

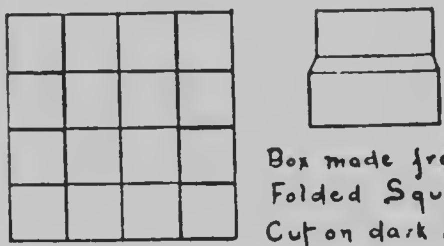
Test. Make a study of a seed pod on the stem, in pencil; also a study of a vegetable, in pencil or crayon.

Draw something appropriate for Thanksgiving.

DECEMBER

The world is happy,
The world is wide;
May joy be yours
This Christmas-tide.

32. Construction Work. Let the work of this month be influenced by the interest of the children in preparing gifts for the Christmas festival. This work will afford some good problems in constructive and decorative design. Instruction should be given to aid the pupils in constructing objects from working drawings. When a working drawing is introduced in this way, its function is readily understood. It means little to the child to make a working drawing of an object, if, in the end, that drawing is not put to some definite use. Through conversation with the children, learn some of the things they would enjoy making, to use as holiday gifts. You might volunteer such suggestions as a candy box, handkerchief box, glove box, work basket, scrap basket, decorated calendar, illuminated Christmas texts.



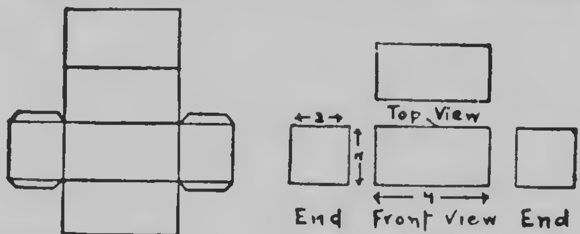
Box made from
Folded Square
Cut on dark lines

33. First Week. (a) Working Drawings. Explain to the children that when any object is to be constructed, either large or small, from a house to a small box, that drawings are first made which give all the facts and details of the form of the object. These are called *working drawings.* The size, proportions, decoration and materials used are fully explained in connection with a working drawing.

Working drawings may represent different views of the object, as the front and side elevations of a house, showing the placing of doors and windows, and shape of the gable; or they may show the development of the whole surface, as a pattern of a dress, or of a box to be made of cardboard. This method is usually employed when objects are to be made of flexible material, such as paper, cloth and tin. Patterns are used as working drawings. When objects are to be constructed of wood, stone and other inflexible material, different views of the object, with measurements, are then given.

To illustrate the making of a pattern, or to show the development of the surface of an object, which is the same as a pattern, a very simple problem may be given to the children in the development of the surface of a box.

The box has a top, bottom and four side faces, so the pattern must have six faces, or sections. Folding a paper



Pattern for Box — Working Drawing of Box

over a box, and creasing the sides along the edges, will show the proper placing of these faces, in relation to each other.

A simple pattern may be developed by folding a square of paper into sixteen small squares. Fold it first on its diameters, then fold the upper and lower edges *to* the diameters, thus making sixteen small squares. Now cut on the folds between the squares, and lap the squares not needed in the actual surface of the box. See the illustration, page 302. From a pattern thus developed, made of cardboard, a candy box can be constructed and covered with bogus paper or any other paper you wish to use.

(b) Making Boxes. The materials necessary for box making will consist of cardboard, rulers, scissors, paste and cover paper, which may be the ordinary manila drawing paper, colored paper, bogus paper, or plain colored wall paper. Ask the children to bring old pasteboard boxes to school to be used in making gift boxes.

If a glove or handkerchief box is desired, let the pupils consider the size and proportion of these boxes best suited to the shape of the objects they are to contain. A square box is most suitable for handkerchiefs, and a long, narrow box for gloves. A handkerchief box should be 5 inches wide, 5 inches long and 2½ inches deep. A glove box should be about 8 inches long, 3 inches wide and 2½ inches deep, according to the size of the handkerchiefs or gloves.

For the handkerchief box, measure on the cardboard, with the ruler, and draw the various faces of the box, making the top and bottom faces 6 inches square, to allow a half inch projection on all sides, and four pieces 5 x 2½ inches, for the sides of the box.

For the glove box, cut two pieces 9 x 4 inches for top and bottom; two pieces 3 x 2½ inches for the ends, and two pieces 8 x 2½ inches for the sides.

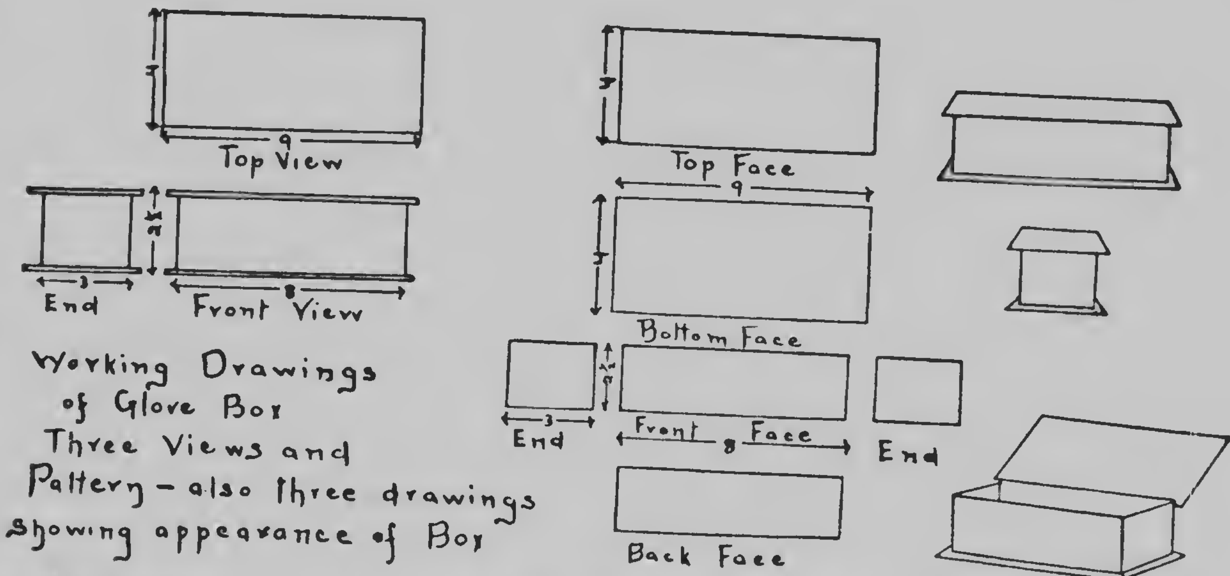
The next step is to cover the separate pieces with the cover paper. Lay each piece of cardboard on the cover paper, and mark around it. Allow a half inch for laps around all sides of these cover pieces. Fold the laps over the edges of the cardboard, and paste the four laps over on the top and bottom faces of the box; but on the remaining sides paste down one long and one short side only. The remaining laps will be pasted to each other to hold the box together.

The top and bottom pieces of the box should be covered on both sides with cover paper, and the inside of the box should be lined with a long strip of paper to fit each side. The lining paper at the back should be allowed to extend above the edge of the box one-half inch, and this should be pasted at the back edge of the top of the box to serve as a paper hinge.

The beauty of the work in construction will depend upon its accuracy and neatness.

(c) Work Basket. If a work basket is to be constructed, a pattern may be developed by drawing a hexagon for the base, and having the six sides fastened to it and to each other.

Draw a circle with a radius of 2 inches. If compasses are not at hand, make a simple compass by taking a strip of cardboard and placing a pin at one point, and push a pencil



Working drawings are drawn to a scale: that is, they are made proportionately **larger or smaller** than the object. The drawings for small objects, like the works of a watch, are made larger, and those for large objects, like parts of a wagon, are made smaller than the object. The measurements of working drawings must be exact.

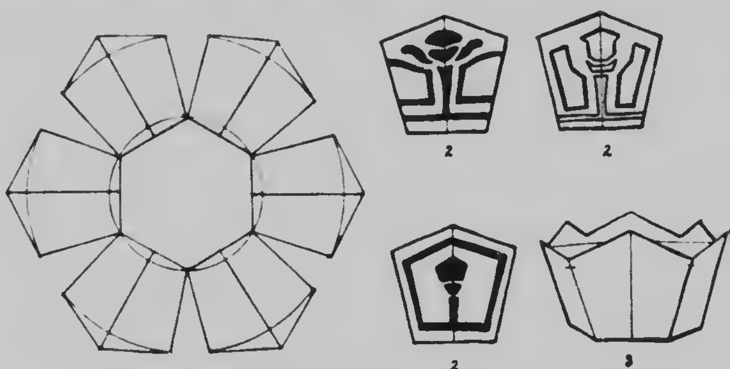
Working drawings deal with the facts pertaining to the construction of an object, and not with the **appearance of the object.**

Five kinds of lines are used in working drawings:

(1) Center lines, indicated by a dot and a dash -·-·-·-·- They are also called construction lines.
(2) Full lines, representing visible edges ————.
(3) Dashed lines, representing invisible edges - - - - -.
(4) Dotted lines, connecting views . . . . . .
(5) Light lines, indicating measurement.

point through a small hole made in the cardboard, at the distance of the radius of the required circle from the pin. The circle may be described accurately with this simple device, by swinging the pencil around the pin as a center. Divide the circumference into six equal parts, by using the radius as a unit of measurement, making a hexagon. On a two-inch base construct the sides of the basket, making them 3 inches in height and 3 inches in width at the widest place.

After the hexagon base and six sides have been cut from cardboard, cover them with colored paper or cloth, using



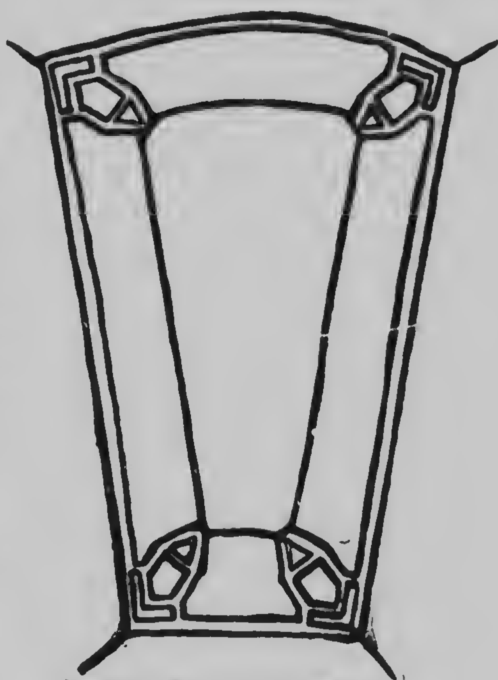
1. PATTERN FOR WORK BASKET
2. DESIGNS FOR BASKET
3. APPEARANCE OF BASKET

plain gingham or linen, and sewing over and over nicely for this purpose. The same is used as in covering the sides of the box previously described. If cloth is used, the cover may be sewed over and over with fine stitches and thread to match. The sides may then be stitched together, and then stitched to the base. If paper is used, instead of fastening the sides by pasting the laps in place, as you did in making the box, they may be held in place by a cord passing through holes punched in each side of the six faces, and tied together in this manner. See illustration of basket.

(d) WASTE PAPER BASKET. Construct a waste paper basket having a base 4 inches square, and four sides each

12 inches long, 4 inches wide at the base and 8 inches wide at the top.

Draw the pattern and make the basket of cardboard, and cover it with paper as described in previous problems in construction work. Plain or figured wall paper may be used for covering the baskets. Some children may wish to bring remnants of wall paper from home so the basket will match the paper in their home, and their wishes should be respected. In general, however, the plain paper is to be preferred.



