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PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS

BY

HOMER B. REED

THE UNIVERSITY OF PITTSBURGH



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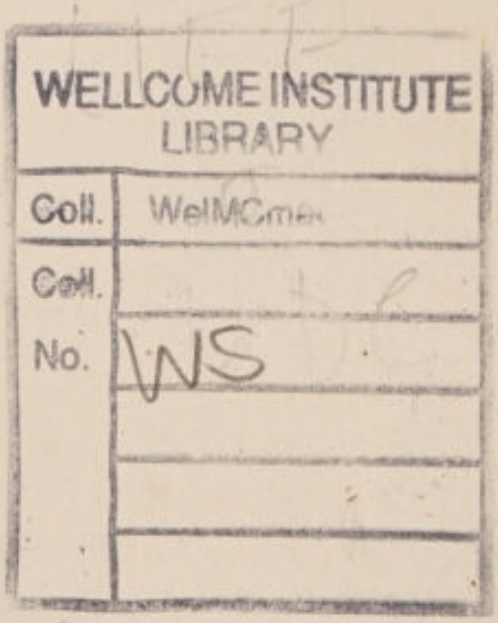
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PREFACE

During the last ten years the foundations for the teaching and learning of the elementary-school subjects have changed from experience and opinion to experiment and science. This is true particularly of the subjects of reading, arithmetic, handwriting, and spelling. It is true in part for language, but only to a small extent for the subjects of history, geography, general science, art, home economics, and manual training. It is the purpose of this book to give teachers and those interested in the scientific study of education an introduction to the scientific studies which have given us this new foundation for the psychology of the elementary-school subjects. Most of these studies have hitherto appeared only in professional journals where they are inaccessible to the majority of teachers. They also lack organization, and give the reader the impression of a vast aggregation of facts having little connection with each other. Every so often it is necessary to summarize and interpret the accumulation of scientific research, to take our bearings anew, to find out how far we have progressed, and to take a view of the new fields which lie ahead of us.

This was done in 1916 by Professor Freeman in his "Psychology of the Common Branches." Because of the small amount of scientific literature existing at that time most of his discussion was necessarily limited to general principles. It was again done in 1919 by Professor Starch in the third part of his "Educational Psychology." Since then, separate books and monographs have appeared on reading and arithmetic, but no single book has brought to the reader the results of the researches on all or most of the elementary-school

subjects. I have tried to do this for the subjects of reading, arithmetic, handwriting, spelling, language, history, and geography. I am deeply indebted to my wife, who has labored constantly with me in the production of this volume, and to my teachers in psychology: J. R. Angell, N. E. Byers, Harvey Carr, J. McK. Cattell, E. L. Thorndike, and R. S. Woodworth.

Acknowledgments are made to the Teachers College Bureau of Publications, the World Book Company, the Public School Publishing Company, The Macmillan Company, The University of Chicago, and others for the privilege of being permitted to make quotations from their tests and books. Acknowledgments are also made to Professors Frank N. Freeman, George E. Jones, F. L. Whitney, J. D. Heilman, and Grant E. Finch for reading portions of the manuscript and offering suggestions.

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PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS

CHAPTER I

INTRODUCTION: THE LAW OF REPETITION

What the Psychology of Elementary-School Subjects Is

The psychology of elementary-school subjects deals with the formation of habits that give skill in their acquirement and all the factors that influence those habits. These factors may be divided into two groups — native and acquired. The former consist of brightness, mental age, sex, age or maturity, instincts and emotions, likes and dislikes, and special capacities and defects; the latter consist of repetition, association or meaning, and devices for making an activity satisfying. There are, besides, certain environmental or hygienic factors that influence the learning process, such as kind of print, paper, and other material used; the child's habits of feeding, working, playing, and sleeping; and the condition of the light, temperature, air, and cleanliness of his places of study and living. Questions which must be considered with reference to all habits are their strength and the specific habits which should be formed. These can only be answered with reference to the demands of the society in which the pupil lives and works. The psychology of elementary-school subjects is therefore dependent on a sociological analysis of the needs of the pupil's community.

The Influence of Native Factors

The influence of native factors on performances in school subjects is a matter of interest to every teacher, for he cannot be held responsible for a pupil's work in so far as it is dependent on that pupil's heredity. The teacher is responsible only in so far as performance is dependent on training. But how much of a pupil's efficiency at any given time depends on his heredity and how much on his training is a problem very difficult to solve. We know that hereditary factors make a difference and that some make more difference than others. We know that an older pupil usually reads, writes, spells, and adds better than a younger one, that a bright child learns more easily than a dull one; that a pupil who is near his maturity in mental age can do more difficult problems than an eight-year-old who is equally bright; that intelligence makes more difference in arithmetic and reading than it does in spelling and handwriting; that intelligence makes more difference in learning school subjects than does sex; and that boys are usually superior in arithmetical reasoning and girls in arithmetical computation; but exactly how much of a pupil's skill is due to each we do not know. However, our effort to find out as nearly as we can is worth while, for hereditary factors are limiting conditions, and acquaintance with them enables us better to select the right kind of teaching and to apply it where it will do the most good.

The Acquired Factors

The acquired factors may be conveniently discussed under three laws: the law of repetition, the law of association, and the law of satisfaction. These are of foremost importance to a teacher, for on the extent to which he makes effective use of these depends the skill that he succeeds in developing in the pupil. The law of repetition refers to the fact that practice makes perfect. Other things being equal, the greater the

number of repetitions a learner gives to a subject, the greater is his skill in that subject. The law of association refers to the fact that the ease of learning is increased by making it meaningful, and the law of satisfaction refers to the fact that the ease of learning is increased if it is satisfying. Since effective teaching and learning depend upon the proper use of these laws, we shall discuss each of them in more detail.

The Law of Repetition

Repetition forms habits. How it does may be seen by doing such a simple thing as saying the alphabet backward twelve times in succession and observing the time of each repetition. One student in doing such an experiment required 60 seconds for the first trial, 35 for the second, 20 for the fourth, 18 for the eighth, and 17 for the twelfth. When the same student repeated the alphabet forward an equal number of times, she required 5 seconds for the first repetition and 4 for the twelfth. Repeating the alphabet forward required much less time than repeating it backward, because the learner in question had had many previous repetitions in doing this task, and therefore the habit was well formed. Because she had little practice in saying it backward and much in saying it forward, twelve repetitions made a large increase in her skill in the first task and little in the second. This shows us not only that repetitions form a habit very rapidly at first, but also that they add little to a learner's skill when the habit is once well formed.

Such Experiments justify Drill

In a simple experiment of this kind we see a justification for that old-fashioned teaching which required boys and girls to do a thing over and over until it was mastered. In spite of the fact that nothing is easier than to require repetition after repetition, the degree of skill obtained by this

method was only moderate. Although modern teaching is more varied and interesting, the results in the fundamentals of the elementary subjects are very little better. Very few graduates of the eighth grade can add problems of three digits wide and nine digits high with an accuracy greater than 80 per cent. A still smaller percentage can write a letter of a hundred words which is errorless in sentence structure, spelling, capitalization, and punctuation. Evidently there is need of more of the practice that makes perfect.

Repetitions should be Attentive

The kind of practice that makes perfect depends upon something else than the number of repetitions. The first of these is that repetitions must be attentive. Although most grown-ups have looked daily for over twenty years at the face of a watch dial with Roman numerals hardly any can draw such a dial correctly from memory. They will write IV instead of IIII, write VI between V and VII and leave out the second hand which takes its place, write the I's on the wrong side of the V in VII and VIII, write the V's upside down or maybe at right angles to the correct position. The reason for such errors is that people never examine the make-up of the face of a watch attentively, and consequently never learn it. Other instances of the effect of inattentive repetitions may be found by asking a pupil how many steps there are leading to his front porch or the upstairs of his house, the color of the houses which he passes by daily on his street, or the designs on the wall paper of the various rooms of his house. In very few cases will he be able to give accurate information on such matters.

Repetitions should be Intense

A second factor is that repetitions are more effective when they are intense or vigorous. This was shown in memory experiments made by Witasek and by Gates. Witasek inves-

tigated the retentive value of intensity by varying the proportion of passive and active reading in memorizing rows of nonsense syllables. The difference between the passive and the active reading was that in the former the subject read the rows, whereas in the latter he recited them from memory as much as possible and was prompted after he halted as long as ten seconds. A row was given a certain number of repetitions varying from 0 to 15. The effect on retention was measured by the time required to memorize a row by the recitation method one hour after the first series of readings. When a row was given eleven passive readings, the learning time was two hundred and thirty-six seconds, but when it was given six passive and five active readings, the learning time was only one hundred and forty-three seconds. When a row was given twenty-one passive readings, the learning time was two hundred and two seconds, but when it was given six passive and fifteen active readings, the learning time was only one hundred and thirty-three seconds. Although there were some exceptions, the results showed that the degree of retention was closely in proportion to the number of active readings. The same fact was shown in the experiment of Gates, which was better controlled, and in which both meaningless and meaningful materials were used. The former consisted of rows of sixteen nonsense syllables, and the latter of short biographies of one hundred and seventy words each. The effect of the intensity of the repetitions was investigated by varying the proportions of time devoted to reading and recitation, and its retentive value was measured by calculating the percentage remembered after four hours. When all the time was devoted to reading, 15 per cent of the nonsense syllables and 16 per cent of the meaningful material was remembered after four hours; when four fifths of the time was devoted to recitation, 48 per cent of the nonsense and 26 per cent of the meaningful material was remembered. The results for two fifths and three fifths of the time

devoted to recitation were consistent with these; that is, the amount remembered was proportional to the amount of time devoted to recitation. This is true for both meaningless and meaningful materials; but recitations count more for the first than for the second, no doubt because the effect of the intensity is modified by the effect of association in case of the meaningful material. Reciting is a better method of memorizing, because it is more intense and vigorous. This is true not only of the entire repetition but also of the halting, or difficult, points, which are given particular emphasis.

Repetitions should be Distributed

A third factor is that repetitions are more effective when distributed. The author found that an hour's addition yielded a gain of 37 per cent in speed when distributed in the form of one sitting a day for three days as against a gain of 12 per cent when the hour's practice was all done in one sitting. Similarly, Pyle found that forty-five hours of practice in typewriting yielded a speed of seven hundred words in the last half hour when the practice was distributed over two sittings a day for forty-five days; but when the practice was distributed over ten sittings a day for nine days, the speed in the last half hour was only five hundred and fifty words. Starch found that in substituting numbers for letters, one hundred and twenty minutes of practice yielded a speed of two hundred and sixty substitutions in the last five minutes when the practice was distributed over two sittings a day for six days, a speed of two hundred and fifty when it was distributed over one sitting a day for six days, a speed of one hundred and eighty when it was distributed over one sitting a day for three days, and a speed of one hundred and fifty when it was all in one sitting. Lyon found that it required one hundred and thirty-eight minutes to learn a row of seventy-two nonsense syllables when he did all the work at one sitting, but a row of equal length required only twenty-five minutes

when he read it once a day until learned. Such results justify the rule that the more distributed the repetitions, the more effective they are; but there are some exceptions due to the nature of the subject matter, the amount of the distribution, and the amount of the practice at one sitting. The reasons for the favorable effects of distribution are that it produces less fatigue, gives more first impressions, and gives the learner the benefit of increased strength in the neurones which have had their nutrition stimulated by exercise. Since subject matter and susceptibility to fatigue condition the nature of the distribution, it must be worked out for each school subject and for each grade.

Repetitions should be distributed according to the Difficulty of the Bond

Another problem in distribution is to give each habit an amount of practice in proportion to its difficulty. The investigations of Thorndike and Osburn in arithmetic have shown that the easy combinations such as $2 + 2$ and $5 + 5$ occur with a far greater frequency in textbooks than the difficult combinations such as $8 + 9$. Similarly, the investigations of textbooks in reading by Housh, Packer, and Gregory have shown that little and easy words occur many hundreds of times, while nearly half the words used occur but once or twice. The result of such conditions is that the performances are quick and accurate for the easy tasks, but halting and inaccurate for the difficult ones. If the frequencies for the different tasks could be made more even, a much higher efficiency could be obtained without any extra effort.

Repetitions should be motivated by a Record of Progress

A factor in making repetitions more effective is to motivate them by a record of progress. We shall see in later pages that enormous gains in speed in arithmetic and in reading were made by pupils after they once began systematic practice and

kept a careful record of the practice from day to day. Some of the experiments show more gain in half a year than is ordinarily made in a year and a half, and some show far greater gain in two months than is ordinarily made in two years. Thanks to the use of standardized tests a reliable record of progress can now be kept for all the elementary-school subjects, but few teachers have as yet formed the habit of keeping records of progress or seem to realize what a boon they are to increased effort and efficiency.

Repetitions should be motivated by Knowledge of the Results and of the End Sought

A sixth factor in making repetitions effective is to motivate them by knowledge of the results and of the end sought. A runner can usually make a better record running against competition than against time, although in both cases he does his best. But apparently the sight of a rival getting the lead releases energy which otherwise remains untapped. Similarly, Arps found that a young man in pulling a weight over a pulley with his finger until it stopped from fatigue was able to make more and better pulls when he saw the results of his efforts than when he was unable to do so. His subject did 18 per cent more work on the days with knowledge of the results than on the days without knowledge of the results. In another experiment Peterson found that a class which was asked to copy a list of words from the blackboard and was told that these words would be called for later remembered 50 per cent more of them than another class which was asked to copy the same list but was not told that they would be called for later. Experiments of this sort give justification for checking exercises and for putting the answers in arithmetics; for corrections of errors in all school subjects; for comparisons with standards in quality subjects such as English, handwriting, and drawing; and for assignments with accompanying information about their purpose.