DESIGN FOR WASTE BASKET

34. Second Week. (a) DECORATING BOXES AND BASKETS. The most appropriate decoration for the boxes and baskets will be obtained by studying the nature material we used in the art lessons during the fall. The leaves, flowers, nuts or seed pods, berries, and holly, with its bright red berries and dark green leaves, are all appropriate.

While the units to be used in the designs may be suggested by nature subjects, they should not be copied in their natural forms. Each unit should be adapted to suit the needs of the design. Illustrations may be given and worked out by the children, as the plates of design units from the rose hip and Indian mallow suggest. See illustrations.

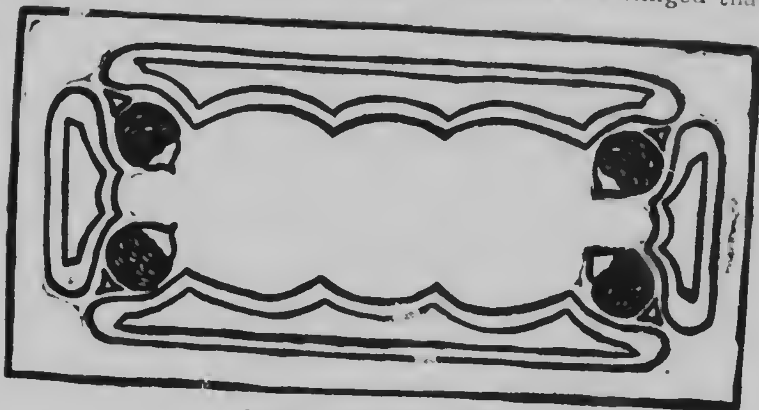
Ask the children to select for a border design some unit from the subjects studied during the fall, such as a leaf, a flower, or a seed pod; then assist them to modify and apply this unit in accordance with the plans shown in the illustrations. After a unit has been selected, consider the space to be decorated, and make such an adaptation of the unit

DESIGN FOR BOX COVER

as will produce the most pleasing effect. If the space is small, as the side of a work basket, a single unit or a row of units may be chosen, making a border, as suggested in designs for the top of the box. Another good design can be made by filling the corners, connecting them with lines, as the design for the scrap basket suggests. Again, the surface may be covered, as the design of milkweed pod suggests.

(b) Conventionalized Forms. A design worked out from a nature motif, as suggested above, is said to be a *conventionalized* form, that is, a nature unit made conventional, or formed for use in design. This method of adaptation of nature's forms is in accordance with the principles of good design, but to copy a nature form without adapting it to the form of the object to be decorated is a violation of these principles.

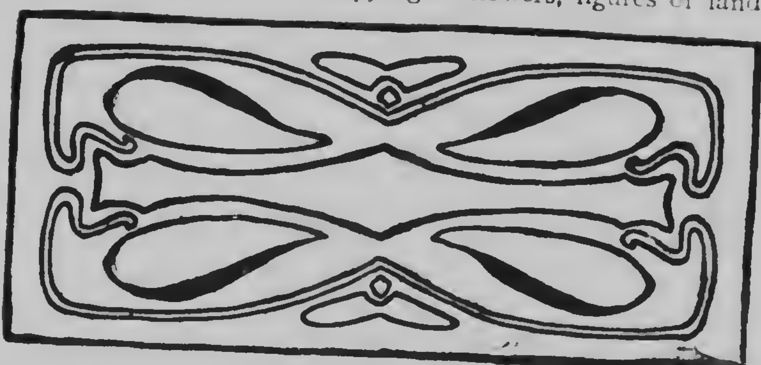
In a conventional design all irregularities of growth are omitted, the aim being to produce a perfect form that will be graceful and symmetrical and yet show clearly the form from which it was taken. It should always be adapted to the use to which it is to be put. If it is to be used in a border, or in a surface covering, it must be so arranged that



DESIGN FOR BOX COVER

a repetition of it will produce a harmonious effect. Study the illustrations given on pages 290 and 291.

Many objects to be found in the stores are decorated (so called) by the mere copying of flowers, figures or land-



DESIGN FOR BOX COVER

scapes in a naturalistic treatment, but these decorations can in no sense be called designs, or even good decorations.

From time to time give the children talks on what should constitute a good design, and call attention to the many violations of the canons of good taste in the objects found in the stores. China ware is not decorated in the best sense of the term by the painting of flowers, heads, figures or landscapes, rendered in a naturalistic way. Such decoration belongs to the field of picture making, and is not true decoration of objects.

(c) Application of Designs to Objects. After a design has been made for the box or basket constructed by the child, it can be transferred to any object by the use of transfer paper, by a tissue paper copy made and drawn over the lines, or by a stencil.

A *stencil* is a pattern so cut as to leave the design in open spaces, through which a drawing or painting may be made.

LAMP SHADE

Care should be used to have each part of the design separated by a little space, if a stencil is to be cut, or the pattern will fall to pieces.

It is well at this point to show the pupils how to transfer their designs by each of the methods given. Let them apply the design to the object, and paint the same with flat tones, in harmony with the color of the cover paper. It is not necessary to imitate the color that nature suggests, but if such coloring is chosen, let each color be grayed by using a little of all three colors, to make a harmonious combination. Tones of the color that the cover paper suggests make a very pleasing effect.


NOVEMBER
-1909-
S -•- 7 14 21 28
M. 1 8 15 22 29
T. 2 9 16 23 30
W. 3 10 17 24 -•-
T. 4 11 18 25 -•-
F. 5 12 19 26 -•-
S. 6 13 20 27 -•-
NOVEMBER WOODS ARE
BARE AND STILL
NOVEMBER DAYS ARE
CLEAR AND BRIGHT.

PLATE THREE

35. Third Week. This w[illegible] is usually the closing one before the holiday season, a[illegible] ay be profitably spent in any of several ways.

(a) December Calendar. A calendar for this month may be decorated by using a winter landscape or some nature subject which suggests the season. A branch of holly, or of fir with cones, or the beautiful poinsettia may be chosen. Ask the children to bring a calendar pad and a piece of cardboard. Cover the cardboard with colored paper, and mount the picture you have made, together with the calendar pad, upon it. Paste a loop at the top, or paste a piece of cardboard to the back to make it into an easel, so the calendar will rest on the table. See the illustration for November calendar, Color Plate Three.

(b) Winter Poems. Read to the children some beautiful poem about winter, and ask them to illustrate it. One suggestion is from *Snow-Bound* (Whittier), the selection beginning:

> So all night long the storm roared on;
> The morning broke without a sun.

Others in which good material may be found are *The First Snow Fall*, Lowell; *Winter*, Trowbridge, *December*, Emerson.

(c) Illuminated Texts. If it is desired, appropriate Christmas texts may be made by children in upper grammar grades, as suggested under work for November; or printed texts may be used and illuminations made in color.

Some very beautiful texts are made expressly for this purpose, and are quite inexpensive. These cards are printed in decorative type, and the decoration is carried in outline, which may be filled in with color by the children. The text may be further embellished by use of gold paint in outlining the decoration. These cards give the children some excellent examples of beautiful painting, and show how nature forms may be adapted to the use of design. Such cards may be procured of any first-class supply house, such as those mentioned on page 262, or from any agents of Raphael Tuck & Sons.

Test. Make a working drawing of a square handkerchief box, 5 x 5 x 2½. Make a design for the top of a box, using a 5 x 5 square. Use a conventionalized nature form—seed pod, holly berries or other appropriate decoration.

JANUARY

A Happy New Year, a Happy New Year,
Oh send it afar,
To the girls and the boys wherever you are;
To the rich and the poor, the high and the low,
Oh! scatter its blessings wherever you go.

36. First Week. (a) VACATION STUDIES. We have all enjoyed the holiday season, and now return to our work with renewed energy and a desire to get the most out of the new year. The children will be interested in telling you of their Christmas joys. Let them illustrate with crayons, pencil or brush, something they did during vacation. Illustrate sliding down hill, skating, snow-balling, helping mother or father. Try making a January landscape with the poem on the blackboard.

(b) SOLIDS. We are surrounded by

a world of objects that become more interesting as we become more familiar with them. We have given special attention during the fall months to the objects in the world of nature. We will give special regard during the next two months to the objects in the world of arts and manufactures. All objects are modified forms of a few types. Froebel classified all forms under three types, namely, the sphere, the cube and the cylinder. Ask the pupils to name a number of familiar objects resembling the sphere, as, fruits, vegetables, etc.; objects like the cube, as blocks, boxes, baskets, stools, tables, buildings, etc.; objects like the cylinder, as tree trunks, stems and some flower forms, besides many manufactured objects, such as bottles, jugs, pails and barrels. After a little study, the children will discover that many objects only remotely resemble any of these types, and so for convenience other types have been added, which are modified forms of the first three. The complete list is as follows: sphere, cube, cylinder, hemisphere, square prism, right-angled triangular prism, ellipsoid, ovoid, equilateral triangular prism, cone, square pyramid and vase form. There are twelve in all, and for convenience they may be divided into groups of three. Name objects like each.

(c) Definitions. Describe each form as to kind and number of faces, edges, etc., as follows:

The *sphere* has one round face.

The *cube* has six equal plane square faces, twelve straight edges and eight corners.

The *cylinder* has two plane faces and one curved face and two curved edges.

The *hemisphere* has one plane face and one rounding face, and one curved edge.

The *square prism* has six plane faces, two square faces and four oblong faces.

The *right-angled triangular prism* has five plane faces, and the two ends, or bases, are right-angled triangles.

The *ellipsoid* has one rounding face having two rounded, small ends.

The *ovoid* differs from the ellipsoid by having one end larger than the other, being egg-shaped

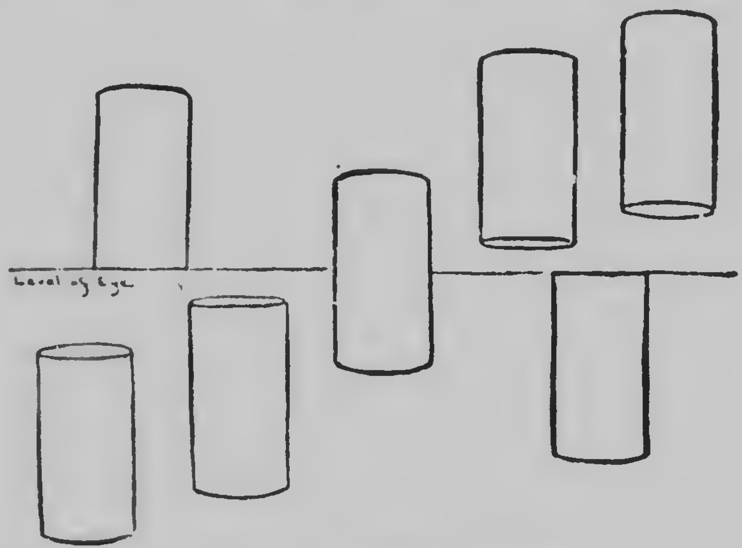
The *equilateral triangular prism* differs from other prisms by having equilateral triangular ends, or bases.

The *cone* has one plane face and one curved face, and one curved edge.

The *square pyramid* has a plane square base, having four equal plane, triangular faces that meet at a common point called the vertex.

The *vase form* has two plane faces and one rounding face having reversed curves.