Repetitions should be applied at the Point of Error

A seventh factor in making repetitions effective is to apply them at the point of error and to stop them when the error is corrected. When we come to think about it, the real business of teaching is to improve the child at his point of error. If we accept this, then the most economical procedure in teaching as well as the most scientific is to give the child a thorough examination and diagnosis in each school subject, discover his points of error, and then apply remedies that are adapted to the correction of these errors. In this respect the teacher's work may be compared to that of a dentist, who first finds the cavities and then sets to work to repair them. He does not grind cavities into sound teeth or apply his silver or gold indiscriminately and give them a general plating. If he did, many of the cavities would not be properly treated and would give trouble later. Effective teaching must adopt similar methods. Children in the upper grades and also adults make more errors with the large combinations than with the smaller ones, and more mistakes with numbers whose sum is more than twenty than with numbers whose sum is less. This is due only in part to the greater difficulty of these combinations, the principal cause being insufficient drill. In spite of the fact that language has been taught in the grades for many generations of school children, such expressions as "you was," "them folks," "it's me," "that's us," and "they ain't" are still found more frequently on the street than are the correct forms. This is not because the rules of grammar covering these cases have not been taught, but because drill in the use of English has not been applied at the right point. The same explanation accounts for many of the common errors made in spelling. Children may become efficient in spelling the words in the textbook; but an investigation that was made of popular spellers published before 1921 showed that over 50 per cent of the words appearing in them

were not in common use, and that a large percentage of the latter did not appear in the books. Inaccuracies in a particular subject are often due not to the fact that insufficient time has been spent on them but that the pupils are required to spend too much time in giving useless repetitions to things they know perfectly well or in giving many repetitions to things which they will never use. Among the most important scientific studies in education that have been made in recent years are analyses of errors in the common branches. Their great value is that they make it possible for teachers to apply repetitions at the right point.

Repetitions should be applied to Useful Reactions

An eighth factor that influences the effectiveness of repetitions and that is closely related to the point of error is the extent to which they are applied to useful reactions. Children are required to learn so many things, useless as well as useful, that neither can be done well. Parents of school children see this in the home work in which they are called upon to assist, and educators see it in textbooks. While writing this chapter the writer has observed a parent assisting his children in such tasks as diagramming, making booklets on France and Poland, writing the names of the states and their capitals forty times, writing the combination 11×12 one hundred times, finding five synonyms and five antonyms for one word a day used in the spelling lesson, and dividing this word correctly into its syllables with the accents and diacritical marks properly indicated. In diagramming, most of the time was spent in difficulties in line arrangement, such as what should go on the main line, whether a T-shaped mark or a diagonal line leaning backward should be put after the verb, what form of arrangement should be used to indicate the adjective modifiers of the subject connected by a conjunction, etc. The booklet on Poland was to have

an account of its history, form of government, industries, cities, boundaries, agriculture, and so on; and all this information was to be obtained by the indefinite method of self-help. The words in spelling for which five synonyms and antonyms had to be found to date were *covetous, credible, custody, satiate, dispatch, affidavit, coercion, expletive, extravagant, florid, fungus, virulent, antiseptic, ingenious, emaciate, magnetism, incorrigible, pastoral, enigma,* and *ponderous.* The parent in question will be thankful when his children finish the grades and will be surprised if they know anything useful.

With conditions of this sort prevailing both in teaching and in textbooks the matter of applying repetitions to useful reactions comes near being the most important problem in education. In a book dealing with the formation of habits that give skill in the common branches, considerable space must therefore be devoted to the questions What habits shall be formed? and How shall we find the useful habits?

Summary

The psychology of elementary-school subjects is a science which deals with habits that give skill in their acquirement and with all the factors that influence these habits. These factors may be divided into native and acquired. The former consist of brightness, mental age, sex, maturity, instincts and emotions, likes and dislikes, special capacities and defects, and the like; the latter consist of repetition or exercise, association or meaning, and devices for making an activity satisfying. The law of repetition refers to the fact that practice makes perfect. Other things being equal, the greater the number of repetitions the more perfect the habit. One must not suppose, however, that all he needs to do to form perfect habits is to multiply repetitions. To use them efficiently he must apply them with attention and vigor, distribute them

over a number of periods, increase their number in proportion to the difficulty of the bond to be formed, motivate them by a record of the improvement effected and by knowledge of their results and of the end sought, exercise them at the point of error, and apply them to useful reactions. Considerations of this kind should make it clear that drill is not necessarily good just because it is drill, but because it is the right sort and is used in the right way.

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CHAPTER II

INTRODUCTION: THE LAW OF ASSOCIATION

What the Law is; its Advantages

The law of association refers to the fact that making material meaningful increases the ease of learning. Usually any learned connection between stimulus and response is called an association, but in this book we shall use the term in a more restricted sense. It refers to the connection between stimulus and response that has been formed by means of some intermediate term or terms; but when the connection is made mechanically or by rote without any intermediate term, we shall speak of it as learned by repetition. In learning the pair of words *elephant, steeple,* a young woman formed the association "an elephant's trunk is like a steeple." When later the stimulus word *elephant* was given, she immediately thought of her previous association and responded with the word *steeple.* The formation of that association enabled her to learn the pair quickly and retain it well. If she had learned the pair without any intermediate association or the observation of any relationship, we would speak of it as learned by repetition. The law of association may be stated in various ways: that the ease of learning is increased by making the material meaningful; or that the ease of learning is increased by the observation of relationships in the material to be learned; or that a response to a situation is strengthened by increasing the number of connections between them; or that the ease of learning something is increased by relating it to the child's experiences and activities; or that the new is learned by means of the old. Each of these expresses in its own way

the essential point of the law — learning through intermediate connections. In terms of nervous action we think of an intermediate association as an indirect path or bypath between stimulus and response, which reduces the resistance in the establishment of a direct connection or path. This law must be put on an equality with the law of repetition in the learning of school subjects. Its advantages are that it greatly increases the quantity of material which can be grasped in one span of attention or act of thought, that it greatly reduces the number of repetitions or the amount of time required to learn, that it makes a thing easy to remember, that it makes possible the transfer of skill from one subject or activity to another, and that, in brief, it contains the secret of economical learning.

Association increases the Quantity of Material that can be grasped in One Act of Attention

That the perception of meaning greatly increases the quantity of material which can be learned in one span of attention may be easily seen in memory-span tests with nonsense and meaningful material. In one such experiment the writer read series of disconnected words varying in length from 4 to 18 words and series of sentences varying in length from 8 to 34 words. Each series was read but once, and the students were requested to write down all that they could remember. The average reproduction for disconnected words was 6.55 words; for sentences it was 18.36 words. The presence of meaning in the sentences increased the students' learning capacity by approximately 300 per cent. This is because the associations suggested by the sentences made the combination of separate words into a single unit of thought. Whenever combination is possible — that is, handling elements in bundles instead of as individuals — there will be economy in proportion to the size of the unit into which the elements are combined.

Association reduces the Time or the Number of Repetitions required to Learn and favors Retention

How the perception of meaning reduces the time or the number of repetitions required to learn may be seen from experiments in which students are required to learn equal quantities of nonsense and meaningful material of difficult and easy prose. The average time required by a class of college students to learn a row of thirty digits was 5.52 minutes; for an equal number of words of poetry constituting a stanza, the average time was 1.72 minutes. Another class required an average time of 261 seconds to memorize nine lines of Hume's philosophical prose, whereas the same class required only 111 seconds to memorize nine lines of easy prose entitled "The Marble Statue," which might be called a love story. In another experiment the complete story of the "Marble Statue" was read to a group of four students, after which they were asked to write down all that they could remember. The same procedure was followed in a selection of equal length from Hume's philosophical prose. For purposes of scoring, each selection was divided arbitrarily into sixty-seven ideas. Each of these reproduced counted one in the student's score. The average number of ideas remembered for the "Marble Statue" was 49 as against 11.5 for the philosophical prose. A week later a second and previously unannounced reproduction was called for which showed an average retention of 56 ideas for the "Marble Statue" as against 3.75 for the philosophical prose. Apparently the retention for the love story had improved during the interval, whereas that for the philosophical prose had decreased two thirds. Although the immediate reproduction for the love story was only four times greater than that for the philosophical prose, the delayed reproduction was fifteen times greater. If learning ability is measured by the time required to memorize, we see in these experiments that it is from two

to four times as great for meaningful material as for meaningless, but in some experiments this ratio is as high as nine or ten. If the ability to learn is measured by the number of ideas acquired during the same time, we see that it may be four times as great for easy prose as for prose that is difficult. We also see that the perception of meaning is more favorable to retention. The perception of meaning ties or knits a new idea to the learner's background of experience and habits; but if the new idea lacks meaning, it is merely, so to speak, pressed against this background of experience without any binding. A better way to express this is to say that a meaningful idea is well remembered because it has numerous bonds with the learner's previously acquired responses; but if it is meaningless, it is an isolated bond without such connections.

The Same Facts shown more Accurately in Experiments with Word-Pairs

In the experiments given above we have been comparing the ability to learn and retain meaningful and meaningless materials, and we have seen that the former are learned and retained with much greater ease. The question may be raised, however, whether it is the perception of meaning or of relationships that is responsible for these advantages. To make certain of this it is worth while to compare materials that are easily learned and remembered with materials of the same kind that are not easily learned and remembered, and inquire whether the learner perceived any relationships in the first case and failed to do so in the second. The writer conducted an experiment in which such comparisons and inquiries were made. He selected four series of ten pairs each of disconnected word-pairs. Two series consisted of English words, one of nonsense syllables, and one of German-English vocabularies. The procedure was for the experimenter to read a series once and then pronounce the first word of each pair and have the subject give the second. If he failed, the

experimenter prompted him and went on to the next pair, but returned to the unremembered word again and again until each stimulus word in the series was responded to correctly. After each correct response the experimenter asked the subject: "What did you think of just before you responded? Was there any association between those two words?" The experimenter recorded the subject's report as well as the reaction time, and the number of promptings for each word. Except for the reading this procedure was repeated daily for six days. On the second day the experimenter noticed that some of the stimulus words were correctly responded to without any prompting, whereas others required one or more promptings. To find the cause of this difference in retention he calculated the learning time of these two groups of pairs on the first and second days and also the percentage of each that was learned by means of some association. He found that the stimulus words correctly responded to without prompting on the second day had an average response, or learning, time on the first day of 7.63 seconds. The pairs requiring promptings on the second day had an average response time of 8.37 seconds, whereas for the first day it was 12.41 seconds.

Of the pairs without promptings on the second day 79 per cent were learned by means of some association on the first day, and for 67 per cent of them the associations were recalled on the second day. Of the pairs requiring prompting on the second day, only 33 per cent had associations on the first day, and for only 5 per cent of these were the associations recalled on the second day. Since the pairs that were remembered on the second day had such a high percentage of associations on both the first and the second day, and since those that were not remembered had less than half as many on the first day and only one thirteenth as many on the second day, it is quite clear that the easy learning and accurate retention of the remembered pairs was due to the perception of relationships

between stimulus and response, and that the difficult learning and poor retention of the forgotten pairs was due to the lack of such perceptions. The truth of this statement was confirmed in another and similar experiment with a series of twenty-five German-English vocabularies that was learned by each of fifty-one college students. In this experiment the pairs were learned on one day and relearned after seven days. The experimenter calculated the average number of promptings required to learn the pairs that had associations and those that had none; also the average number of promptings required to relearn them. The average number of promptings required to learn the associated pairs was 1.56, and to relearn them after seven days, .21. The corresponding results for the nonassociated pairs were 3.22 and 1.04. The pairs having associations required less than half as many promptings to learn and only one fifth as many to relearn. Both experiments, therefore, establish the fact that it is the perception of relationships which makes material easy to learn and easy to remember.

Associations may be the Means of Transferring Skill from One Activity to Another

How skill is transferred from one subject or activity to another through common associations or through the perception of relationships between them may be seen from the fact that learning a series in one order helps to relearn it in another order. This was shown in the experiment with disconnected words referred to above. On the sixth day, in addition to the regular test, the subject was asked to learn the first word of each pair in a new order. In some of them a so-called "down" test was given and in some a so-called "up" test. In the "down" test the experimenter said to the subjects, "After I say a word, you name the first word of the pair just below it"; in the "up" test he said, "After I say a word, you say the first word of the pair just above it." From

one fourth to one third of the words were responded to successfully in this test. On the average, it was found, 87 per cent of the successes were due to the use of some association formed in the learning. These were for the most part associations either of position, for example "Elephant is the third word in the series," or of order, for example "I thought of *anregen — stimulate* and that *persevere* comes before *stimulate* and goes with *beharren*." Where such associations were lacking the subject failed, and the correction of these failures required so much time that in two of the series the average learning time for the pairs in the "down" and "up" tests was longer than for the first order. This experiment suggests the clue to the psychological process by which transfer of training occurs from one subject or activity to another. It occurs when an old bond can be used in the new situation. However, the specific use to be made of it requires an invention. In using a Bunsen burner a boy may learn that the combustion is increased by supplying more oxygen and decreased by supplying less, and that this is done by opening or closing the holes. To the situation "need of more fire" he forms the response "supply more air." This principle may suggest putting the camp fire over a grate if the fire does not burn well on the ground, opening the draft or closing the check when more heat is needed from the furnace, and taking deep inhalations when the dying fire in the smoker's pipe needs to be revived. In each case the device used is an invention if the situation is new, but one which was made possible by the perception of a relationship between it and the response "supply more air."

The Relation of the Law of Association to Economical Learning

These experiments suffice to show us that the perception of relationships makes possible quick learning, good retention, and spread of improvement. Learning may be economical

because of any one of these effects or because of all of them together. At best any individual can give his time only to a few subjects or activities and must depend upon transfer effects to help him to meet situations for which he has had no specific training. It is to his interest to become familiar with devices that increase the economy of training; and the secret of these is found in the perception of relationships, or the development of meaning, in the activities or material selected for mastery. It is important, therefore, to discuss some devices which are helpful in developing meaning.