(d) PERSPECTIVE. The study of the appearance of form and representing forms as they appear, without regard to



CYLINDER IN DIFFERENT POSITIONS

facts of form, is called *perspective*. All objects may be grouped under two heads in the study of perspective, namely, cylindrical perspective and rectangular perspective.

Cylindrical perspective deals with objects that resemble the cylinder, having curved edges.

Rectangular perspective includes the study of objects having rectangular faces and straight edges.

After the children have had a number of lessons on the study of types of form, ask them to make a cylinder by rolling a piece of 6 x 9 manila paper, and pinning it in place. Ask the children to hold the cylinder upright, at arm's distance, and observe the changes in the apparent form of the top and bottom faces. Hold it out so that the top edge is on the level of the eye. Lead them to observe the essential points by such questions as these: How does the circle appear in that position? (Answer: A straight edge.) How does the bottom edge appear? Put your pencil under the lower edge, and notice the downward curve of this edge. Could you draw the picture of the cylinder in this position? Draw what you see, on the paper and on the blackboard. Again, try placing the cylinder with the bottom edge on the level of the eye, and draw what you see. Place the cylinder below the level of the eye, about on a line with your shoulder; can you see into it? How does the circle appear now? (Answer: A narrow ellipse.) Place the cylinder still lower; how has the top changed in appearance? (Answer: It appears a wider ellipse.) Now place the clyinder above the level of the eye, and watch the gradual widening of the ellipse at the bottom. Carry these observations far enough to establish these principles regarding the appearance of the circle:

(1) The appearance of the horizontal circle on the level of the eye is a straight edge.

(2) When the circle is seen obliquely above or below the level of the eye, it appears an ellipse.

(3) The nearer the horizontal circle is to the level of the eye, the narrower the ellipse appears.

(4) When the horizontal circle is seen directly above or below the eye, it appears as a full or complete circle.

Draw the cylinder with relation to the eye-level in the following positions, and note the change of appearance of the circular bases.

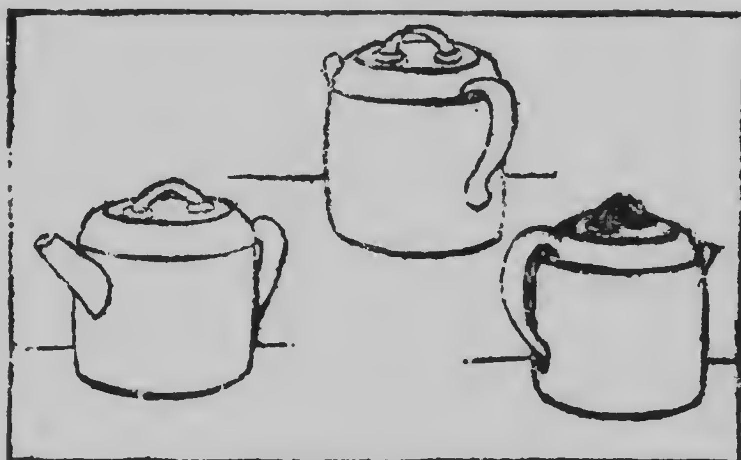
(1) Draw the cylinder with the top on the level of the eye.
(2) Draw the cylinder with the bottom on the level of the eye.
(3) Draw the cylinder with the middle on the level of the eye.
(4) Draw the cylinder a little above the level of the eye.
(5) Draw the cylinder a little below the level of the eye.

Draw a horizontal line across the center of the paper, to represent the level of the eye, and draw the cylinders in relation to that line. See the illustration of the cylinder in different positions.

Caution. It will be well to give the foregoing study of type solids slowly, according to the ability of the children to receive it. The first group may be given the first week, the second group of three the second week, and so on, letting the work cover the whole month, if necessary.

37. Second Week. Application of Principles. After the pupils have a working knowledge of the principles learned in studying the cylinder, ask them to bring to school objects resembling the cylinder—a tin cup, a pail, a crock, a jar, a flower pot, a jug. Use also the objects found in the schoolroom—the cup, pail and dinner pail.

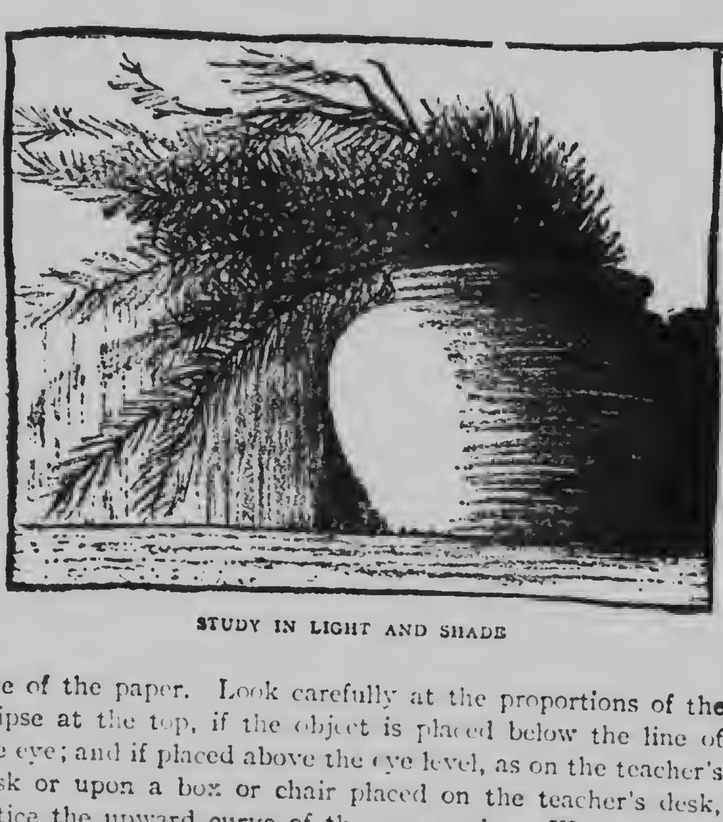
Study the proportions of each object. Proportion is the relation of height to width. Teach the children how to find



CYLINDRICAL OBJECTS IN OUTLINE

proportions by measuring on their pencils, held at arm's length, with one eye closed. Hold the pencil vertically at arm's length, allowing the top of the pencil apparently to touch the top of the object, and let the thumb indicate on the pencil where the bottom edge comes; this shows the apparent height of the object. Now, with the pencil held horizontally, compare the apparent width with the apparent height.

Use manila paper for sketching, and draw several of these simple objects in outline. Draw two light lines to suggest the height of the object, then two lines to suggest the proportionate width. Make the sketch as large as will suit the



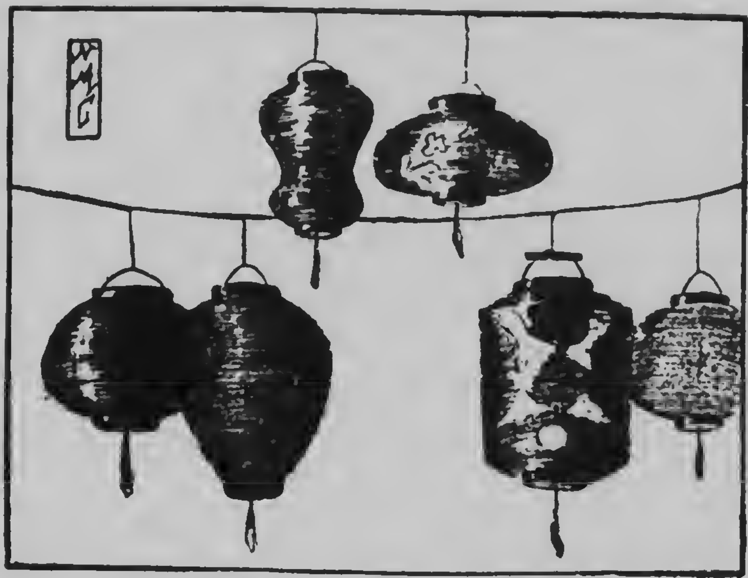
STUDY IN LIGHT AND SHADE

size of the paper. Look carefully at the proportions of the ellipse at the top, if the object is placed below the line of the eye; and if placed above the eye level, as on the teacher's desk or upon a box or chair placed on the teacher's desk, notice the upward curve of the upper edge. What kind of a line will you draw to represent the base, if the object is above the level of the eye? (Answer: If it is on a box above the eye level, draw a straight line to represent the edge of the box. If the object is below the eye level, indicate the downward curve at the base.) Draw from various objects in outline, using pencil and manila paper. See illustration of objects drawn in outline.

38. Third Week. OBJECT DRAWING. Objects showing dark and light color in the ware, crocks and jugs, brown and white bowls, furnish excellent studies. Use manila paper and pencil or crayon. Place the objects on boards between the desk, so that children along two rows can see the object well. One object placed in every other aisle will be sufficient, unless the object is small; then place two objects in the aisle, putting one half way down the length of the aisle on a board placed across the desks. By leaving an aisle entirely free, it gives opportunity for the teacher to pass through for class criticism.

STUDY IN COMMON OBJECTS

Sketch the outline lightly with pencil or brown crayon, first indicating by light, sketchy lines, called *blocking in*, the general proportion of the object. After the outline is sketched in lightly, study the object to see what parts are of dark color and which are light, then with pencil or crayon show by lines drawn parallel to the curve at the top, the dark part of the object. Is there a high light on the light side of the object? If so, look carefully at its shape and leave that spot the color of the paper.



LANTERNS IN LIGHT AND SHADE

Try several different objects, showing the effect of dark and light, as suggested by the illustrations.

39. Fourth Week. (a) OBJECT DRAWING (CONTINUED). The purpose of the study of objects this week will be to see and express the effects of light and shade. Use the same materials which were used last week. The objects must be placed to receive light from one side of the room; the window shades should be lowered at the back and other side of the room, if there should be windows on more than one side. Choose some light colored object, a flower pot, bowl, peck measure or bushel basket will be suitable. If the object is small, place it on the boards between the aisles; if large, it may be placed on the teacher's desk. Ask the children to observe the effect on the light side, and compare with the shaded side of the object. If you can see into the object, compare the color effect of the ellipse with the outside of the object.

Sketch in as before, and, leaving the light side the color of the paper, show the dark side by pencil or crayon shading, or painting with the pencil, as it is called. See the illustrations for January work.

(b) REVIEW. Review the work of the month by calling for blackboard work, making memory sketches from objects previously drawn.

Test. Name two objects like each of the following type solids: sphere, cube, cylinder, square prism, cone, triangular prism.

Draw a cylinder in five different positions with reference to the level of the eye.

Draw from a cylindrical object having a handle (a cup or a pail), placed below the level of the eye. Draw in outline.

Draw from a group, a tumbler and lemon. Use the pencil.

Write the principles pertaining to cylindrical perspective.

FEBRUARY

Sunset red and quiet air;
Ponds are ice and trees are bare;
Fields are frozen far and near,
February days are here;
Bitter cold the night draws down
On the country and the town,
But in cheerful warmth we sit,
And the nursery lamp is lit.

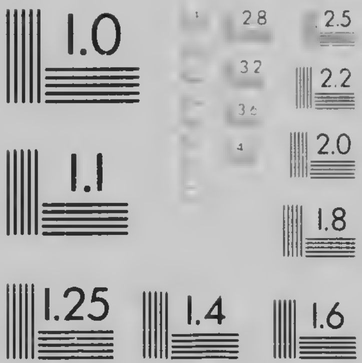
—*K. Pyle.*

40. First Week. (a) FEBRUARY POEM. Read the children this poem, descriptive of February, and ask them to imagine the picture. Then let them represent this picture with water colors or colored crayons, bringing out the sunset sky, the bare trees and ponds of ice. Some may like to picture the skaters on the pond. Perhaps the ground is white with snow, if so, leave the paper the natural color, to represent the white ground. See Color Plate Four.


E M. Galsworthy

[illegible]

MICROCOPY RESOLUTION TEST CHART



APPLIED IMAGE Inc

If the landscape is to be done in water colors, moisten the paper with one or two brushfuls of water, and tint the sky space to suggest a bright sunset, using red or red and yellow, blending the colors together, as you recall seeing them in an evening sky. Practice making bare trees, such as you can see from the window, on a dry paper, while the sky is drying a little. Then try the same on the first paper. Hold the brush upright, to get a fine, firm stroke for the little branches. The icy pond may be shown with a gray, blue-green color, made by mixing all three colors (blue, yellow

ILLUSTRATING APPARENT CONVERGING OF HORIZONTAL RECEDING LINES

and a little red). If the pupils have no water colors, a study in brush and ink work or colored crayons may be used. If these little landscapes are saved, each can be mounted with an appropriate verse for a valentine.

(b) Landscape Illustrating Perspective. Use the landscape to illustrate to the children the appearance of receding lines and edges as they are noticed in the road, railroad, telegraph poles, trees and houses in perspective.

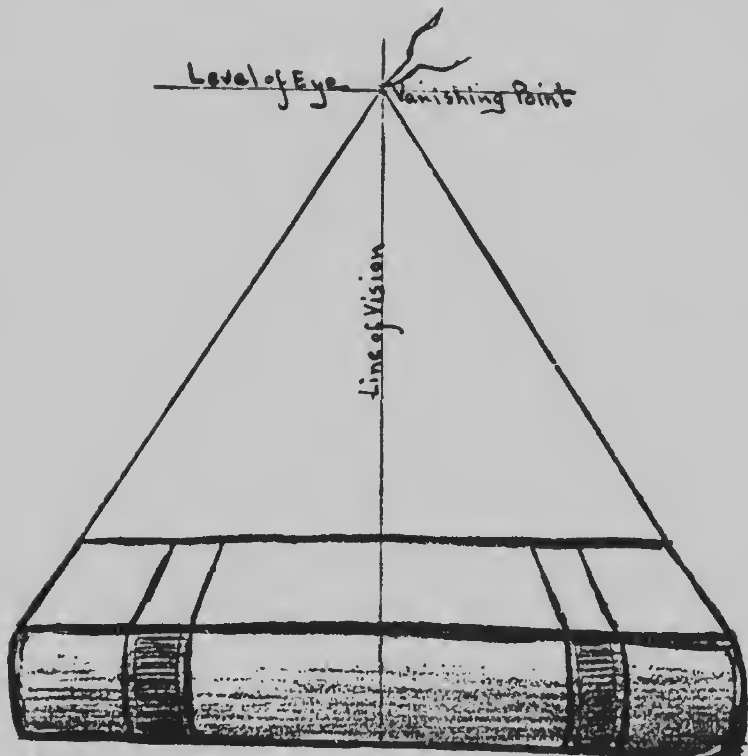
By questioning, the children may be led to recall that the parallel horizontal receding lines found in railroad tracks, seem to converge or come together, and if you can see them at a great distance, they appear to meet at the horizon, or eye level. Illustrate this principle by drawing a horizon line, and lines for track converging to a point. Add lines parallel to these lines, converging at the same point, to indicate lines for telegraph poles and trees at either side. Draw lines for tops of telegraph poles and trees, converging to the same vanishing point. Finish the sketch by drawing vertical lines for poles and trees, making the distance between them less and less as they approach the horizon. Finish by drawing in the details—telegraph wires on the poles, foliage on the trees, ties on the track, and other details of the landscape. Illustrate these points by drawing on the blackboard while the children follow with pencils and paper.

41. Second Week. Rectangular Objects. After the children have observed the appearance of parallel horizontal receding lines in the landscape features, it will be well to follow this exercise with observation of rectangular objects in the schoolroom.

(1) *Book.* To further demonstrate the principle that parallel horizontal receding lines appear to converge, and if sufficiently extended will meet at a point on the level of the eye, called the *vanishing* point, allow the children to make the following experiment:

Take a book and a long string; slip the string under the cover of the book close to the back edge. Now place the book as far away from the pupil as possible, resting it on the desk, with the back of the book toward the observer. Take the string at both ends, and by holding the ends of the string slanting toward each other, and closing one eye, adjust the string apparently to conceal the short, receding edges of the book. If the string is sufficiently long, the ends will cross at the eye level, proving the statement made at the beginning of this lesson. What was observed in the railroad is also true of even short horizontal parallel receding lines.

To find the apparent width of the face as it rests on the back of the desk, place a ruler upright on the back edge of the book, and let the finger or a pencil indicate how many inches wide the top face *appears*. Close one eye to make all these observations. With the strings in position again, the apparent length of the *farther* edge may be discovered by

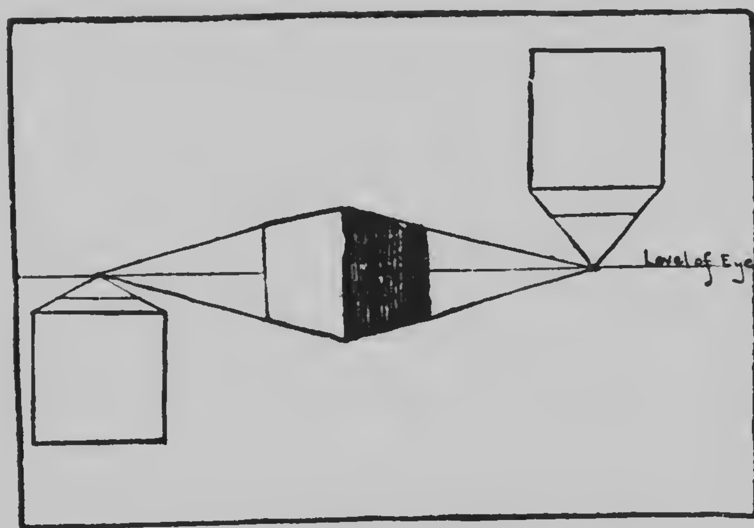


EXPERIMENT ILLUSTRATING CONVERGING OF HORIZONTAL RECEDING LINES

measuring between the two farther corners, on the ruler, placing it against the strings.

Make a large drawing of the book, dealing with the actual measurements of the back, and apparent measurements of the top. Use a comparatively thick book, as a school reader, for this exercise. If the drawing is made smaller than the actual size of the book, the measurements must all be reduced proportionately.

(2) *Cube.* After experimenting with the books and strings, next let the children observe the hollow cube. Fold a strip of manila paper, 2 x 9 inches, to make a two-inch cube. Observe the cube as it looks, with a face toward you and on the line of the eye. How many faces do you see?



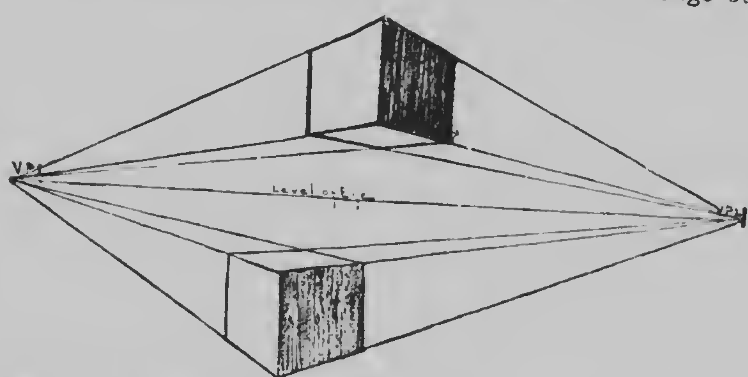
CUBES IN PERSPECTIVE

(Answer: One face.) Draw what you see. Keeping the face towards you, hold the cube a little below the line of the eye. What face comes into view? (Answer: The top face.) How does it look? (Answer: Foreshortened.) How wide does it look? Lower it and notice the change. Notice the converging lines of the receding edges. Draw the cube in this position.

Hold the cube a little above the line of the eye. What face comes into view? (Answer: The bottom face.) How does it look? (Answer: Foreshortened.) Draw it as it appears. Draw on 9 x 12 paper a long horizontal line to represent the eye level. Draw the appearance of the cube as it looks when the top edge is on the level of the eye; when a little below the level of the eye, and when a little above the eye level. Note the extended lines which come to a point on the level of the eye. See the illustration.

After the foregoing is quite clear to the children, try placing the cube turned with one edge toward you and the sides turned equally away. Hold it by the back corner, and observe how it looks when a little below the level of the eye, and also a little above the eye level. The top face and the bottom face in these positions resemble what figure? (Answer: A diamond shape.) Notice the slant of the side lines. There will be a group of parallel lines that will converge to a vanishing point at the left, another set at the right, the vanishing point being on the line of the eye. Illustrate this by drawing these two sets of converging lines on the blackboard, showing the two vanishing points.

Teach the children how to measure the foreshortened faces by measuring with the ruler from the front edge out

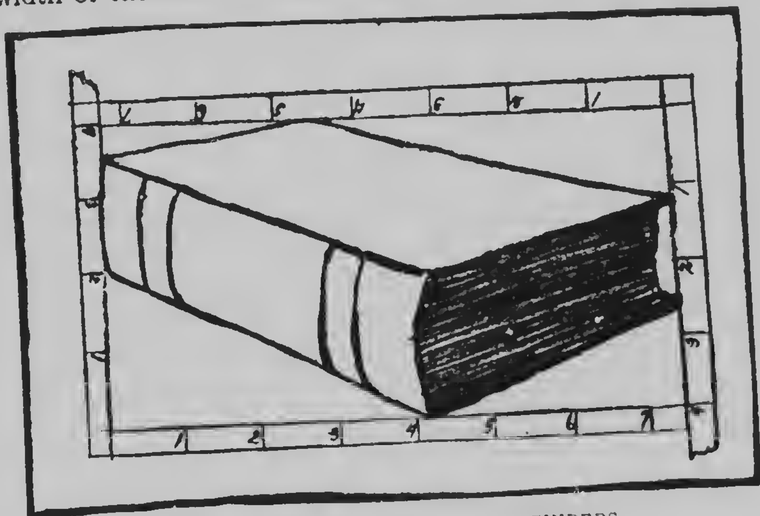


CUBE ABOVE LEVEL OF THE EYE, DRAWN AT AN ANGLE OF 45 DEGREES
CUBE BELOW LEVEL OF THE EYE, DRAWN AT AN ANGLE OF 45 DEGREES

straight to the left and right, not on the slant. The two faces will appear equally foreshortened. We saw the cube turned at an angle of 45°.

At the next lesson develop the problem when the cube is turned so that one side appears smaller than the other. Place the cube on the back of the desk. Draw the vertical edge which is nearest and shows the actual height. Measure with the ruler, touching the front edge, to find how far to the right and left the farther edges must be drawn. Place the ruler flat on the desk, just touching the front vertical edge, and notice the angle made between it and the lower receding edges. The more foreshortened face will be drawn at a greater angle from the horizontal line which indicates the position of the ruler than the less foreshortened face.