Grade the Material

First of all, the material must be graded in difficulty with respect to the mental age and experiences of the learner. It should relate to objects of which the learner has some understanding, and it should use the language of the learner. Textbooks in reading more nearly satisfy these requirements than those in any other school subject — for example, arithmetic, history, spelling, or geography. Arithmetics are apt to contain problems of interest to adults only. In fact, many problems do not concern even the adult; they are given for mental exercise. Some spellers are still full of long and hard words seldom used except by technical writers. Histories relate to human experience, but often speak of *constitution, power of veto, nullification, extradition, excise,* and *embargoes* as if they were words occurring in the everyday language of the child. Many grammars deal with the abstract, with definitions and rules, and presume powers of generalization and analysis, in a way that is far beyond the mental level of most children in the upper grades. Geographies are inclined to presume that one sentence is sufficient to describe a city in South America or the vegetation of the entire continent of Australia. Successful textbooks should treat of conditions and facts within the grasp of the child's experiences and should enable him to reconstruct the objects described.

Create a Favorable Mental Set

Secondly, meaning may be increased by creating a favorable mental set toward the task or assignment. For example, comprehension in reading depends upon the excitation of the proper associations for each word. What these are depends upon the context or relation of one word to each other word in a sentence. Each word, however, has a number of associations; and, unless the proper mental set is in control, will arouse free associations or revery and suggest a content which is meaningless and unrelated to the material. If the proper mental set is in control, the free associations are inhibited, and only such as relate to the goal at hand are suggested and consequently give the correct meaning. The proper mental set may be created by telling the learner in advance what he is to look for, by giving advance questions, or by making clear the goal that is to be achieved by the task.

Connect Ideas with their Appropriate Objects and Actions

Thirdly, meaning is increased by connecting ideas with their appropriate objects or actions. Fundamental operations with integers and fractions are made clear by working them out with objects and measurements. Similarly, the meaning of such business terms as *stocks, shares, bonds, dividends, margins, overhead, assessment, common stock, preferred stock, watered stock,* and *mortgage* are made clear by the organization and operation of a stock company. In teaching beginning reading, dramatization has become a familiar device; but it should be extended into history to make clear such terms as *constitutional convention, nominating convention, Australian ballot system, majority rule,* and the like, and into geography to make clear the manners, customs, vocational activities, and commerce of foreign people. This will bring to light the details necessary to make the objects in question living realities.

Coördinate Ideas with Useful Activities

Fourthly, meaning is increased by coördinating an idea or process with others or with useful activities. Cancellation and reduction to a common multiple may be taught as separate subjects; but they are made more meaningful if the former is taught as a quick method of multiplying fractions, and the latter as a convenient device for adding or subtracting fractions. In the same way the fundamental operations may be taught as separate subjects, but the idea that each of them is an abstract process and unrelated to life is avoided if the fundamentals are taught in connection with operations in denominate numbers. Physiology and hygiene also become meaningless unless they are taught in connection with the development of habits of brushing the teeth daily, taking regular baths, eating the right food, and drinking proper quantities of milk. The same is true of such subjects as language if it is not related to the correction of the common errors in speech, or civics if it is not related to participation in the political and social life of the community.

Make Explanations and Descriptions Concrete and Full

Fifthly, meaning is increased if the explanation and description of processes and objects are made concrete and full. Pictures, models, maps, manuscripts, monuments, collections of products, and field trips help to make reading, history, and geography concrete, but full explanations are helpful in all school subjects. In arithmetic texts explanations of a new operation are often so brief that a beginner cannot follow them. The illustrative examples used are often not typical, and not all the steps are included. The pupil is therefore forced to rely on his teacher, and cannot understand his text until he has mastered the process. But in the so-called content subjects, such as history, geography, civics, and elementary science, the lack of full descriptions and explanations

is their most serious defect. Of the hundreds of topics discussed many lack the fullness to make them comprehensible. When a traveler visits a new city such as London or Chicago, he can profitably spend two hours a day for two or three weeks in viewing and studying it. Later he may write from twenty to forty pages about it and convey some of his main impressions to a reader who has not seen these cities. Even a description of this length does not begin to contain the richness and fullness of the original experience, but it may be sufficient to give a reader a fair idea of the city. If the description should be reduced to forty lines, the reader could get very little except the area, the location, the population, and some of the industries; but if the description were reduced to two lines, he would get little more than the names, which would be insignificant. Descriptions are not meaningful unless they enable the reader to reconstruct the object described. To make that possible an adequate story is necessary.

Use the Project Method of Teaching

Sixthly, meaning is increased by the project method of teaching. This method is meaningful because it combines many of the devices mentioned above. There is a clear statement of the problem and of the goal to be accomplished. This makes a favorable mental set. In addition to a number of processes coördinated in relation to the desired goal, new ideas are connected with objects and useful activities, and, best of all, the child often gets a first-hand experience of an object or process, which is the best way to make a new idea concrete and meaningful.

The Law of Satisfaction: its Interpretation and the Evidence in its Favor

The law of satisfaction, often called the law of effect, may be stated in several ways: "the ease of learning is increased if either the result or the action used in reaching it is satisfy-

ing, but is decreased if either the result or the action used in reaching it is annoying"; or "a response is strengthened if its result is satisfying, weakened if its result is annoying." Both animals and human beings eliminate reactions which are useless or painful, but they form into habits those reactions which lead to useful or satisfying results or conditions. When animals are required to run a maze, dig a passageway, pull a string, lift a latch, or turn a button to secure food, in the course of a period of practice they eliminate useless movements into blind alleys and make only those which lead to food. So human beings, in tracing a pencil maze or in learning an act of skill such as typewriting, start out by making many errors, but in the course of practice they rapidly eliminate them. The elimination of the wrong movements can in many cases be explained by the greater frequency of the correct movements, but it often happens that errors are avoided which have had the benefit of many repetitions and are replaced by correct movements which have had little or no opportunity to gain strength from repetitions. The law of satisfaction is helpful in explaining cases of this kind, but apart from this it has little clear-cut experimental evidence in its favor. Its chief attractiveness is theoretical rather than experimental; nevertheless, if present pedagogical practice may be said to prove anything it justifies such methods of teaching as emphasize interest and pleasantness. The success of these methods points to the truth of the law of satisfaction, but there are some difficulties in the way of its acceptance. As an example let us take the experiment of Thorndike in which cats secured release from a cage by pulling a string that opened a door. How can the act of going through a door have any effect on the act of pulling the string which had already been completed? We may suppose that the act of going through the door is accompanied by a very vigorous discharge of nervous energy because it accomplishes the end result and also puts a stop to the sensory conditions

which initiated the preparatory reactions leading to it, and that the reaction of pulling the string is retained because it becomes a stimulus to the end reaction. In spite of the haziness of such an explanation we may assume that the law of satisfaction is a good law of learning, and that it is worth while to make learning activities as well as end results satisfying and to discover as many devices as possible of making the law effective. Among these we may mention, first, that any device which makes learning meaningful also makes it satisfying, so that the devices given under the law of association may also be said to be justifiable under the law of satisfaction. Besides these, we may assume that learning is made satisfying (1) if it leads to mastery — that is, if it accomplishes what the learner sets out to accomplish, or at least accomplishes an improvement in this direction; (2) if it appeals to some native impulse such as action, self-assertion, curiosity or exploration, play, social approval, or avoidance of punishment; (3) if it appeals to some acquired interest. For example, if a boy has an acquired interest for baseball, he will be interested in learning how the relative standings of the different teams and the batting averages of the different players are computed. Valuable information for the first condition may be obtained by analyzing the objectives to be attained in each subject, and for the second, by finding out the native impulses to which each subject may be most easily attached. The principal source of information for the third is the learner himself, and the best method of obtaining it is through intimate acquaintance.

Plan of the Book

In the following pages we intend to examine how skill in each of the elementary-school subjects discussed is dependent on the hereditary and acquired factors named above: intelligence, age, grade, sex, instincts, individual differences, repetition, association, and satisfaction. We shall also consider

what are the most important habits to be formed in each subject and the bases for selecting them. We shall for the most part follow scientific investigations, but where these are lacking we shall follow the best-established theories.

Summary

The law of association refers to the fact that the ease of learning is increased by the observation of meaning or of relationships in the material to be learned. Its advantages are that it greatly increases the quantity of material that can be grasped in one act of attention or thought, that it reduces the time or the number of repetitions that learning requires, and that it makes a thing easy to remember. These facts are shown by experiments in which the memory span is tested for meaningless and meaningful materials, by measures of the time or the number of repetitions required to learn equal quantities of easy and difficult prose or of numbers and poetry, and by measures of the amount of each recalled after a given interval. They are proved more exactly by calculating the times or the number of promptings required to learn and relearn vocabularies, some of which were learned with associations, some without. Learning materials by observation of associations may also be helpful in transferring skill from one activity to another. This is particularly true when a group of facts is mastered through the comprehension of a general principle which has wide applications through inventions from generalization. Because of these results the law of association contains the secret of economical learning.

The law of association may be applied to the learning of school subjects by properly grading the material, by creating a favorable mental set toward it, by connecting ideas with their appropriate objects and actions, by making explanations full and concrete, and by using the project method of teaching.

According to the law of satisfaction the ease of learning is increased if either an activity or its result is satisfying. Although the experimental evidence for this law is a bit dubious, nevertheless the law is handy for explaining the elimination of useless or wrong movements which have had the benefit of much exercise. It also seems to be justified by experience. Its application to learning requires that practice should lead to the goal sought and that it should appeal to some native want or acquired interest.

The aim of this book is to show how the learning and teaching of the elementary-school subjects are influenced by native factors and by the application of the laws of repetition, association, and satisfaction.

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These papers report experiments which show the economy of forming associations in learning, in retention, and in the transfer of training.

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CHAPTER III

READING: OBJECTIVES AND EYE MOVEMENTS

Aims

The major aims of reading are two: to get information and enjoyment from the printed page. There are many kinds of information and enjoyment, and each may be sought for many purposes. One may read to get information on any one of a number of topics, and his purpose may be to gain some advantages for himself, to satisfy curiosity, to convey information to others, to verify his own opinion, or to find arguments by which he may convince others. So one may seek enjoyment in any one of many types of reading, such as puns, fiction, poetry, classified advertisements, or sensational news, and his purpose may be to spend moments of leisure pleasantly or to entertain others. Sometimes one may seek a type of reading which gives both information and enjoyment. But whatever the material sought or the purpose for which it may be used, the ability to read implies mastery of a certain amount of comprehension and speed. The amount of enjoyment or information obtained from the printed page depends upon these two factors.

Reading, a Complex of Many Habits

The ability to get information and enjoyment from the printed page implies the mastery of many habits, such as learning the meanings of thousands of words; forming automatic associations between the sound and sight of each; learning the principles of phonics and voice control; using a

table of contents, an index, and a dictionary; interpreting pictures, graphs, and cartoons; opening, closing, and caring for books; mastering specific devices in finding facts, opinions, and principles; and becoming familiar with many types of reading or literature. Each of these skills is the name of a group of habits rather than of one habit alone. If we could count all the single elementary habits that must be formed in reading, their number would reach into the hundreds, but even without such a count we know that the teacher of reading has a big job. At some time or other she must give specific attention to each elementary habit, but all the while she must relate each to the gaining of speed and comprehension. That her efforts may be well directed it is necessary to understand all the factors that influence these. To explain such factors will be the burden of these chapters on reading. In the remainder of this chapter we shall study eye movements and pauses.

Eye Movements and Pauses

Careful experiments show that the speed of reading is directly dependent on the number and duration of the eye pauses and also on the character of the movements. To understand this it is necessary to describe the character of eye movements and pauses in reading. The eye moves across the page in a series of jumps with intervening pauses. When the end of the line is reached, a long, backward sweep is made to the beginning of the next line. If the eyes fail to pause at the proper spot, they make scouting movements or a further backward movement in order to see the right word. Sometimes when a word is missed a backward movement is made in the middle of the line in order to correct the reading. Such backward movements are called regressive movements. These movements may be seen either by direct observation of another's eyes in reading or indirectly by a mirror placed on the right-hand page when the reader is reading the left-hand

page. The pauses condition the rate of reading because the eye sees only when at rest. Therefore the time required to read a line depends on the number and duration of these pauses. The movements condition speed principally in causing the eye pauses to fall at the right points. If they fail in this, time is lost in finding them. The eyes cannot see while in motion, because an impression does not rest on the retina a long enough time. For an object to be seen, its light must rest on the retina about 0.006 second, but according to careful calculations a black mark on a printed page rests upon the retina only about 0.0003 second. If the eyes cannot see while in motion, it would follow that objects above a certain speed are invisible. One may easily convince himself of the truth of this by trying to see passengers through the windows of a rapidly moving express train. All that is visible is a streak of light.

The Development of Eye Movements in Relation to Grade and Other Factors

The number and duration of eye pauses and the character of the movements are conditioned by such factors as the age or grade of the reader, the mode of reading, the quality of the material, and the purpose of reading. The relation of eye movements to grade and mode of reading was investigated by Buswell, who photographed the eye movements of one hundred and eighty-six readers selected from all grades (except the eighth) from Grade I to the senior year of college. In selecting the readers care was taken to choose those who represented the average ability of each grade. From the photographic records were calculated the number of pauses per line. The results are given in Table I. Fig. 1 shows the curves of the same facts. Figs. 2 and 3 show the location, the number, and the duration of the eye pauses of two subjects, a second grade pupil and a college senior, in reading a certain passage of prose.

TABLE I. GRADE MEDIANS FOR EYE MOVEMENTS IN SILENT AND ORAL READING. (After Buswell)

	IA	IB	II	III	IV	V
Average number of pauses per line						
Silent	18.6	15.5	10.7	8.9	7.3	6.9
Oral	16.0	14.5	12.0	10.4	10.3	8.7
Average duration of pauses in seconds						
Silent	0.660	0.432	0.364	0.316	0.268	0.252
Oral	0.768	0.512	0.392	0.404	0.308	0.288
Average number of regressive movements						
Silent	5.1	4.0	2.3	1.8	1.4	1.3
Oral	4.4	3.1	2.5	1.8	2.0	1.4

	VI	VII	IX	X	XI	XII	COLLEGE
Average number of pauses per line							
Silent	7.3	6.8	7.2	5.8	5.5	6.4	5.9
Oral	8.9	8.7	9.1	8.3	8.0	9.3	8.4
Average duration of pauses in seconds							
Silent	0.236	0.240	0.244	0.248	0.224	0.248	0.252
Oral	0.292	0.280	0.268	0.264	0.280	0.260	0.300
Average number of regressive movements							
Silent	1.6	1.5	1.0	0.7	0.7	0.7	0.5
Oral	1.4	2.0	1.5	1.5	1.1	1.4	1.2

We see a decrease in the number of pauses per line for silent reading from 18.6 in Grade IA to 5.9 in college, and for oral reading from 16.0 to 8.4; a decrease in the duration of the pauses during the same period from 0.660 second to 0.252 second for silent reading and from 0.768 to 0.300 for oral reading; and a decrease in the number of regressive movements during the same period from 5.1 to 0.5 for silent reading and from 4.4 to 1.2 for oral reading. The curves show that nearly all these decreases are made during the first three

grades, that from the fourth grade on they are small, and that during Grade I much greater decreases are made than during any other one year. When we come to study the speed of reading in relation to grade (Fig. 6), we shall see that the increase from Grade II to Grade VIII is very rapid, but also that the increase is very gradual from grade to grade, although some curves show more increase from Grade II to Grade V than thereafter. The curves for the development of eye movements and for the speed of reading are far from being parallel, but the parallelism is close enough to make evident a close dependence between them. The lack of perfect parallelism points with equal clearness to the fact that there are other important factors conditioning the speed

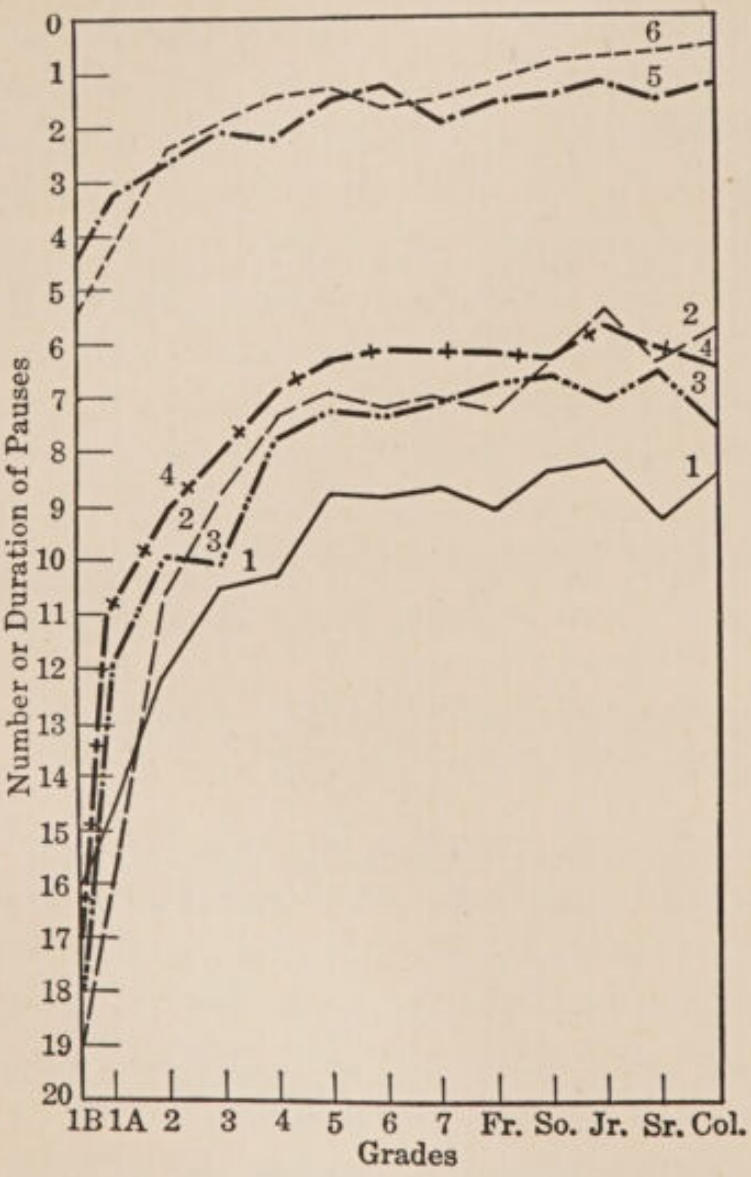


FIG. 1. Curves showing the Number and Duration of Eye Pauses (lower curves) and the Number of Regressive Movements (upper curves) per Line in Relation to Grade

1, duration of pauses, $\frac{1}{25}$ second, oral reading; 2, duration of pauses, $\frac{1}{25}$ second, silent reading; 3, number of pauses, oral reading; 4, number of pauses, silent reading; 5, number of regressive movements, oral reading; 6, number of regressive movements, silent reading; number or duration of pauses along vertical; grades along horizontal

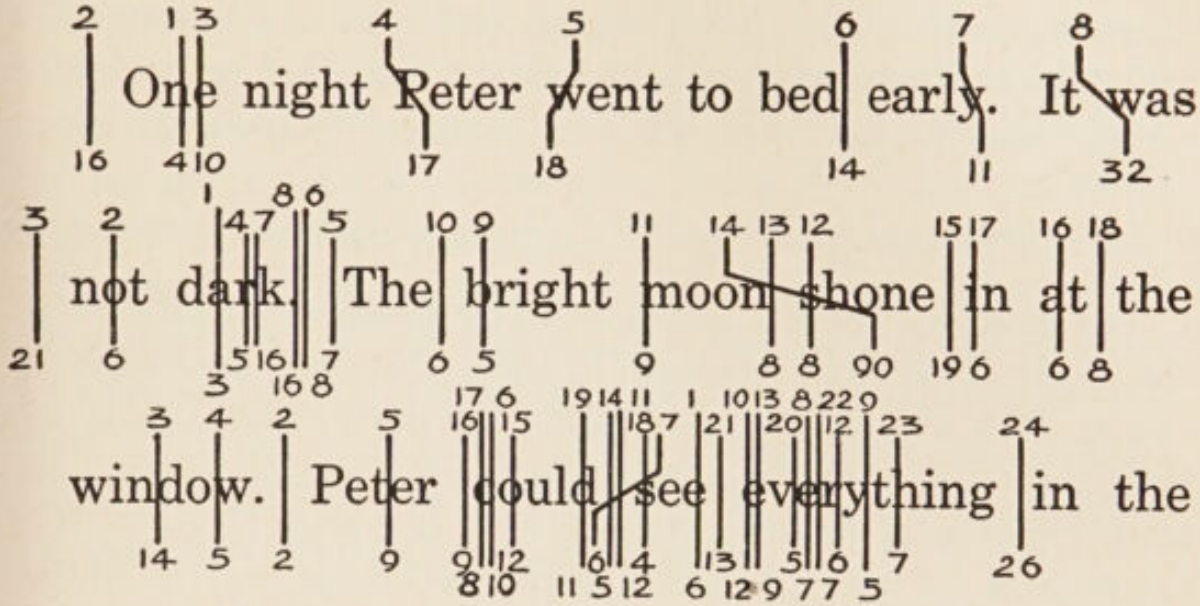


FIG. 2. Silent Reading of S_{38}, Grade II

Vertical line indicates position of eye pauses. The numbers at the upper end of these lines show the order of the fixations; those at the lower end show the duration of the fixations in twenty-fifths of a second. (After Buswell)

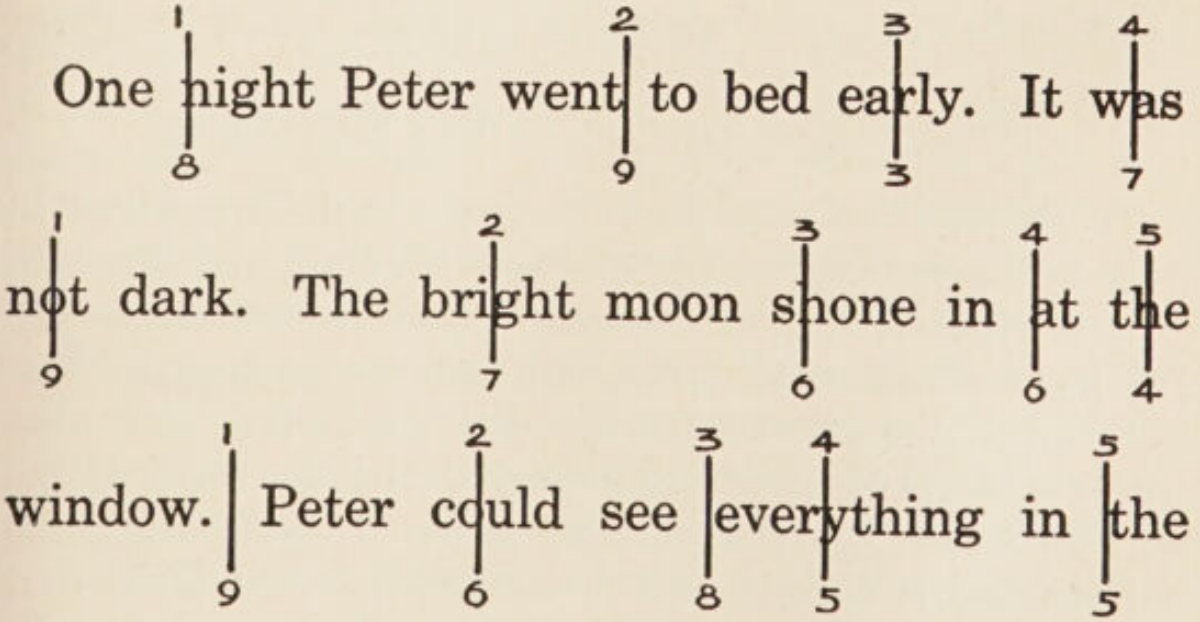


FIG. 3. Silent Reading of S_{175}, College Senior. (After Buswell)

of reading. It is certain, however, that the fundamental eye movement habits are formed during the first three grades. Since there is a close relationship between eye movements and the ability to read, it is important that the formation of correct reading habits be stressed during these years.

Influence of Mode of Reading on Eye Movements

The facts in Table I also enable us to see the influence of the mode of reading, whether it is oral or silent, on eye movements. We see that during Grade I the number of the pauses, their duration, and the number of regressive movements are greater for silent reading than for oral, but after Grade I they are greater for oral; and that with few exceptions the differences between oral and silent reading increase with advancement through the grades, a fact which may be seen from the divergence of the curves for oral and silent reading. The necessity of accurate perception and the time required for vocalizing in oral reading are the principal reasons for the fact that it is slower than silent reading. It is faster in Grade I because nearly all the training in this grade is in oral reading.

Influence of Purpose on Eye Movements

The influence of purpose on eye movements was shown in an experimental investigation made by Judd and Buswell, who photographed the eye movements in oral and silent reading when the reader read with various purposes, such as just to read, to answer specific questions, to notice peculiar words or parts of speech, to dictate all that he remembered, to paraphrase the material, to pick out verbs that had objects, and to make a verbatim report. It was found that the number of pauses varied from 11.8 per line when the purpose was to answer questions to 48.0 when the purpose was to paraphrase. There were also some increases in the duration of the pauses, but they were much less noticeable than

those in the number of the pauses, the greatest being for the purpose of paraphrasing, in which case the average duration was 0.36 second. However, the fact that the pauses were from two to eight times as numerous as for ordinary reading is enough to make corresponding reductions in the speed of reading, even when the pauses are no longer. The reasons for the increase are due in part to the necessity of accurate perception and in part to the necessity of accurate and careful comprehension. When one reads a passage for the purpose of paraphrasing it, he must see the words accurately, get the correct thought, and get all of it. To do this in one reading would require a comparatively long time, for in such cases the reader is both reading and studying.

Influence of Quality of Material on Eye Movements

Judd and Buswell also investigated the influence of the quality of the material on eye movements. They used English mixed with a little French, English mixed with a good deal of French, English mixed with a little Latin, English mixed with a good deal of Latin, and Latin. Each kind of material was read silently and then translated orally. It was found that the number of pauses in the case of Subject A_{27} varied from 10.5 for reading English mixed with a little French to 21.0 for the oral translation of easy French. The duration of the same pauses varied from 0.22 to 0.32 second. In the case of Subject A_{29} there were 16.7 pauses per line for reading English mixed with a little Latin to 45.4 pauses per line for reading Latin. The duration of the same pauses was 0.23 and 0.29 second respectively.

The influence of the quality of the material on eye movements was also shown in Terry's experimental study of reading. Some of the findings are given in Table II on page 36. As we should expect, these show that numbers are much more difficult to read than words.

TABLE II. EYE MOVEMENTS IN READING

	Average Number of Pauses per Line
In reading five problems (first reading)	8.08
In reading ordinary prose	8.05

	Average Number of Letters or Digits per Pause
In reading five problems	5.56
In reading ordinary prose	7.69
In reading isolated numerals	1.67

	Average Duration of Pauses in Seconds
In reading five problems	0.237
In reading ordinary prose	0.215
In reading isolated numerals	0.478

Here we see that the pauses for numerals are more than twice as long as for ordinary prose and that they are from four to five times as frequent. These facts enable us to appreciate the slowness of the reading of numerals.

REASONS FOR FEWER AND SHORTER EYE PAUSES IN WORDS

The principal reason why eye pauses are fewer and shorter in words is probably that letters in ordinary prose are perceived in groups of familiar units but letters in a foreign language or numerals are not so perceived. We have much experimental evidence to prove that familiar words are perceived as single units just as are letters. The perception time for a familiar word is no longer than for a single letter and often is less. Words can be recognized at distances which are too great for the identification of the component letters, when the letters are too small for separate identification, when the words are misspelled, and when some of the letters are missing, as in *p–nc–l, w–tch, g–ld, M–k–do.* The last task is, however, much more difficult when the large letters in a word are left blank as in *i–en–i–ica–ion, –e––er,* and *–ro–a–––*, all of which occur in this paragraph.