After these base lines have been drawn correctly and the width of the faces indicated, the other lines must be drawn



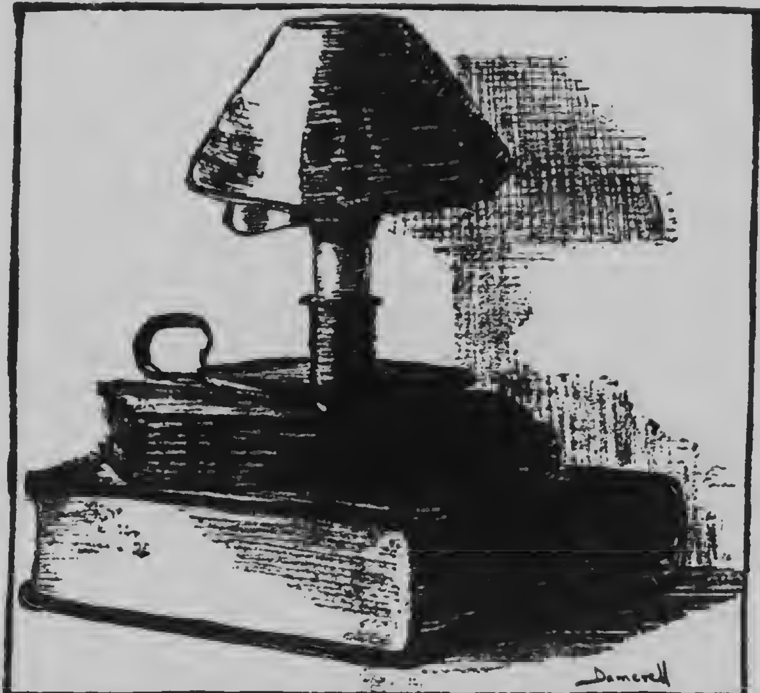
BOOK DRAWN WITH THE AID OF FINDERS

slightly converging with these base lines, making the farther vertical edges a little shorter than the front vertical edge. Notice the position of the farther corner and the shape of the top face. Sketch lightly with tentative lines, until the drawing looks right.

Make several experiments with the cube placed in different positions, and draw what you see. After studying it turned at an angle below the line of the eye, look at it a little above the eye level, and draw again.

42. Third Week. RECTANGULAR OBJECTS (CONTINUED). (1) *Cube* (Continued). It will take some time for the pupils to gain a working knowledge of the principles of perspective; to help them to visualize the appearance of the cube placed at any angle, the teacher may suggest the different positions by partly sketching the cube on the board, and asking the pupils to hold their cubes in the position indicated by the lines drawn. Ask them to finish the sketch by observing how the other lines should be drawn. Practice on this until the pupils can draw the cube in any position. Heavy lines indicate the lines to be drawn on the board. See illustration.

(2) *House.* In the next lesson apply these principles by drawing a house in perspective. The teacher should draw

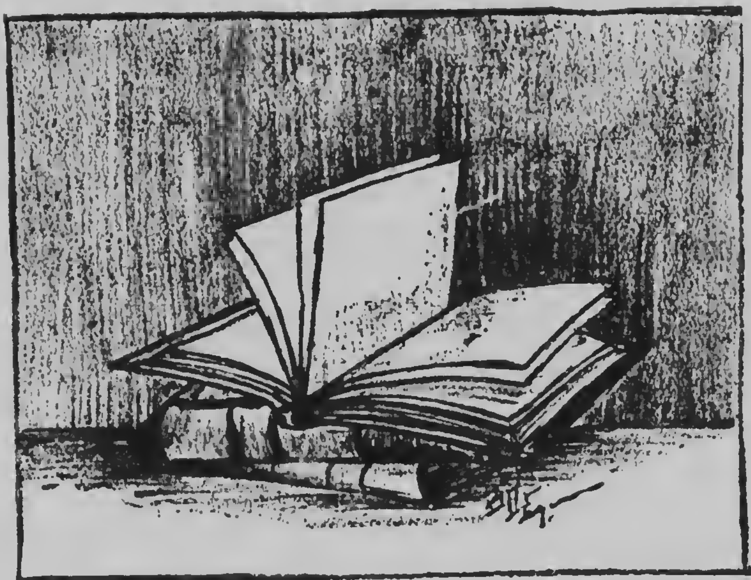


GROUP OF RECTANGULAR OBJECTS IN PERSPECTIVE

a sketch of the house on the blackboard, commencing with the vertical corner nearest to the observer. Then indicate the farther corners, showing the amount of foreshortening observed in the sides of the house, and the length of the corners compared with the first corner drawn. Place the gable by finding the center, shown by drawing diagonal lines at the end and erecting a vertical line. Remember the lines at the eaves and roof will slant downward a little, while the lines at the ground will slant slightly up toward the horizon, or level of the eye.

Some place associated with Charles Dickens would be an appropriate sketch to make this week, also the old log cabin which is so familiar as the birthplace of Lincoln.

43. Fourth Week. (a) RECTANGULAR OBJECTS (CONTINUED). Continue drawing rectangular objects, including boxes, books, tables and other common objects. Use pencils or colored crayons.

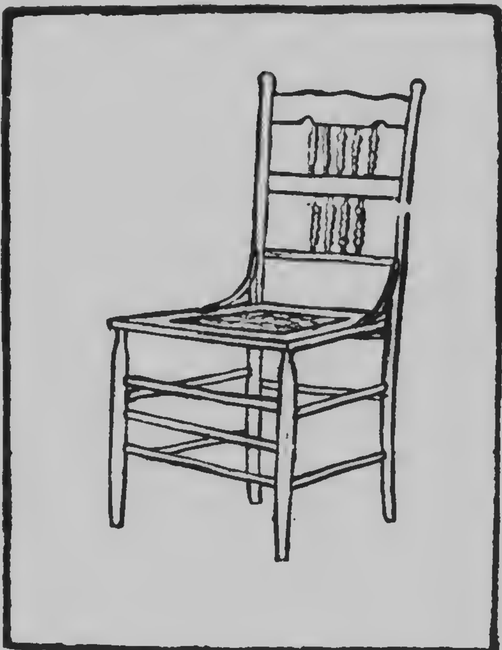


BOOKS IN PERSPECTIVE

Place the objects to be studied on boards between the desks, and call the pupils' attention to their position. Are the objects seen in parallel or in angular perspective? Hold the ruler out and notice the angles made by the receding edges of the object with the ruler, as it appears to touch the lower edge of the object. Finders made of a piece of cardboard, or paper, and shaped like a carpenter's square, may be held to show the exact angle made by any receding line. Hold one arm of the finder vertical, and let the other follow the base lines of the object.

Try drawing a single book in different positions; then try a group of books, a candlestick or a piece of pottery. See the illustration of books.

If the view from the schoolroom window gives an opportunity to try sketching houses, a part of the week might be taken up in so doing, or the teacher may sketch a winter landscape on the blackboard, and the pupils may make sketches from this.



CHAIR IN PERSPECTIVE

(b) REVIEW. Review and reiterate the principles learned this month in observing the appearance of rectangular objects. Give the pupils the following principles and ask them to write and learn them:

(1) The apparent width from front to back of any horizontal face decreases as it approaches the level of the eye.

(2) The farther of two edges horizontal from left to right appears shorter than the nearer.

(3) All parallel horizontal edges receding from the eye appear to converge.

(4) All receding horizontal edges appear to incline toward the level of the eye, and must be drawn so that, if produced, they will meet in a point on the level of the eye.

This month's work deals with some prosaic facts in object drawing, but upon these truths more interesting work will be developed. It has been well observed that "Nobody really knows about any subject until its length, breadth and height are equal in clearness in his mind." This is particularly true of the subject of perspective.

Test. Make a drawing of the chalk box facing below the level of the eye. Make a drawing of this box turned at an angle, below the level of the eye. Make a drawing of a group of two books in angular perspective.

Write the principles involved in drawing objects in parallel and angular perspective.

MARCH

We love best when we see them painted
Things we have passed a hundred times
Nor cared to see,
And so they are better painted,
Better for you and me.

—*Browning.*

44. First Week. REPRESENTATION. During January and February the pupils have been learning something of the alphabet of form and the principles governing its representation. Let them continue their drawing of objects for a few weeks in order that they may express in terms of beauty some of the common forms about them.

You have studied the single object with considerable care. Now consider the grouping of objects, placing two or more together in a way that they may illustrate a thought—in other words, tell a story.

(1) *Grouping.* In making a group, determine first the idea to be expressed, thus leading to the selection of objects having harmonious relations, that is, objects that seem to

belong together. For example, objects to be found in the kitchen can be placed together, but objects from the kitchen are not to be grouped with parlor bric-a-brac.

(2) *Composition.* One of the most important elements in representation is that of composition. This element enters into all representation, whether of single objects or a group of objects. In the single object it is a question of proper placing, or composing, in the space on the paper upon which it is to be represented. In grouping, the first thought is to have the objects well arranged or composed so as to make a pleasing whole. Unity is the great law of good arrangement or composition. Ruskin defines composition as "the help of everything in the picture by everything else.

(3) *Arrangement of a Group.* Learn the essentials of good arrangement by placing objects together. Have for use in the lesson several pieces of pottery used in previous lessons, and some vegetables—potatoes, onions or squashes. Think of the objects that would be associated together in preparing these vegetables. Choose a pot, a pan or a basket for the potatoes or onions, and arrange them together as they might look on the kitchen table.

Place the potatoes with an object by themselves, the onions with another; then place them beside the pan, but not directly in front of it, thereby concealing the whole base of the pan.

Place one vegetable a little behind another. This gives us a variety. Compare this arrangement with that obtained by placing the objects in a row, or at random. If the squash is used, a larger object would be most suitable to place with it. A jug placed beside the squash, or partly back of it, would suggest a cellar group.

Try representing a group arranged on boards between the aisles, using pencil and manila or white drawing paper. Sketch in light, blocking-in lines, and be careful to place the object which is nearest you in a lower portion on the paper than the object farther away. Then compare the light and shade sides of the objects, and show the shading on the vegetables with slanting strokes. See illustrations, including Color Plate Five.

Try grouping two pottery forms together, choosing those that are varied in form and have interesting color contrasts. For instance, a tall jar with a shorter one; a dark jug with a light one; a pitcher and cup or bowl placed together; a teapot with cup and saucer, jug, bowl, etc. Select objects of interest around the schoolhouse; for instance, the coal pail, some sticks of wood, fire tongs, poker, and the water pail and dipper make interesting studies.

STUDY IN GROUPING

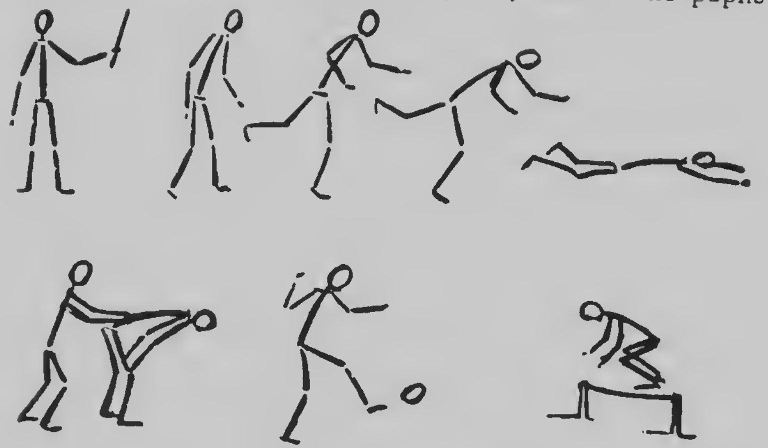
In a good group, the principal object is placed near the center. The secondary objects should be arranged so that their bases will not be in a straight line, or in a direct line with the base of the principal object. Arrange them so that a partial view of some object is seen, and try to have a variety in position; but make the objects seem to belong together and to be at rest. Do not leave too great a space between them. A good group gives one a feeling of repose and harmony, and if boundary lines were drawn about it, they would form an irregular figure, usually a triangle.