SUMMARY

The major aims of reading are to get information and enjoyment from the printed page. The amount of each that a reader gets depends upon his comprehension and speed; but before efficiency in these can be attained he must master a very complex system of habits, among which are meaning and pronunciation of words, principles of phonics and voice control, using a table of contents, an index, a dictionary, and many devices for finding facts and thought. The speed of reading is conditioned by the number and duration of the eye pauses. These in turn are influenced by the grade of the child, the mode of reading, the kind of material read, and the purpose of the reader. The number of pauses per line for silent reading begins with 18.6 in Grade IA and decreases to 6.9 in Grade V, after which there are small decreases; for oral reading the corresponding decrease is from 16.0 to 8.7. The duration of the pauses for silent reading decreases from 0.660 second in Grade IA to 0.252 second in Grade V, after which the decreases are small, if any; for oral reading the corresponding decrease is from 0.768 second to 0.228. The number and duration of the pauses are considerably greater for study reading than for recreational reading. In reading to study, the number per line may vary from 11 to 48, according to the purpose of the reader. Introducing foreign words or digits into ordinary prose may cause a similar variation in the number of pauses per line. The number of elements perceived in one eye pause varies from 1.67 for digits to more than 8 for ordinary prose. The principal reason for this is that words can be recognized from their general form, but numbers cannot. Some of the factors that determine the form of a word are its length, the height of the letters, and their shape. The importance of all these facts is that they condition the speed of reading and, less directly, its comprehension.

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CHAPTER IV

READING: FACTORS THAT INFLUENCE SPEED

Besides eye movements the principal factors that influence speed are the span of perception, the eye-voice span, the amount of vocalization used by the reader, the age, grade, and intelligence of the reader, the mode of reading, the kind of print and paper used, the arrangement of the lines, the amount and kind of drill, the distribution of the frequency of the words in the text, and individual difficulties of many kinds. The purpose of this chapter is to explain and to give the main facts on these points.

Influence of Span of Perception on Speed of Reading

The finding of Terry that an average of 7.69 letters can be recognized in one eye pause as against an average of 1.69 numerals is one important reason why ordinary prose is read so much more rapidly than are numbers. This shows that the span of perception (the number of letters or words that can be seen in one eye pause) has an important relation to the speed of reading. The influence of this factor was studied by C. T. Gray, who grouped fifty-nine grade children into four groups according to their speed of reading and then calculated the size of the perception span of the members of each group. Table III, on page 40, gives his results.

From this table we see that the fast reader has a larger perception span than the slow reader. This suggests that efforts to increase the span of perception are valuable for increasing the rate of reading. This is usually done by drill with flash cards on which the length of the words or phrases is gradually increased.

TABLE III. RELATION OF SPEED OF READING TO SIZE OF PERCEPTION SPAN. (After C. T. Gray)

GROUP	NUMBER OF CHILDREN	WORDS PER SECOND	SIZE OF THE MOST FREQUENT PERCEPTION-SPAN (WORDS)
1	5	0.1–1.0	1.1–2.0
2	28	1.1–2.0	2.1–3.0
3	18	2.1–3.0	2.1–3.0
4	8	3.1–4.0	3.1–4.0

INFLUENCE OF EYE-VOICE SPAN ON SPEED

Closely related to the span of perception is the eye-voice span, by which is meant the number of letters between the letter that the eye sees and the one that the voice pronounces. The relation of this factor to reading was studied by Buswell, who classified fifty-four readers into five groups according to the rate of reading and then calculated the average eye-voice span of each group. Table IV gives his results. Figs. 4 and 5 show two specimens of original records from which the data in Table IV were obtained.

TABLE IV. RELATION OF SPEED OF READING TO SIZE OF EYE-VOICE SPAN. HIGH-SCHOOL SUBJECTS. (After G. T. Buswell)

GROUP	NUMBER OF CHILDREN	WORDS PER SECOND	AVERAGE EYE-VOICE SPAN
1	1	0–0.9	3.4
2	2	1–1.9	5.7
3	10	2–2.9	11.3
4	29	3–3.9	12.7
5	12	4–4.9	16.5

It is clear that the speed of reading and the size of the eye-voice span increase together. This suggests that it is worth while to cultivate the habit of looking ahead as far as possible in reading.

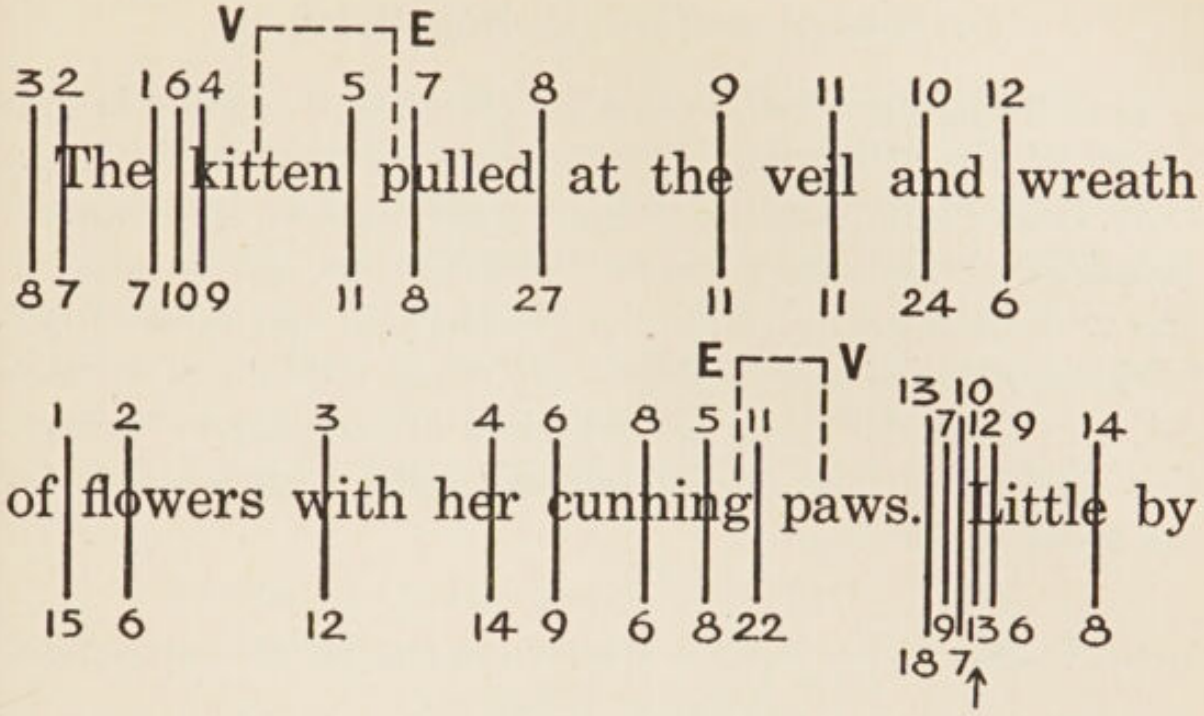


FIG. 4. Eye-Voice Span of Subject E_{22} (poor reader, Grade VII)

V indicates the position of the voice, and E the position of the eye. The number of letter spaces between V and E is eye-voice span. Numbers and vertical lines as in Figs. 2 and 3. (After Buswell)

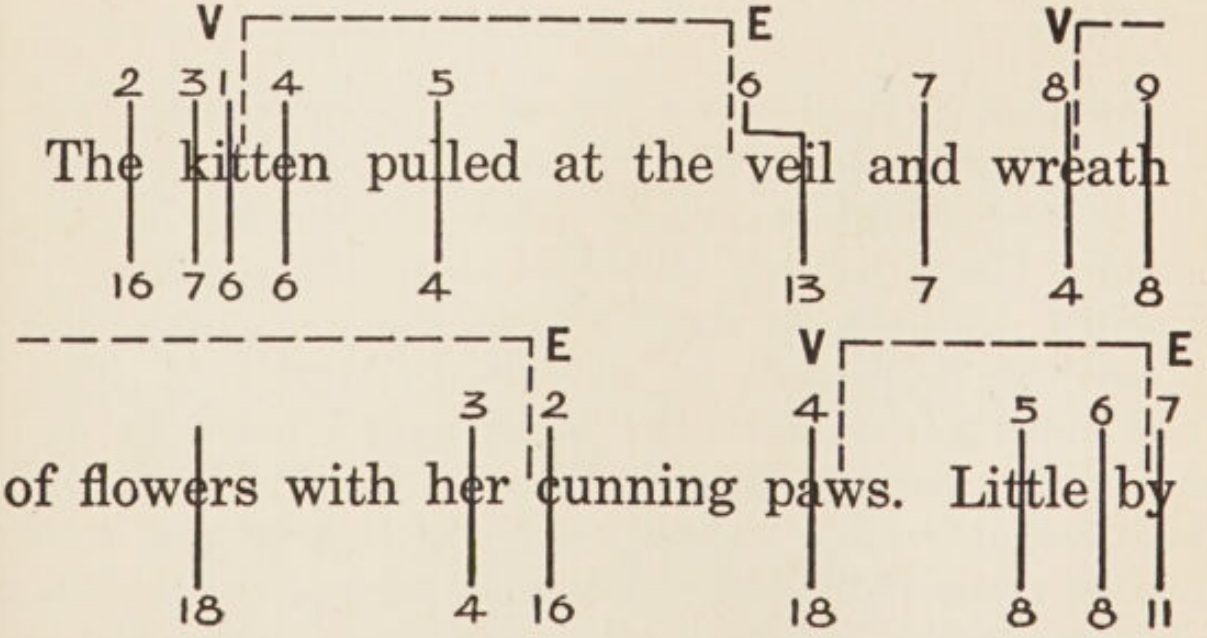


FIG. 5. Eye-Voice Span of Subject E_{24} (good reader, Grade VII)
(After Buswell)

Influence of Vocalization on Speed

Another factor which influences the rate of reading is the amount of vocalization, or inner speech, used in reading. C. T. Gray found that the percentage of children using much vocalization decreases with advancement through the grades and with increase in the rate of reading. In fact none of his subjects taken from high school or college used much vocalization. Table V, taken from Gray's results, shows clearly that the amount of vocalization decreases with increase in the speed of reading.

Table V. Relation of Speed of Reading to Amount of Vocalization
(After C. T. Gray)

Words per Second	Number of Subjects	Percentage using Vocalization		
		Much	Little	None
1.9–3.9	29	37.9	34.4	27.7
4.0–5.9	20	15	50	34
6.0–10.0	10	0	40	60

From this it is also clear that other factors influence the rate of reading, for some slow readers use no vocalization. But since vocalization requires time, it necessarily delays the speed of recognition and should be eliminated as quickly as possible. This may be done either by direct voluntary suppression or incidentally by emphasizing increase in speed. The former may eliminate the habit in a short time, but it has the disadvantage of dividing the attention and interfering with comprehension. It would seem better, therefore, if the teacher would simply emphasize rapid reading but hold the child responsible for the content or meaning. The child in order to make a good record will just naturally eliminate his vocalizations without a special effort.

Influence of Age and Grade

Undoubtedly the most important factor influencing the rate of reading is maturity, as is shown by the way in which speed increases with age or with advancement through the grades. The standardization of tests in recent years has furnished us with standards for each grade. The standard rates are medians or averages computed from a very large number of pupils. Table VI gives the median rates for silent reading for three tests the content of which is narrative in type.

Table VI. Grade Medians for Reading Tests

Test	Grades						
	II	III	IV	V	VI	VII	VIII
Starch	108	126	144	168	192	216	240
Gray	90	138	180	204	216	228	240
Courtis	84	113	145	168	191		

Note. Numbers signify median number of words per minute.

The curves for these rates (Fig. 6) show a steady and constant improvement from grade to grade for the Starch and Courtis tests, but for Gray's test the curve rises most rapidly during the first five grades, turning toward the horizontal at the fifth. This indicates much slower improvement after that point. This is probably the usual result; but we shall see later from O'Brien's experiment that it is not necessarily the case, and that by diligent practice the greater gains may be made in the upper grades.

Influence of Intelligence

Pupils of the same grade and age show wide differences in their rates of reading. These are due principally to differences in intelligence or in brightness, although some may be due to differences in training and in effort. The influence of

intelligence is shown in the degree of correlation between speed of reading and intelligence quotient, or I. Q. This was found to be 0.68 between the Burgess Reading Test and the Stanford Revision of the Binet-Simon Scale when calculated from over seven hundred cases in a certain school system. If the reader is not familiar with correlations he may be helped to understand the meaning of this figure by observing that if there were a point-for-point correspondence between speed of reading and intelligence, the correlation would be 1; if there were no correspondence, it would be 0; and if possessing a high reading speed meant a proportionately low degree of intelligence, it would be −1. Since 0.68 is over two thirds of the way between 0 and 1, we should expect most bright children to be rapid readers and most dull children to be slow readers. Such a relationship may be seen in the nine individual cases from the same grade which are given in Table VII, on page 45.

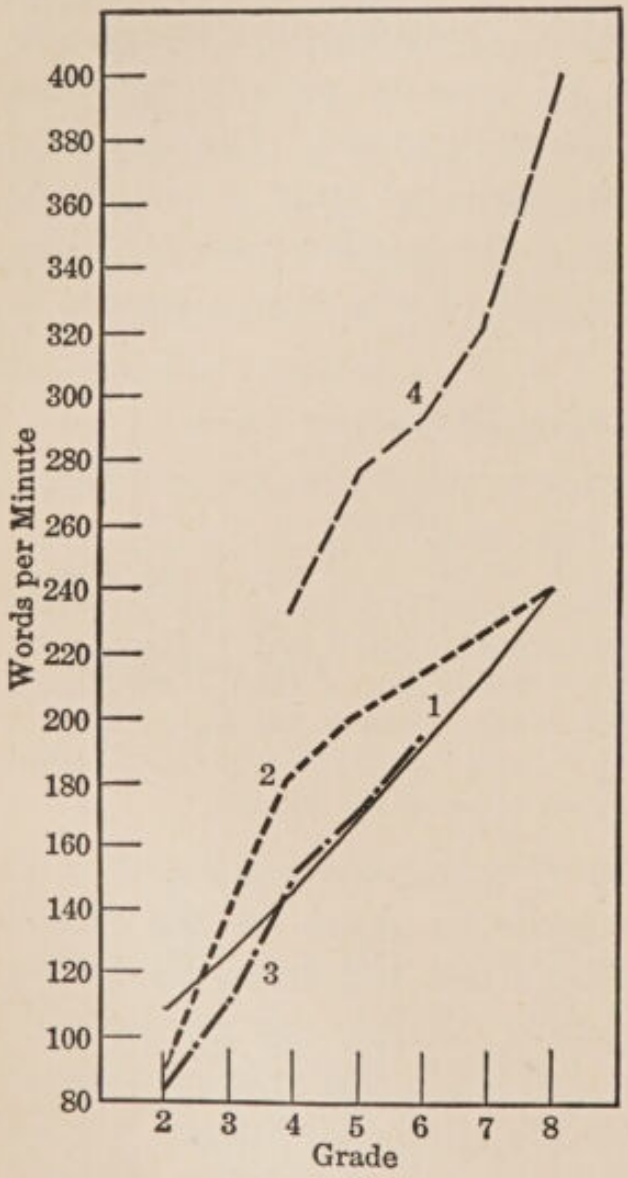


FIG. 6. Showing Grade Norms for four Silent Reading Scales

1, Starch; 2, Gray; 3, Courtis; 4, O'Brien

Here it is seen that those with very high I. Q.'s make almost perfect scores in the Burgess test and that those with very low I. Q.'s make very low scores. This cannot be due to training,

TABLE VII. RELATION OF SPEED OF READING TO INTELLIGENCE QUOTIENT

PUPIL	AGE		GRADE	I. Q.	READING SCORE
	Years	Months			
A	11	5	VII	152	100
B	11	7	VII	132	98
C	11	5	VII	141	100
D	11	5	VII	145	100
E	11	8	VII	139	98
F	15	9	VII	66	44
G	15	7	VII	74	39
H	15	8	VII	66	38
I	15	9	VII	71	20

for those with low I. Q.'s, being on an average four years older than those with high I. Q.'s, have had much more training. That the correspondence between brightness and the ability to read should be so large in these cases is not surprising when we consider that reading is a process of thought as well as of perception; that is, it is a process of seeing relationships, and this is also the principal element in intelligence.

INFLUENCE OF THE MODE OF READING

We noticed above that the mode of reading influences the eye movements, therefore we should expect that it would influence the speed of reading. How it does so was investigated by W. S. Gray, who, after selecting passages of equal difficulty, used them to measure the relative speeds of oral and silent reading in all the grades except the eighth, from Grade I through the college. Table VIII, on page 46, gives his results.

We see that the rates for oral reading are faster for the first three grades, but after this point silent reading is more rapid and becomes increasingly more so with advancement through the grades. Buswell's experiment showed that the number and duration of the eye pauses were smaller for oral reading than for silent reading during the first grade only,

TABLE VIII. SILENT AND ORAL READING RATES FOR PASSAGES OF EQUAL DIFFICULTY. (After W. S. Gray)

	Grades											College
	I	II	III	IV	V	VI	VII	IX	X	XI	XII	
Words per minute in												
Oral reading . .	60	111.6	147	189	210.6	228	234	234	246	240	238	241
Silent reading .		87	138	207	231.0	252	240	255	253	266	255	270

and because of the close relationship between speed of reading and eye movements we should expect the same to be true of the speed of reading. The change in the relative speeds of the two modes of reading may vary between the end of the first grade and the end of the third. The probable cause of this is the variation in the amount of practice given in silent reading by different schools. If so, we have experimental grounds for emphasizing silent reading in the first grade. But even if oral reading is necessarily the more rapid in the first grade or in the first three grades, there are many other reasons why training in silent reading should be given some attention from the beginning. It is the mode most often used by adults, it is more rapid and economical, and it forces attention to content and so favors comprehension. The last is true because training in silent reading is always accompanied by a check in comprehension.

THE LAW OF REPETITION APPLIED TO DEVELOPMENT OF SPEED

The rate of reading may be greatly increased by systematic practice. Intelligence, span of perception, eye-voice span, vocalization, age, and eye movements condition the rate and amount of improvement, but do not make it impossible for the rate to be changed by training. In support of this we can point to the results of a number of experiments in which different types of training were used.

Influence of Training: C. T. Gray's Experiment

One of the first careful experiments which showed that the rate of reading is influenced by training was made by C. T. Gray, who experimented with five different types of training. In the first type the emphasis was on speed and the increase in the span of perception, in the second it was entirely on the increase in speed, in the third it was on increasing the degree of comprehension, in the fourth it was on decreasing the amount of vocalization, and in the fifth the training was entirely in phonics. All these except the last produced remarkable increases in the rate of reading, varying from 0 to 400 per cent according to the individual and the quality of the materials used in the tests before and after training. But in all there was a loss in comprehension varying from 0 to 75 per cent. This is likely to be the result if too much emphasis is put on speed and if careful checks are not made on comprehension. Gray, however, used only two subjects for each type of training, and the periods of training lasted from twenty to thirty minutes for only twenty days. The results on comprehension might have been more favorable if a larger number of subjects had been used. Gray's experiments have the value of showing us that the rate of reading can be modified by training, but it is very doubtful if improvement in speed is worth while at the cost of loss in comprehension.

Influence of Training: O'Brien's Experiment

That remarkable improvement can be made without any loss in comprehension was shown in a very elaborate experiment made by O'Brien. He used three types of training. In the first the emphasis was simply on rapid reading, in the second it was on rapid reading and the elimination of vocalization (lip and tongue movements and inner pronunciation), and in the third it was on rapid reading and increasing the span of perception by exercises with flash cards.

A total of thirty-eight classes from Grades III to IX from nearly as many schools took part in this experiment. The registration in all the classes amounted to 828 pupils. Each class was divided into two groups: Group A, the experimental group, which received the special training, and Group B, the control group, which received the traditional instruction in reading. The training continued for thirty minutes a day from April 8 to May 29, comprising thirty-nine school days. Before the training, after it, and in the middle, the Courtis Silent Reading Tests were given to all the pupils for measuring the effect of training on speed and comprehension. To stimulate interest in speed each pupil in Group A was required to keep a chart showing his daily progress in reading. There was also conspicuously displayed before the class a similar chart showing the average daily speed of the class. To avoid loss in comprehension the pupils were instructed not to skip anything and were required immediately after the reading exercise to reproduce what they had read. Table IX shows the results of the experiment on the rate of reading for the upper five grades.

TABLE IX. RESULTS FROM O'BRIEN'S EXPERIMENT ON IMPROVING RATE OF READING

Courtis Tests. Test I, before training; Test III, after training. A, training group; B, control group

GRADE	NUMBER OF PUPILS	TEST I		TEST III		GAIN		A'S SUPERIORITY IN GAIN	
		A	B	A	B	A	B	Amount	Per Cent
IV	236	155.7	155.1	236.4	188.2	80.7	33.1	47.6	31
V	154	190.7	199.9	277.8	222.1	87.1	30.2	56.9	30
VI	128	197.8	204.4	292.6	235.0	94.8	30.6	64.2	33
VII	206	205.6	202.5	321.6	249.7	116.0	47.2	68.8	33
VIII	92	220.8	211.7	393.0	301.8	172.2	90.1	82.1	35

NOTE. Rate of reading expressed in median number of words read per minute. Average gain of all A grades, 56 per cent; B's gain, 25 per cent; A's superiority over B, 31 per cent.

In comprehension the A classes made a gain of 0.9 per cent, the B classes a loss of 0.7 per cent, giving the former a superiority of 1.6 per cent. This means that the degree of comprehension was unaffected by the special training. The important thing is that there was no loss. To gain 56 per cent in the speed of reading and to maintain the same degree of comprehension means that the pupil could do half again as much work in the same unit of time without any loss in the quality of the work. What this means may be seen from Table X, where the medians attained by O'Brien's A classes after training are given in comparison with the actual averages of the Courtis rates. In this connection the reader should also refer to the O'Brien curve in Fig. 6.

TABLE X. O'BRIEN STANDARDS AND ACTUAL AVERAGES OF COURTIS TESTS IN RATE OF SILENT READING

	GRADES				
	IV	V	VI	VII	VIII
O'Brien	236	278	293	322	393
Courtis	160	180	200	250	280

NOTE. Rate of reading expressed in number of words read per minute.

The different methods of training had practically the same value. In some grades a slight advantage lay with the second type — emphasis on speed and suppression of vocalization. These slight differences show that the improvement was due primarily to the common elements in the three methods — the emphasis on speed and the devices used for stimulating it, such as the display of individual and class charts, the encouragement to "do better today than you did yesterday," and the putting of time limits on the reading. Fig. 7, which shows the daily progress made by the sixth grade in St. Mary's School, Bloomington, Illinois, must have had a very stimulating effect on improvement. It would create an ambition on the part of the pupil to make the curve rise as rapidly as possible.

Another factor which conditioned the improvement was the reduction in the number of eye movements. In the case of five elementary pupils whose eye movements were photographed both before and after the special training this amounted to 25 per cent. The pauses averaged about 8.3 before practice and 6.0 after; the regressive movements, 1.5 before and 0.8 after. In view of the great increase in the speed of reading these facts mean that a great increase occurred in the perception span, and apparently justify O'Brien's conclusion that "development in speed in silent reading is in reality reducible to the more effective utilization of the perceptual span in reading."

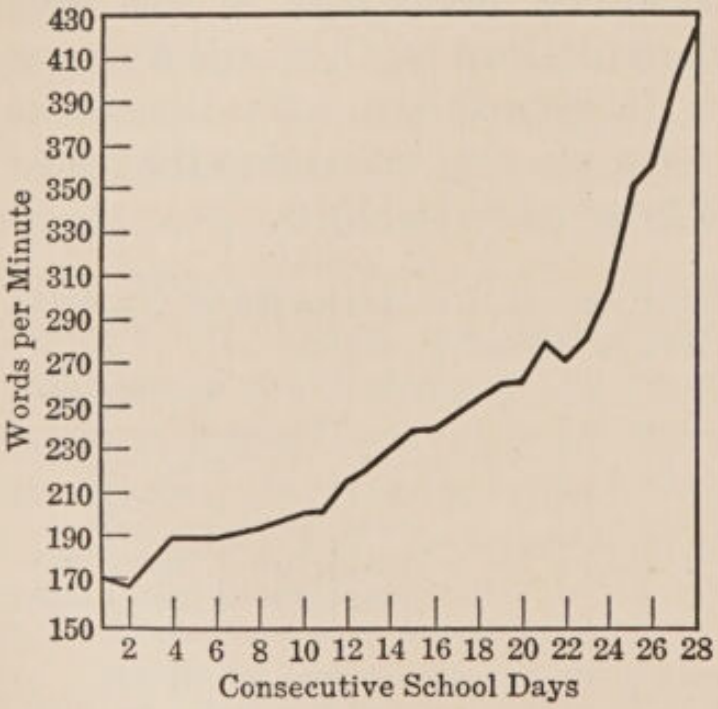


FIG. 7. Progress in Rate of Silent Reading
St. Mary's School, Bloomington, Illinois. Nineteen pupils, Grade VI. (After O'Brien)

O'Brien's experiment is of great value to teachers. It shows that remarkable gains in speed can be made in a short time by the proper methods of training, and that this can be done without any loss in comprehension. His methods are simple enough to be used by any teacher who is interested in using them. The reading graph, the time-limit test, the flash cards, the emphasis on the suppression of vocalization, the reproduction test, and the encouragement to beat the previous day's record are devices applicable to the daily classroom exercise. The experiment also suggests that the purpose of the flash-card exercise to increase the span of perception and of voluntary efforts to eliminate vocalization may be accomplished indi-

rectly, and without division of attention, by merely emphasizing the idea of speed in the daily lessons.

Distributions of Repetitions on Different Words

The number of times a word is read naturally has some effect on the time required to read it, but just what is the effect on speed of varying the frequency of words has never been investigated experimentally. However, investigations of the frequency of words in school readers reveal gross violations of the law of repetition, particularly the law of distribution. Selke, who tabulated the frequencies of words in twelve primers, found some effort at repetition, but it was far from uniform. In four of the primers 70 per cent of the total number of words occurred less than ten times, in four others this percentage was from 60 to 69, and in three it was less than 50.

Packer, who analyzed the vocabularies of ten first readers, found 15 words having a frequency of 700–5250 and 2048 words having a frequency of only 1–4. These constituted over half of all the different words used. Housh, who made an analysis of the vocabularies of ten second readers, found only 419 words common to all the readers. The number of different words occurring but once in a single reader varied from 318 to 826. The percentage of words occurring once in a single reader varied from 21 to 43. Gregory studied the reading vocabularies of third-grade children in the state of Oregon and found that 5190 different words appear in the state minimum course of study for the first three grades, 289 of which have a frequency of from 50 to 7267. But nearly one third of the words occur but once. Conditions of this sort are probably due to the fact that in the construction of these readers the authors never paid any attention to the law of repetition. The distribution is due largely to chance. No doubt a great deal can be done to improve this condition. There will be some such words as *the, it, be, you, and, is,* which

will always have a very high frequency, but a conscious plan on the part of the authors could reduce the frequency of some of the words and set up 10 or 15 as the minimum frequency for any one word. The result of the present condition necessarily means the overlearning of a small number of words and an underlearning of at least one third of those which occur in our readers. The result is fluent reading when frequent words occur and halting and erroneous reading when the rare words occur. Teachers, however, can do much to remedy this by (1) keeping in mind that a textbook has too much frequency for some words and too little for many others, (2) making a list of the important rare words and using these as materials for drill, and (3) giving a minimum number of repetitions to all new words. What this minimum should be we do not know; but we can estimate that it will be from 25 to 35 in Grades I and II, from 20 to 30 in Grades III and IV, and from 10 to 20 in the upper four grades.