45. Second Week. Representation (Continued). Last week cylindrical objects were used in grouping; try rectangular objects this week. Use the material available in the schoolroom, such as chalk boxes and books. Various sizes of books can be used to give variety to the groups.


SEEING BEAUTY
IN COMMON THINGS

What can you place with a chalk box to make an interesting group? Something appropriate would be two or three pieces of chalk and an eraser. Arrange them to make a pleasing group. Draw in outline and complete in light and shade. If a group of books is chosen, two or three arranged carelessly together will afford an excellent problem in perspective.

To assist the children to see the appearance of receding edges, direct them to cut out two right angles from a piece of cardboard or stiff paper. By holding these in front of a group, the amount of slant is quickly seen. The pupils



POSES IN OUTLINE

will receive considerable assistance in getting a correct idea of the foreshortened faces of the top of the books by sticking pins vertically in their faces near the corners, then comparing the placing of the distant corners and edges with the height of these pins.

Another method of determining the foreshortening is to measure with the ruler held upright, allowing the top of the ruler to touch the highest point in the group, and the thumb to slide down to show the lowest point, then compare that measurement with the whole length of the group. Of course, these measurements must be made with the same existing proportions in your study. For instance, if the books appear three inches high and five inches long, then these measurements, or those bearing the same ratio, must be used in the drawing. We may enlarge the drawing, or reduce it, by multiplying or dividing the original measurement by the same number.

The dictionary and teacher's bell will make an interesting group, and a dinner box with a cup will make another. Other groups of interest would be a candlestick with books and the globe with books.

46. Third Week. THE HUMAN FIGURE. In some schools where a thorough course in drawing in the primary grades has laid the foundation upon which to build, the work in object drawing might be continued, and advanced problems like a corner of the school room, an open door, a chair or the teacher's desk could well be studied during the remainder of the month. See illustrations. But if the children have not had much previous work, it will not be well to continue object drawing to the exclusion of many interesting exercises which may be included in the spring work.

Though March is such a variable month, before this time there will be some signs of the awakening of new life—the return of a few birds, the swelling buds and the exuberant activity of the children, who will be anxious to try the spring games of marbles, flying kites, jumping rope, playing ball, and other pastimes. Utilize these natural activities in connection with a study of the human figure. It will be well to review the simple action lines, or skeleton figures, preliminary to working from the figure.

Choose one of the smaller boys to pose, and ask him to stand on a chair, or table, where all can see him. Observe the upright figure. Can you draw one line to express this position? (*Answer:* A vertical line.) Compare this with a prostrate figure, which may be shown with a horizontal line. Now compare parts of the figure, trunk, limbs and head. By measurement you will discover the relative proportion of the parts of the body, the trunk and head forming the upper half, and the lower limbs the lower half of the figure.

Draw a small circle for the head and straight lines to express the trunk and limbs, leaving a small open space at the knees and elbows.

FIGURE POSING

Ask a boy to walk across the floor, then to run; observe the change in direction of trunk and limbs.

Try representing the figure in action, using straight lines. After representing the skeleton figures, showing walking and running, illustrate jumping, pulling and pushing poses, until the pupils can show quickly, with a few lines, the action of the figure. See the illustration, page 333.

Follow these exercises with a study of the figure in mass, making a silhouette in ink or black water color, which will show the shape of the figure. See the illustration.

Let the boy take some position for decided action, as the position of a boy with a bat, or stooping to catch a ball, or aiming with a gun (using a pointer for a gun). Form a group by having two boys pose for playing leap-frog.

Use brush and ink to show the direction the trunk and limbs take, then fill in, working from the center to the outer edge to get the shape of the figure. Show the position of the head, body and limbs in simple mass effect. See the illustrations.

47. Fourth Week. Figure Work (Continued). After showing the figure in mass effect, try expressing the pose in

STUDY IN CHARCOAL

pencil outline, which is a little more difficult, but also more explicit.

Vary the work by allowing one of the girls to pose; if she wears a hat and coat and carries an umbrella it will make an interesting pose. Use blocking in lines as before, and place the center of the figure, waist line, etc. Sketch in light, loose, tentative lines at first, getting the relative placing of the parts before making firm lines for the finished sketch.

FIGURE POSING

If possible, use some idea developed in reading to suggest interesting poses. A Puritan figure can be quickly shown by using white paper cap, collar and cuffs, with a white apron. If the figure is represented as reading, we have a very good Priscilla. Try to show the dark parts of the dress by pencil painting, leaving the white parts the color of the paper.

The children will soon become interested in making each other's pictures, and often some real talent in figure drawing will be discovered. See the illustrations.

In connection with the study of the figure, try to show the children some of the great masters' work in figure painting. Jean Francois Millet, the French peasant painter, has shown us how simply treated some of the great themes of farm life may be. *The Sower, The Peasant, Grafting a Tree, The Shepherdess, Knitting, Bringing Home the New Born Calf,* and others, make us feel the simplicity and poetry of the life around us.

Test. Make a drawing of a group of objects found in the schoolroom illustrating both cylindrical and rectangular perspective.

Name three essentials in good grouping.

Make a drawing of a child posing, illustrating some game, such as playing ball or marbles.

APRIL

Come children, dance and sing
For spring is here.
The crust of earth is breaking,
The flowers are all awaking.
Come, dance and sing.

48. First Week. Bird Study. To enumerate the joys of life in the spring is to suggest abundant material for art study. The return of the birds, the new growth of the buds, the first flowers, the spring landscape, the animal life, spring gardening, are all fruitful sources for observation and expression.

Have you kept a record of the return of the birds this past month? (See Volume Five, page 31.) Have you seen the robin, the blue jay, the blue bird and the flicker? Do you have the bird pictures in the schoolroom? Outline bird studies for children to color, published by the Davis Press, Worcester, Mass., are helpful.

From bird pictures and observations from nature, try painting or drawing pictures of the birds named above. The color adds great interest, and if water color is used, paint the body of the bird egg-shaped, then add the head, tail and wings. If a written record of observations is kept, a cover for the bird booklet would be a good problem. Try

COVER FOR BIRD BOOK

using the bird motif in a decorative way for the booklet cover, making a symmetrical unit instead of a mere picture of a bird. See the illustration.

49. Second Week. Animal Studies. Besides the birds, the rabbit and chickens make interesting studies at this time. Ask the children to bring some of their pets to school, and after a few lessons from the animals indoors, encourage the children to sketch from the animals at home.

(1) *The Rabbit.* The rabbit makes one of the best subjects in animal study, because it is so gentle. It may be brought to school in a basket and placed on the table for study during the lesson period; or, better still, have a box in which it may be kept and allowed to remain several days. The easiest way to express the animal form is by the use of ink and brush. Make a silhouette to show the shape of the body, head and other prominent parts. Second, try sketching in outline with a pencil. Third, show spotting by pencil painting.

ANIMAL STUDY

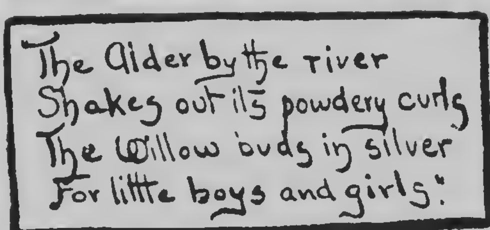
The proportion of the body, and the relative size of the head to the body, should be carefully studied, and blocking-in lines should be used to express these proportions.

The rabbit makes an excellent subject for a lesson in clay modeling. Soften the clay by soaking in water, then placing it in a cloth bag, and working it to the consistency of putty. First, make a ball-shaped body, then the head and ears, and press them into position. Shape all the parts from the one piece of clay, instead of making the details in separate pieces and putting them on. Allow the clay models to be dried, and then, when desired, they may be soaked up again for another lesson in clay modeling.

(2) *The Chicken.* A rooster or a pet hen makes a fine subject for a lesson. It may be wise to have the bird in a cage, unless it is very tame. Use the same process as outlined before. Make a mass painting first with brush and ink, getting a silhouette; then try with pencils or crayon.

50. Third Week. Animal Study (Continued). Ask the children to bring other pets to school—a gentle dog or cat; in the country even a lamb might be attempted. If the animal moves frequently, try making snap shots, as it were, working from memory. Silhouette work and outline drawing in pencil will be the best methods to employ.

51. Fourth Week. (a) EASTER DECORATIONS. Choose something appropriate for an Easter sentiment, and plan to print it carefully. In the upper grades an appropriate decoration can be added, using a conventionalized flower. The Easter lily, crocus, spring anemone or the daffodil will be most suitable. Print a simple, straight-line alphabet on the board, and after the children have chosen their text, let them plan with rulers the space for the letters. They should place lines at the top and bottom of each row of letters, divide the long space into small spaces for each letter, then place each letter in its space, leaving a small space between the letters and longer spaces between the words.



Here are some appropriate texts:

May Joy be Yours,
This Easter-tide.

O the glory of the spring-time
Making all things bright and new!
O the rosy eve's surrender
To the Easter moon-light tender.
—*Havergal.*

Within, above, and all around
The chimes of deep cathedral bells
An early herald peal that tells
A glorious Easter-tide begun.
—*Havergal.*

In planning a decoration for the sentiment, plan a border space, dividing it also into spaces. With paper and scissors, make a little flower shape that will fill the small space. Place this pattern in each square space into which the border is divided, and trace around it. Paint the border in appropriate color, to suggest spring; green and


EASTER
"Rejoice! Rejoice! the robins
Trill. Be glad! the breezes
Flutter "Tis Easter day!"
Each bright sunray
In dancing seems to utter.
Farewell to darken day
And cold for all life's
Gray has turned to gold!

PLATE X

white, purple and green, or pink and green are suitable colors. Outline the design in black, using a fine brush and ink or black water color. See Color Plate Six.

This week's work may be taken at the time most suggestive of the Easter day. More elaborate designs for Easter thought may be worked out if the children have had some previous work in designing. If preferred, an appropriate text simply bearing on spring may be chosen instead of the special Easter thought.

(b) MEMORY DRAWINGS. Memory drawing should be encouraged frequently in other lines of work, instead of always depending on the object; then the mind would be accustomed to retaining the image, and greater working power would be the result.

Test. Make a drawing from two tree branches having buds. Use a pencil. Make a cover for a nature booklet. Print the words, "Nature Booklet," and make a border, using bird or flower motif. (Use ink or black water color.)

MAY

Robins in the tree top,
Blossoms in the grass,
Green things a-growing
Everywhere you pass.
Sudden little breezes,
Showers of silver dew,
Black bough and bent twig
Budding out anew.
Pine tree and willow tree
Tinged elm and larch,
Don't you think that May-time's
Pleasanter than March?

—*Thomas Bailey Aldrich.*

52. First Week. SPRING FLOWERS. Do you know the spring flowers as they appear? The trailing arbutus in the northern woods, the pussy willows, now to catkins grown, the hepatica, the anemone, the spring beauty, the wake-robin, Jack-in-the-pulpit, dogwood blossoms, violets and buttercups in the woods and fields, and in our gardens the tulips, iris and firebush all make delightful studies. Besides the birds, buds and trees, the brooks are teeming with wonderful lessons of

MAGNOLIA

life. The water bugs, fishes, frogs and frog's eggs and tadpoles and a stray tortoise can be collected to make a school aquarium. All of this material will serve in its turn not alone as interesting material for nature study but for art subjects, as well.

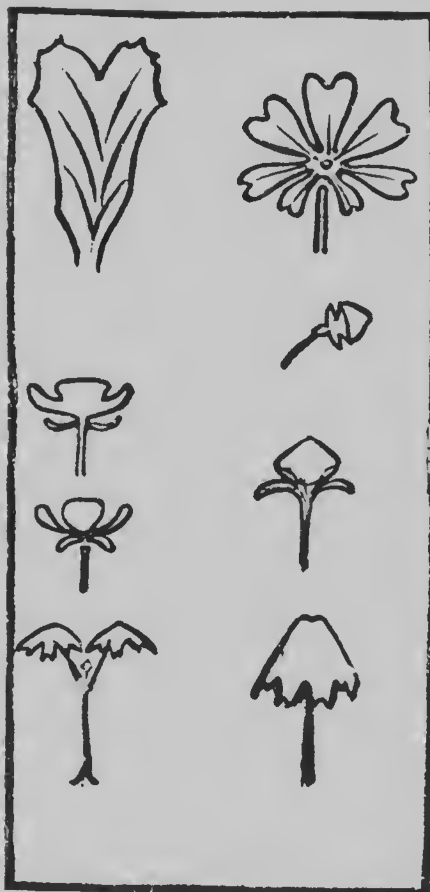
DESIGN FROM MANDRAKE

Choose the large, single flowers, like dogwood blossoms, tulips, Jack-in-the-pulpit and magnolia, rather than the small, intricate flowers, like the violet, the anemone and the hepatica.

Fasten the study chosen to a cardboard easel, and place this on boards between the front desks. Study the plan of growth, the arrangement of leaves, whether alternate or opposite, the position of the flower, whether at the end of the stem or in the axil of the leaf. Observe carefully the amount of foreshortening in the flower and leaf, and show by light, blocking-in lines the direction of the stem and the position of the various parts. Represent the color effect by pencil painting. See the illustration.

53. Second Week. FLOWERS OR TREE BUDS IN COLOR. The same flowers used last week may be chosen, or others may be selected. Use water colors and manila paper, if flowers are chosen, and colored crayons, if tree buds are studied.

Study the color and form of the subject, and practice mixing colors to match the flowers and leaves, if water color is the medium. Have the pupils practice on paper, to gain freedom in handling the brush and color. Express slender stems by holding the brush upright. Press on the brush to obtain breadth of stroke for the leaves. Work in mass effect; do not outline the flower and leaves and then fill in, but work from the center out. Commence with the part of the study, flowers or leaves that you find at the top, and work down to the bottom, expressing leaves and stems as you come to them. See Color Plates Seven and Eight.



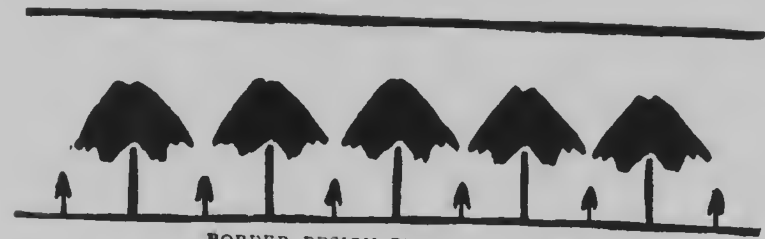
DESIGN UNITS FROM MANDRAKE

Try several flower studies in this way, or vary the week's work by using tree buds expressed in water color or colored crayon. The waxy horse chestnut, the popular catkins and others may be used as soon as they

PLATE SEVEN


Bissell

appear. Let these lessons be given when the nature material is in season.

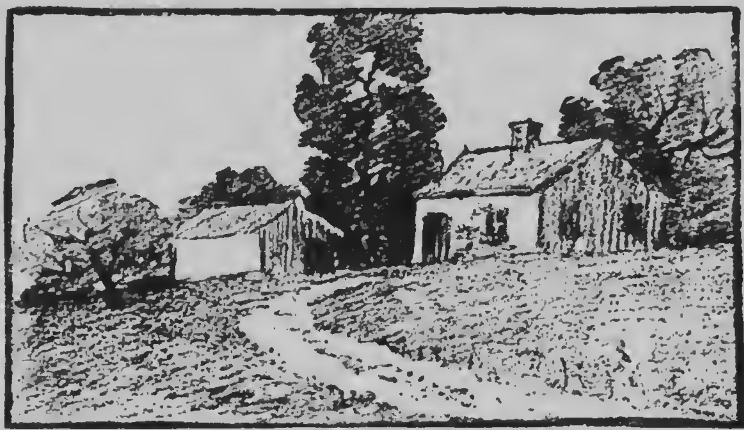


BORDER DESIGN FROM MANDRAKE

54. Third Week. SPRING BOOKLET. The last two weeks can be very profitably devoted to written exercises pertaining to spring. The nature walks and talks will make very profitable material for subject matter for writing lessons, and the art work will illustrate these very acceptably. Plan to make a cover for the booklet of exercises, and use some appropriate nature unit, either insect or flower, for the design. If the flowers are used, select one which is simple, like the marsh marigold, trillium or Jack-in-the-pulpit.

Analyze the flower to see the underlying plan and the number and shape of the petals. Draw the top and side view of the flower in outline. The top view will give a radial arrangement, called a rosette, while the side view gives a bi-symmetric unit, based on a center line.

Plan the units to make a border or a surface pattern, leaving space for the printing of the name and date. After



SPRING LANDSCAPE

the outline of the design is drawn, paint the same in water colors or ink, or use colored crayons. See the illustration.

Plan the printing carefully, drawing lines with the ruler at the top and bottom of the letters, and then spacing off the letters, making them with straight lines. Paint with ink, or water color which will harmonize with the design. The paper used in this exercise may be manila, but the colored papers, or bogus paper, are to be preferred. Fasten the papers in the cover with a cord.

55. Fourth Week. SPRING LANDSCAPES. To aid the children in choosing good subjects for landscape study, draw a long stretch of horizon, including several trees, perhaps a house or two, on the blackboard, and show the children how to use a finder by folding or cutting two right angles of paper and holding them to make a little frame, through which they may choose a small section of the landscape drawn. See illustration, page 345. Draw the part selected on manila paper, and show by pencil painting the color of the trees and the ground. Follow this lesson in copying from the blackboard by a sketch from out of doors, either window observations or a memory sketch.

The Bartholomew and the Woodbury *Pencil Sketches from Nature* make very helpful studies for the children to copy at this time. They are inexpensive (25 cents per set of six), and can be obtained of the Prang Educational Company, Chicago.

Test. (a) Draw in outline a spring plant—a tulip or other large flower. (b) Make a painting from a flower study, using water colors or ink

JUNE

Look without!
  Behold the beauty of the day; the shout
Of color to glad color, rocks and trees
And sun and sea, and wind and sky!
    All these
Are God's expression, art work of his hand
Which men must love, ere they can understand.

—*Richard Hovey.*

56. First Week. Spring Landscapes (Continued). The children have attempted to represent the landscape in pencil painting during the last week. Let them try this week to express the beauty of color in sky and tree and ground—possibly a stream, or pond, which will reflect the glory of the sky.

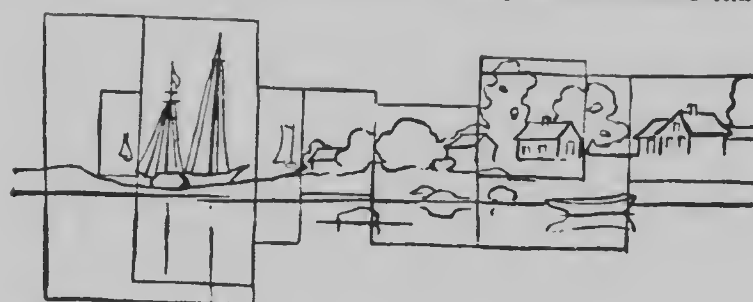
Paint in the color of the sky, after putting a water wash over the paper, and then paint the green for meadow or lawn.

After practicing the shape of the trees on a dry piece of paper, paint the trees in mass to suggest the particular trees they may be studying. Possibly the peach or apple trees in bloom are chosen; if so, paint the delicate pink blossoms first and then add the green.

The teacher may again sketch a long stretch of horizon on the board, showing perhaps the elements spoken of in the poem, "the sky and sea" and "rocks and trees;" let the children choose a composition from it with their finders, and then draw the principal forms very lightly before painting. See the illustration below.

Try several simple color impressions representing different times of day by different color schemes in sky and water. A sunset, an afternoon or a morning scene may be represented.

57. Second Week. Decorative Landscape. When the landscape is used to decorate a book cover or magazine, it is rendered in a purely decorative way, which means that



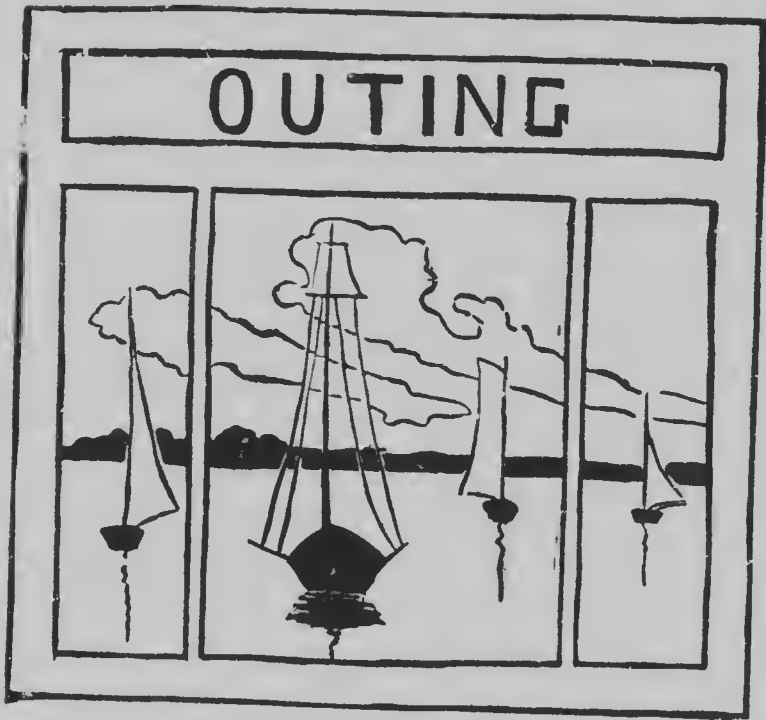
HORIZON STUDY, ILLUSTRATING USE OF FINDERS

the various elements are drawn carefully and the color is applied in a flat wash. Use either black and white and gray, or color, using tones of one color, like light and dark green, or blue, or a combination of a few colors, always mixing the colors to produce a gray.

Draw the landscape composition carefully, using a motif from the blackboard sketch previously made. After the drawing is made, decide which parts of the landscape should be light and which dark. With a little ink or black water color mixed with water, apply the tone for the sky, then a darker color for the ground, and a very dark color for the trees, using more ink or water color where the darkest color is desired.

Try this lesson first with black and gray, then with tones of one color, as green or blue, using light and dark tones, as in the previous study.

58. Third Week. Application of Decorative Landscape. A portfolio or envelope in which the term's drawings



DECORATIVE LANDSCAPE

may be kept will make a fitting problem to close the year's work.