Effects of Applying Repetition at the Point of Error

Speed of reading as well as comprehension may be increased by applying repetitions at the point of error. The procedure in this type of training is first to record and analyze the errors made in a series of standardized and informal reading tests and then apply remedies that are adapted to the correction of these errors. Investigations show that errors made in reading are by no means peculiar to the individual. On the contrary, most of them are common to many readers. An investigation by McLeod of the errors in oral reading by two hundred and thirty-eight children distributed nearly evenly through the grades showed percentages of distribution according to kind in different grades as given in Table XI.

Here we see that the majority of the errors fall in three classes: mispronunciations, substitutions, and repetitions.

In class instruction, therefore, the teaching emphasis should be put on these points. The effect of such emphasis at the point of error can be seen in individual cases.

The diagnosis and treatment of individual cases have been developed to a high degree by W. S. Gray and his coworkers. A child who has unusual difficulty in reading is made the object of a searching examination. First, a careful record is secured of his history. This includes his home conditions, his physical history and condition, his mental characteristics,

TABLE XI. DISTRIBUTIONS OF PERCENTAGE OF ERRORS IN ORAL READING ACCORDING TO TYPE OF ERROR IN DIFFERENT GRADES. (After McLeod)

TYPE OF ERROR	GRADES		
	I	IV	VIII
Gross mispronunciations	44.8	11.6	10.5
Minor mispronunciations	1.9	21.8	41.9
Omissions	1.6	8.0	4.7
Substitutions	31.9	30.8	18.9
Insertions	4.7	7.5	7.0
Repetitions	15.1	20.2	16.8

temperament, and play activities, and his school history, part of which is a detailed account of what he has been taught in reading and with what success. Secondly, the child is given a preliminary diagnosis with standardized tests. These include an intelligence test and four or five standardized reading tests — one in oral reading, some in the rate of silent reading, and some in the comprehension of silent reading. These show the status of the child in reading in comparison with the average of other children of his age and grade. Thirdly, he is given a series of informal tests. These include tests of ability to recognize sight and phonetic words usually found in primers, short-exposure tests of the accuracy and span of recognition, photographic measurements of eye movements, tests of ability to get the main point of the story, and tests of ability to interpret factual material.

After the child is given a detailed diagnosis by these methods, remedial instruction, suited to his particular case, is prescribed. This is usually individual and is continued until the greater part of the difficulties are overcome, when the child is again given a series of standardized tests to measure the effect of the prescribed instruction.

To give a clear idea of this method of diagnosis we shall describe the case of A. N., a fourth-grade girl aged nine years and ten months. An analysis by the Stanford Revision, the Gray Oral Reading Test, and the Monroe Silent Reading Test showed about normal intelligence, two years' retardation in oral reading, a very slow rate of silent reading, and good comprehension in the Courtis Tests but poor in the more difficult passages of the Monroe Test. The Jones Vocabulary Test showed that she had many inaccuracies in the recognition of simple words appearing in Grade I. The visual-memory test showed that she had made fewer errors than many good readers of her grade, and the short-exposure exercises showed little difficulty in the recognition of words having three or four letters but much difficulty with isolated letters and with phrases having two and three words. These facts indicated a narrow span of recognition. This condition was also seen in the photographic records of the eye movements, which revealed long pauses and more numerous fixations and regressive movements per line than the normal for Grade IV. Careful observation during the informal oral tests showed that the child did not keep her attention on the lines of print while she read, that she read one word at a time, and that she did not group the words effectively. The informal tests in interpretation also showed that she did not direct her attention to the content nor keep in mind the important points.

The remedies applied were (1) directing attention to thought by frequent questions during reading; (2) giving reading problems by printed directions on cards; (3) developing span and accuracy of recognition by flash-card

exercises containing words, phrases, and sentences which gradually increased in length; (4) assigning selections having few or no difficulties of thought on which were based specific questions to be answered within time limits; (5) assigning many simple selections for home reading; (6) keeping a record of the amount read daily.

The results of this instruction from October to March are shown in Table XII.

TABLE XII. EFFECTS OF REMEDIAL INSTRUCTION

	OCTOBER SCORES	MARCH SCORES	STANDARD FOURTH GRADE
Gray Oral Reading Test	37.50	42.50	47
Burgess Silent Reading Test	26	38	50
Courtis Silent Reading Test, No. 2			
Rate	90	136	145
Comprehension	90	95	89
Monroe Silent Reading Test, Comprehension	3	8	12.7

Although A. N. was still below the standard of the grade in most of the tests, according to the Courtis Test she made in six months over one and a half years' progress in rate of reading and a noticeable improvement in comprehension.

Other devices which W. S. Gray has found helpful in overcoming individual difficulties in speed are reading selections which appeal to the special interests of the child, reading with emphasis on speed, accurate oral reading of familiar stories, drill exercises on the recognition of phonetic elements, and re-reading until an errorless reading is secured. Additional devices found helpful by Gray in meeting difficulties in rate as well as in mechanics of reading are flash-card exercises in recognition of thought units; reading typewritten material in which thought units were widely separated; oral reading preceded by silent reading with attention on content; insistence on slow, accurate, and distinct reading; reading sentences in which missed words were frequently used; training

in dividing polysyllabic words into syllables and phonetic elements; oral reading of simple selections in which the teacher quickly supplied words over which a pupil hesitated; training in the self-correction of errors by questions on the appropriateness of substitutions and by exercises in using a dictionary; training in making accurate return sweeps; and reading to the child, with emphasis on effective groupings.

Influence of Hygienic Factors

The speed of reading is influenced by the character of the make-up of the printed matter, such as the quality of the paper, the length of the lines, the size of the print, the evenness of the lines, and the amount of leading, or spacing, between the lines.

The effect of the quality of the paper on the fatigue of the eyes and the speed of reading was investigated by Hull and Ames and reported by Starch. Four qualities of paper were used: dull-white, pink, blue, and glossy-white. Fair-sized books were made up from each kind of paper and were read under such conditions that the distance from the eyes, the angle of the book, and the amount of illumination were the same for each kind of paper. The changes in the eyes produced by the reading were measured by (1) the number of lines read during a fifteen-minute period, (2) the number of spontaneous winks per minute, and (3) the amount of loss in the keenness of vision as indicated by the distance required to discriminate faint parallel lines. The average of these measures showed that dull-white paper was by far the most favorable and that glossy-white paper had the worst effects. The glare was found to be the most decisive factor in diminishing the efficiency of the eyes.

The careful investigations made by Dearborn and Blackhurst show that lines from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long are the most favorable for developing regular and rhythmic eye movements. The objection made to lines from 5 to 7 inches long

is that the eyes lose their place in making the long backward sweep, and consequently have to spend some time in "scouting" before the beginning of the next line is found. This causes regressive movements, extra pauses, and a consequent breaking up of the rhythmic and regular movements of the eyes. Effective speed is difficult to develop under these conditions. The same objection applies to unevenness in the lines. In some books there are numerous indentations in the printed matter to make room for illustrations and pictures, and sometimes these are scattered irregularly all over the page. Such breaks in the printed matter throw the eyes off from their regular course, break up the rhythmic movement, and produce "scouting" until the proper place is found again. Fortunately the majority of our new primers are almost entirely free from these conditions. The upper half of the page is used for illustrations, and the lower half for the story. The lines are regular on the left and have the proper length, but the right margin is usually irregular.

The size of the print has an influence on speed. Two factors have to be considered: the clearness of the impression and the number of impressions. Speed is delayed if the impression is too small to be clearly seen and also if the impressions are so large that only a small number can be perceived in one eye pause. Blackhurst, who made a careful study of these factors, found that 24-point type was the most favorable in Grade I, 18-point in Grades II–IV, and 11-point in the higher grades. As regards the spacing, or leading, between the lines, his investigations show that this should be 3.8 millimeters for Grade I, 1.3 millimeters for Grade II, and 1 millimeter for higher grades.

Summary

The speed of reading is influenced by many factors; namely, span of perception; eye-voice span; amount of vocalization; age, grade, and intelligence of the reader; mode

of reading; kind of print and paper used and arrangement of the lines; amount and kind of drill; frequency of the words in the text; and individual difficulties and attitudes of many kinds.

The speed of reading increases with (1) increase in the size of the span of perception, (2) increase in the size of the eye-voice span, (3) decrease in the amount of vocalization, (4) increase in the age and grade of the pupil, and (5) increase in the amount of intelligence. With respect to advancement through the grades the increase is usually more rapid during the first five grades than it is thereafter. But this is not necessarily true, for O'Brien's experiment shows that the greatest gains can be made during the upper grades. The speed of reading is greater for silent reading than for oral reading, therefore the schools should put the greater emphasis on silent reading.

According to experiments the speed of reading may be greatly increased by training without causing a loss in comprehension. The following devices have proved useful for this purpose:

Rapid reading, with time limit followed by a check on comprehension.

Flash-card exercises for increasing the span of perception.

Suppression of vocalization.

Graphic chart of the progress of the individual pupil and of the average of the class.

Assigning selections with few or no thought difficulties.

Assigning selections which appeal to the special interests of the child.

Exercises in recognizing thought units.

Accurate oral reading of familiar stories.

Exercises in recognizing phonetic elements.

Training in dividing polysyllabic words into syllables and phonetic elements.

Oral reading in which the teacher quickly supplies words over which a pupil hesitates.

Training in self-correction of errors.

Training in making accurate return sweeps.

The effective use of such devices depends upon applying them to the needs and difficulties of the pupil, which can be discovered only by a careful diagnosis with standardized and informal tests.

The textbook is in part responsible for difficulties in speed. Its greatest weakness is that a comparatively small number of words occur with a very high frequency and that about half the words occur only from one to three times. To overcome this fault teachers must use devices of their own for giving a minimum number of repetitions to all new words.

In regard to the physical make-up of the textbook, experiments show that speed and ease of reading are promoted by such factors as dull-white paper, a length of line varying from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches, lines unbroken by pictures and cuts, even and regular margins on the right and possibly also on the left, and 24-point type for Grade I, 18-point for Grades II–IV, and 11-point beyond Grade IV. The leading should be 3.8 millimeters for Grade I, 1.3 millimeters for Grade II, and 1 millimeter beyond Grade II.

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CHAPTER V

READING: FACTORS INFLUENCING COMPREHENSION

Comprehension due to Associations

To comprehend reading matter is to get its meaning. Just what meaning is, how it arises, and how it exists in consciousness are questions to which psychologists have given many theoretical answers. Fortunately the teacher of reading does not need to decide between them. One thing is certain, however: to give meaning to an object one must form associations with it. For example, *insure* acquires meaning when it becomes associated with the act of securing property against loss by fire or theft. It means more when a child has the experience of seeing his father receive a check from an insurance company for the home which was destroyed by fire, and it means still more when he sees his mother receiving from an insurance company a monthly income which became due at his father's death. The meaning of the word is enriched as the number of associations with it is increased. The awareness of the meaning of a word seems to be conditioned by the arousal of these associations. It makes little difference in what form these associations appear. The important thing is to have the right ones. Therefore the teacher's first duty in teaching the comprehension of a word is to develop some associations with it; for example, the sight of the object, the image of the object, and, in some cases, merely the sound of the word. These devices will usually be accompanied by explanations, illustrations, and, where possible, brief dramatizations.

Comprehension a Case of Controlled Association

When words are grouped into sentences and paragraphs for the purpose of expressing thought, the important psychological condition of comprehension is that each word shall arouse such associations as are related to the main thought. This is rather difficult; for each word has many associations, one or all of which may be aroused by the stimulus word. If this happens, we have a condition of free associations, or revery, but no comprehension. The latter is a process of controlled association determined by the context, or central thought, of sentences or paragraphs. Failure to get the right control results in nonsense.

The relationship of associations to comprehension was shown by an experiment of Thorndike. He presented to two hundred pupils from Grade VI copies of the following paragraph with questions to be answered by them:

> In Franklin, attendance upon school is required of every school child between the ages of seven and fourteen on every day when school is in session unless the child is so ill as to be unable to go to school, or some person in his house is ill with a contagious disease, or the roads are impassable.

The answers to the first question (What is the general topic of this paragraph?) are typical of the replies to all the questions and were in part as follows:

Franklin
In Franklin
Franklin attendance
Franklin School
Franklin attending school
School days of Franklin
Doings of Franklin
Franklin attends to his school
It is about a boy going to Franklin
It was a great inventor
A few sentences

Made of complete sentences
A sentence that makes sense
A group of sentences making sense
A group of sentences
Subject and predicate
Subject
The sentence
A letter
Capital
A capital letter
To begin with a capital
The first word
A general topic
Good topic
Leave half an inch space
The heading
Period
An inch and a half
An inch and a half capital letter

Here we see two groups of free associations, one of which is related to the second word in the assigned selection, *Franklin*, and the other to the word *paragraph* in the question. Evidently these were called up because only the word *Franklin* or the word *paragraph* impressed the reader. As Thorndike says:

> Understanding a paragraph is like solving a problem in mathematics. It consists in selecting the right elements of the situation and putting them together in the right relations, and also with the right amount of weight or force for each. The mind is assailed as it were by every word in the paragraph. It must select, repress, soften, emphasize, correlate and organize, all under the influence of the right mental set or purpose or demand.

The last sentence suggests the key to a device by which free associations may be avoided and the right ones recalled. It is to be done through creating the proper mental set, or purpose, in the reader. This may be accomplished by advance ex-

planations, by questions, by suggestions of content, by statements of main ideas, and in numerous other ways which we shall discuss later.

Factors influencing Degree of Comprehension

Since comprehension is conditioned by recalled associations, its degree is limited by the child's background of experience, his age and grade, his intelligence, his mode of reading, his speed, and the kind of special training he received in developing associations.

Influence of Age and Grade

The influence of age and grade may be measured by any one of the standardized tests in comprehension, such as the Thorndike-McCall, Haggerty, Courtis, Monroe, or Stone tests. Table XIII gives the age and grade norms for the Thorndike-McCall Reading Scale.