The pattern for the envelope was given in September work (see page 277, Section 21). If the portfolio is desired, the following materials are necessary: Two pieces of cardboard 12 x 14 inches; a piece of toweling 16 x 28 inches, or bogus paper, for covering. The paste may be either library or flour paste.

Paste a strip of paper or cloth between the two pieces of cardboard, to form the back of the portfolio, allowing a space of an inch between them. Cloth is better than paper, because it makes a stouter back. Any cotton cloth will be satisfactory. Cut the covering (bogus paper or toweling) large enough to cover the two halves of the portfolio, and leave an inch to spare all around, to fold over as a lap. The

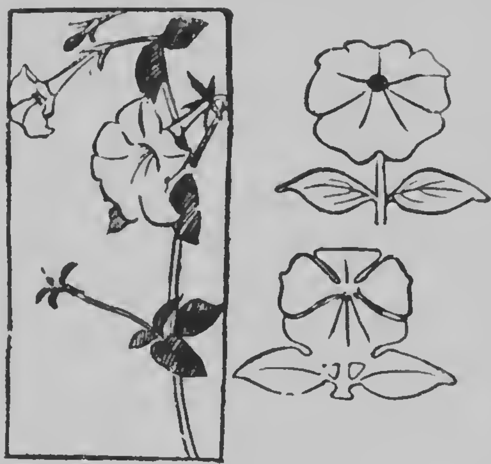
DESIGN FOR BOOK COVER

covering may be pasted down flat on the boards, or it may be creased and the lap only pasted down.

The lining paper should cover the inside up to within a half inch of the edge, and should be pasted all over to insure its being flat. Manila paper will serve very well for a lining. An extra strip should be pasted down the back before the lining is pasted on the inside of the covers.

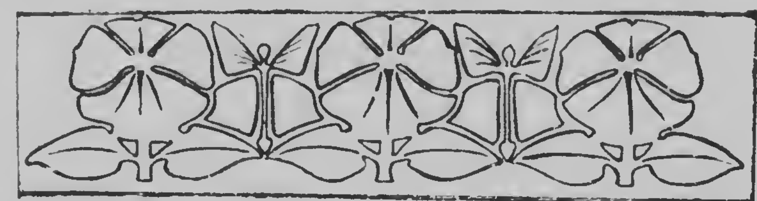
Decorate the portfolio with the decorative landscape previously drawn. Paint it in black or tones of one color. If the toweling has been used for the cover, use a little paste with the colors to prevent them from spreading.

The word *Drawings* or *Portfolio* might be added to the decoration. Great care should be used in planning the letters, drawing a line at the top and bottom, and spacing the letters equally. Use plain block letters.



DESIGN FROM PETUNIA

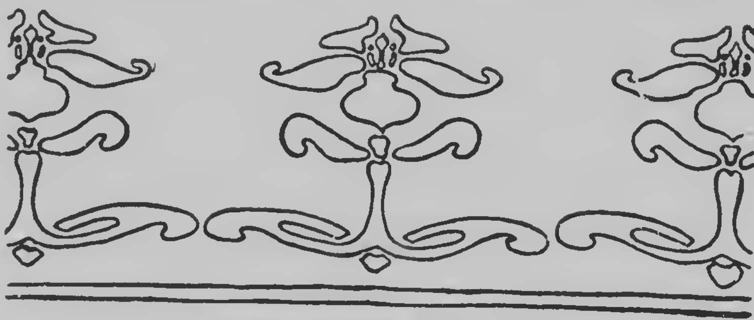
Instead of a decorative landscape, a conventionalized flower in a border might be used across the front cover of the portfolio. Choose some simple flower form, like the tulip or petunia (see the illustration), and draw the outline of form and cut a paper pattern of this unit, which may be traced around to make a design on the cover. Plan the space to be decorated. Commence in the center to place the pattern, and use as many units as the space will permit.



CONVENTIONALIZED DESIGN FROM PETUNIA

59. **Optional Problems.** The whole month of June may be used in making and decorating something useful for the

home. Pillow cov -s or curtains may be stenciled, using a conventionalized flower motif in a design. After the flower has been chosen and studied carefully, have the pupils make a careful drawing, or painting, as the flower studied may suggest. They should take one flower and make a careful drawing of the top, or front view, leaving an open center and the petals separated to suggest a stenciled design, as the



MAGNOLIA DESIGN FOR BORDER

magnolia design in the border herewith reproduced suggests. Such a border would make a very appropriate design to use as a stencil on curtains or a pillow.

Let the final work of the year be a problem which includes the application of art to something both useful and beautiful for the home. In this way fine art will become useful art, and the useful arts become fine arts.

Test. Make a design suitable for a curtain, using some flower motif. Paint the design in two colors or in ink.

Of what value is art training in the home and in the school?

PICTURE STUDY

60. Selection of Pictures. The use of pictures to illumine all the work of the schoolroom needs no discussion at this period of educational advancement to prove its value. It is often only the question of what pictures are available to illustrate the reading, geography, history, nature and art study, and where they may be obtained, that the enterprising teacher is asking.

A request for a catalogue from any of the following houses will give the teacher much valuable information: Perry Pictures Co., Tremont Temple, Boston, Mass.; The Educational Publishing Co., Toronto; George M. Hendry Co., Toronto. Pictures appropriate for use in teaching history and geography are completely listed under the heading of the names of the different countries in each of these catalogues, so that a list here is unnecessary.

Besides the pictures used merely to illustrate other subjects, there should be added the study of some of the great masterpieces in painting and sculpture, and the inexpensive reproductions of these famous works of art are the best means afforded to become acquainted with them. If one or two new pictures were presented to the children every month, they would know a representative collection at the end of the eighth year.

The following list has been chosen from the penny pictures, and grouped as in the catalogues, under the head of the different countries, so that they may be easily found by consulting the catalogues. The classification is not made according to grades, as the teacher often finds pupils in upper grammar grades who are unacquainted with the most commonly known works of art.

The teacher will choose those pictures she thinks will be most interesting to her pupils. The pictures of animals, country life and activities, figures, landscapes and historical subjects are, in the order enumerated, interesting to children. Some of the pictures will be found especially helpful to use in connection with the lessons in landscape and figure work; notable among these are the Corot pictures in the former, and Millet pictures in the latter case. Some of the pictures, especially those of Madonnas, are most appropriate for study at the Christmas season. Others will be helpful to the work in history. This is particularly true of some of the works of Italian artists.

61. Method of Study. (1) Allow the children to enjoy the pictures without much discussion on the part of the teacher, then by a few questions lead them more fully to appreciate the message the artist intended to convey.

(2) Learn something of the life of the artist and the century in which he worked.

(3) If the picture is a landscape, study it to get the character of the country, time of the year, mood of the day, or characteristics of the trees or sky or ground which the artist wished to reveal. Can you tell the time of day by the color contrasts, that is, by the effects of dark and light, or the length of the shadows?

(4) If the subject is a figure, study to see the message or story it contains. Does it tell of work or play, or is it a portrait which expresses well the individual characteristics of the sitter?

(5) Do not fail to speak of the beauty or strength of line in the figures, the placing of the figures in the landscape setting, the simplicity of environment, the naturalness of pose, and the national characteristics in dress and feature.

62. Helps. For helps along the line of picture study, try to obtain copies of the works of Estelle Hurll, who has written interestingly on many of the great artists; also Mrs. Wilson's *Picture Study.* If possible, obtain back numbers of the *Perry Magazine. How to Enjoy Pictures* by Mabel Emery, and any of Russell Sturgis' books on art topics are very valuable.

63. Lists for Reference. (a) AMERICAN ARTISTS. Whister, *Portrait of the Painter's Mother;* Hunt, *Hamlet;* Boughton, *Pilgrims Going to Church, John Alden and Priscilla;* Blashfield, *Christmas Chimes;* Abbott Thayer, *Caritas (Charity);* Sargent, *Frieze of the Prophets.*

(b) ENGLISH ARTISTS. Turner, *The Fighting Temeraire, Venice, Wreck of the Minotaur;* Millais, *The Princess in the Tower;* Burne-Jones, *The Golden Stair;* George F. Watts, *Sir Galahad;* Rossetti, *Dante's Dream, The Blessed Damosel;* Landseer, *Highland Shepherd's Chief Mourner, Dignity and Impudence, Member of the Humane Society, The Deer Pass, The Connoisseur.*

(c) FRENCH ARTISTS. Rosa Bonheur, *The Horse Fair, Coming from the Fair, Ploughing, Cattle in Brittany, Landais Peasants, Scotch Cattle;* Troyon, *Return to the Farm, Oxen Going to Work, Landscape* *with Sheep;* Millet, *The Sower, The Gleaners, The Angelus, Going to Work, Sheep Shearing, Potato Planting, Shepherdess Knitting;* Julien Dupre, *Haymakers' Rest, Pitching Hay, Before the Storm,* Corot, *Dance of the Nymphs, Lake Albano, The Lake, Landscape with Willows.*

(d) DUTCH ARTISTS. Rembrandt, *The Night Watch, The Anatomical Lesson, Rembrandt's Mother, Saskia* (his wife); Mauve, *Shepherd and His Flock, The Returning Sheep.*

(e) FLEMISH ARTISTS. Van Dyck, *Children of Charles I;* Rubens *Portrait of Himself, Descent from the Cross;* Alma-Tadema, *Reading from Homer.*

(f) GERMAN ARTISTS. Schreyer, *Arabs on the March, Arabian Outposts, A Halt in the Oasis;* Hofmann, *Christ in the Temple, Christ and the Rich Young Man, St. Cecelia;* Holbein, *Madonna of the Burgomaster Meyer, Martin Luther, Luther's Wife;* Durer, *Portrait of Himself, Adoration of the Magi.*

(g) ITALIAN ARTISTS. Michelangelo, *David, Moses, The Fates;* Raphael, *Sistine Madonna, Transfiguration;* Botticelli, *Allegory of Spring;* Leonardo da Vinci, *Mona Lisa, The Last Supper.*

(h) SPANISH ARTISTS. Velasquez, *Portrait of Himself, Portrait of Philip IV;* Murillo, *The Madonna and Child, Immaculate Conception, The Melon Eaters.*

(j) GREEK SCULPTURE. *The Parthenon; Venus de Milo; Hermes,* by Praxiteles; *The Fates* (from the Parthenon); *Victory of Samothrace; The Wrestlers.*

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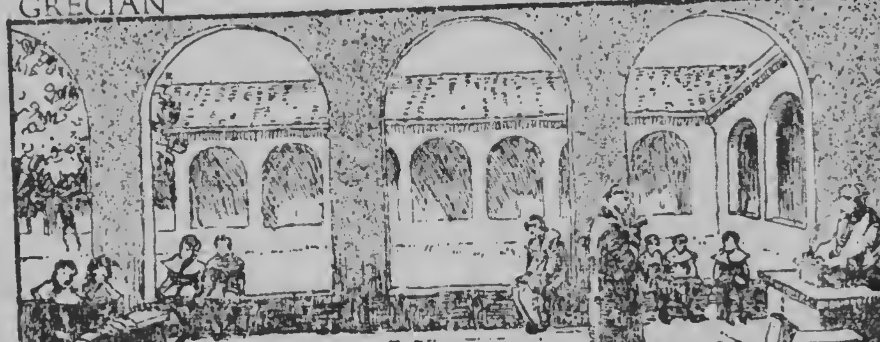
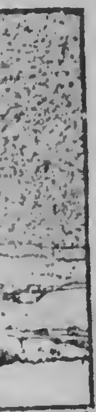


MEDIEVA



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