Table XIII. Age Norms for Comprehension in Silent Reading (Thorndike-McCall Test)

Age (months)	73	84	96	110	121	133	144	155	167	181
Approximate years . .	6	7	8	9	10	11	12	13	14	15
Score	23	27	31	36	40	44	48	52	56	61
Age (months)	192	203	215	229	240	252	263	275	287	293
Approximate years . .	16	17	18	19	20	21	22	23	24	24.41
Score	65	69	73	78	82	86	90	94	98	100

Grade Norms. (Thorndike-McCall Test)

	Grades											Superior Adult
	II B	III B	IV B	V B	VI B	VII B	VIII B	IX B	X B	XI B	XII B	
Score	30	37.3	41.84	48	53.7	58.3	59.6	62.1	63.6	65.4	68.1	72

What these scores mean may be found by comparing some of them with the difficulty of the paragraphs which they represent. Below are three paragraphs from this scale.

Three Paragraphs from the Thorndike-McCall Reading Scale[1]

Read this and then write the answers. Read it again if you need to.

Fred lives in the country. He likes to hunt and fish, and has a gun that cost sixteen dollars. His sister Grace keeps hens and ducks, and sells the eggs. She is learning to play the piano, and goes to Miss Thomas for a lesson every Saturday. She likes music but Fred doesn't.

1. What does Grace sell? _____
2. What two things does Fred like to do? _____
3. On what day does Grace go for her piano lesson? _____

Read this and then write the answers. Read it again if you need to.

EVERY HOME NEEDS A GARDEN

A Magazine published to promote real gardening. Most people do not think much about their gardens at this time of year, but if more people did there would be more good gardens. If you live in a city where space is at a premium, we provide pleasure for you by suggesting how to grow flowers indoors. If you live in the country and have a garden and do not experience the satisfaction of seeing things grow as a result of your own efforts — then you need the X. Y. Z. magazine.

24. According to the advertisement what sort of people do not easily find room to have a garden? _____

_____

25. What does the advertisement say would be the result if people thought more about their gardens in the time of year referred to? _____

_____

What source of pleasure is suggested for city dwellers? _____

_____

[1] Quoted by permission of the Bureau of Publications, Teachers College, New York City.

Read this and then write the answers. Read it again if you need to.

Religion has meant many things in human history; but from now onward when I use the word I mean to use it in the supernaturalist sense, as declaring that the so-called order of nature, which constitutes this world's experience, is only one portion of the total universe, and that there stretches beyond this visible world an unseen world of which we now know nothing positive, but in its relation to which the true significance of our present mundane life consists. A man's religious faith (whatever more special items of doctrine it may involve) means for me essentially his faith in the existence of an unseen order of some kind in which the riddles of the natural order may be found explained. In the more developed religions, the natural world has always been regarded as the mere scaffolding or vestibule of a truer, more eternal world, and affirmed to be a sphere of education, trial or redemption.

34. In relation to what world does the paragraph say that the true significance of men's earthly lives is found? _____

_____

35. Of what is this world's experience constituted? _____

36. What differentiates the developed from the undeveloped religions? _____

The first paragraph is the easiest in the scale, the second is about the middle of the scale in difficulty, and the third is the most difficult one in the scale. Answering one question on the first paragraph will give a score of 27; answering two questions on the second paragraph and all those on previous paragraphs will give a score of 50; answering two on the last paragraph and all the preceding questions will give a score of 73. Nearly 99 per cent of the twelve-year-olds can make a score of 27, 50 per cent of them can make a score of 50, and only one in a thousand can make a score of 80.

The scores for the ages beyond the sixteenth year do not represent the average score of the people of those ages but merely degrees of ability. Practically speaking, intelligence

does not increase beyond the sixteenth year; but theoretically we can represent degrees of intelligence by seventeen, eighteen, or twenty years.

INTELLIGENCE

No doubt the primary factor which causes an increase in the reading score with age and grade is the growth of intelligence; the gain may be partly due to the increase in the number of associations with words because of practice and experience, but how much is due to this has not yet been measured. The importance of intelligence, however, is indicated by a high correlation between the Thorndike-McCall and Stanford Revision scales. In a certain city where over seven hundred children were tested with both tests this was found to be 0.72, which is very high. But the size of this figure varies with the kind of tests used. Haggerty, who has made both intelligence and reading scales, computed the relation between intelligence and comprehension in reading by sorting the reading scores of two hundred adults into tenths and then calculating the intelligence score of the corresponding groups. In this way he found the score of the lowest 10 per cent in the reading test to be 45.5, and the score of the same persons in the intelligence test to be 90.5. The reading score of the highest tenth was 111 and their intelligence score was 139.5. Between the lowest and the highest tenth there was a close correspondence between the increments in the reading score and those in the intelligence score. The relationship between intelligence and comprehension may also be seen from the changes in quality of interpretation produced by differences in mental level. At the three-year-old level the normal child simply names objects in a picture, as *kitty, girl, mamma, table, bread*; at the seven-year-old level he is descriptive and states relations between objects, as "The bread is on the table," "The little girl is crying"; at the twelve-year-old level he gives reasons for certain appear-

ances, "The little girl is crying because she is hungry or because her mother punished her." The significance of this for the learning and teaching of reading is that the material used in reading must be carefully selected with reference to the mental level and brightness of the child.

Rate of Reading

The rate of reading influences the degree of comprehension. How much it does so may be judged from the results discovered by W. S. Gray in his survey of the schools of Cleveland and St. Louis. He tested 1831 children in Cleveland and 2949 in St. Louis both for speed and comprehension, using his own silent-reading tests. He classified the children into three groups according as they were rapid, medium, or slow readers, and then calculated the percentage in each group who had good, medium, and poor comprehension respectively. Table XIV gives the results.

Table XIV. Relation of Speed of Silent Reading to Comprehension. (After W. S. Gray)

Comprehension	Rate		
	Rapid	Medium	Slow
Cleveland			
Good	14	11	8
Medium	12	11	10
Poor	6	11	15
St. Louis			
Good	13.1	10.7	9.5
Medium	9.5	13	11.3
Poor	11	9.9	12.3

It appears that the rate of reading has only a slight influence on comprehension; for, whatever the rate, the reader may be good, poor, or medium in comprehension. But it is important to notice that a rapid reader is likely to be good in comprehension and that a slow one is likely to be poor in

comprehension. One reason for this relationship is that probably when a person reads more rapidly, he must give his whole mind to the task and cannot stop for daydreaming or contemplating the beauty of the sunbeam coming through his window. Another is that when a number of words come before one's mental vision in quick succession their relationships are more perceptible. But a better explanation is that both rapid reading and good comprehension are due to a common factor — high native ability.

Summary

The meaning of reading matter is given by the associations aroused by the words. The correct meaning is due to a process of controlled association under the influence of a mental set which inhibits free associations, selects the right ones, and puts them together in the relationship required by the context. Most errors in comprehension are due to the arousal of free associations unrelated to the context, a condition caused by the reader's failure to form the proper mental set.

The degree of comprehension increases with the age and grade of the pupil. It also increases with the mental age and brightness of the pupil, and it has a tendency to be greater for rapid readers than for slow readers.

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CHAPTER VI

READING: THE LAW OF ASSOCIATION APPLIED TO IMPROVING COMPREHENSION IN READING

Use Meaningful Material

In applying the law of association to improving comprehension of reading matter the first suggestion is that meaningful material be selected. When the words used in teaching beginners to read mean nothing, there is no opportunity for comprehension, and all that the children can learn is pronunciation (or word-calling), phonetics, and spelling. These were the principal results obtained by the alphabetic system and certain of the older phonetic systems of teaching reading. They were due in part to the meaningless character of the material and in part to the method of teaching. But in practically all modern systems of teaching beginning reading meaningful material in the form of interesting stories is used. This at once creates the proper impression that words are not only to be pronounced but also to be understood.

Use Materials containing the Pre-School Child's Spoken Vocabulary

A second suggestion is that the material used should be within the child's background of experience. Since comprehension is due to recalled associations it is evident that nothing can be recalled when it is about objects and actions of which the child has no experience. Not only should the things described be familiar, but the words should be taken from the vocabulary the child uses in speech. If this is true,

it is worth while to consider if the pre-school child's oral vocabulary is sufficiently large to form a basis for reading.

Size of the Pre-School Child's Vocabulary

Such counts as have been made of the pre-school child's words reveal astonishingly large vocabularies. Mrs. Nice, who not only counted the words used by her own children but also summarized similar investigations made by others, finds that counts have been made of two six-year-olds, two five-year-olds, seven four-year-olds, and eleven three-year-olds. These showed averages of 1338 at the age of three, 1843 at the age of four, 4225 at the age of five, and 3103 at the age of six. These are no doubt above the average, for the children studied were born of competent professional people and had the advantage of unusual gifts and opportunities. However, three investigations made on large numbers of school children showed a total vocabulary of nearly 5000 words. These were made by Ernest Horn, who made an individual study of the oral vocabulary of eighty children varying in age from one to six years; by Mrs. Ernest Horn, who directed the recording of 200,000 running words spoken by kindergarten children; and by Packer, who recorded 70,000 words spoken by first-grade children. The words which had a frequency of 25 or more in two of the lists and of 15 or more in the three lists numbered 1120. This number may be taken as the approximate vocabulary of the beginning school child and is amply large to serve as a basis for learning to read.

The Child's Words refer to Objects he understands. What they Are

The importance of using the child's vocabulary is that it refers to objects and relationships which he understands. An analysis which Mrs. Nice made of her daughter's vocabulary with respect to parts of speech showed that 56.8 per cent

were nouns, 20.7 per cent were verbs, 13.7 per cent were adjectives, 5.4 per cent were adverbs, and that pronouns, prepositions, and conjunctions constituted from 1.5 to 0.4 per cent of the total number of words. An analysis of the nouns showed that 28.7 per cent referred to personal experiences such as play, food, baby, health, and clothes, 37.9 per cent to outdoor environment such as animals, plants, and landscapes, 11.2 per cent to the house and other belongings, and that the remaining 16 per cent were divided among pictures, people, and things abstract. A similar analysis of a large number of children would show some changes in the proportion, but this gives us a fair idea of the kind of experiences which beginning school children can comprehend.

In Primary Grades give the Major Portion of the Time to Oral Reading

A third suggestion from the law of association is that the major portion of the time given to reading in the primary grades should be devoted to oral reading. To do so is the most economical way of developing comprehension. Hundreds of spoken words already have meaning for the child. Hence to make reading meaningful it is necessary only to attach the oral form to the visual; that is, to learn to pronounce the words in print. It is true that often oral reading is only a process of word-calling; but this is due principally to the method of teaching in which the child's attention is drawn only to such elements as pronunciation, phonetic analysis, or spelling, and in which the question what the words mean is never raised. Nevertheless there is a rich background of associations behind many auditory words, and with proper checks on comprehension these can readily be attached to the printed words in oral reading. Theoretically there is no reason why meaning should not attach just as directly to the visual forms of words as to the auditory. If this could be done, it would mean that many could read pages

almost as rapidly as they do lines in oral reading, for it takes only a moment to see all the words in a page. But at present there appears to be no technique for developing this type of reading. Most persons must take the slow method of recognizing mentally at least the pronunciation of a word before it yields a meaning.

Create a Proper Mental Set

A fourth suggestion from the law of association for developing ability in comprehension is to create the proper mental set. This may be done by some devices which direct attention to content. Most of the devices which experiments have found helpful come in this class.

Motivated Drill with Directions requiring a Response

How comprehension may be improved by motivated drill was shown by Hoover, who carried out an experiment with 1139 third-grade children in Kansas City, half of whom received drill ten minutes a day three times a week from January 1 to April 1, and the other half only the traditional instruction. Four types of drill cards were used:

1. Action cards of the type: School closes at four o'clock in the afternoon. Show how the face of the clock looks at that time.
2. Language response cards of the type: Name some good winter games.
3. Pretense cards of the type: Act as if you were hoeing in the garden.
4. One-word response cards of the type: Is ten greater than nine?

Two special features of the drill were variety and play. Variety was supplied by having from one hundred to two hundred and fifty cards for each set; play was introduced by passing a card from one child to another, then having one child do the acting and the other the judging and the scoring.

Before and after this drill all the children were tested by Monroe's Silent Reading Tests. The following summary gives the average results for comprehension:

TABLE XV. EFFECT ON COMPREHENSION OF DRILL WITH PROBLEM CARDS

	JANUARY	APRIL	STANDARDS FOR GRADES		
			III	IV	V
Drill Group	4.0	9.0	4.2	7.2	9.0
Non-drill Group	3.9	7.0			

It will be seen that the drill group made as much improvement in three months as a class receiving the traditional instruction ordinarily makes in two years.

Printed Directions for Paper-Cutting

Another experiment showing the value of motivated drill for comprehension was made by Miss Smith in the primary grades of the Detroit schools. The drill work in reading consisted of directions for making group pictures by cutting and piecing together individual pictures. The names of the objects were indicated by a "dictionary" in which the name of each object appeared in both print and script in connection with each picture. After the group picture was completed, a story describing it was composed. The effect on comprehension was such that the children gained in three months as much as they ordinarily gain in a year.

Advance Questions on Content

Comprehension is enhanced by a test given in advance of the reading. Yoakam tested grade pupils for their comprehension of prose when they were given a test in advance which contained questions on the main parts in the selection and also when they were not given such a test. Table XVI

gives the percentage scores of questions correctly answered immediately after the reading, for Group A, which had the test both before and after the reading, and for Group B, which did not have the test before reading. Both groups spent the same amount of time on their work.

TABLE XVI. EFFECT OF ADVANCE QUESTIONS ON COMPREHENSION OF READING. GROUP A, WITH ADVANCE QUESTIONS; GROUP B, WITHOUT

GRADE	GROUP A	GROUP B
IV	24.2	17.0
V	30.5	24.7
VI	39.3	29.8
VII	48.2	34.6
VIII	52.4	37.8

The advance questions had the effect of directing the attention of the pupils of Group A to facts that remained unnoticed by Group B. The value of advance questions was also shown in some experiments made by Germane, who in one experiment assigned a selection to a class of eighty-eight college students which was divided into two groups, A and B, each group spending twenty minutes in studying the selection. Group A was given a list of questions and was told that after reading them it should spend the remaining time in answering the questions mentally. Group B had no advance questions and spent all the time in reading and re-reading. A comprehension test which followed showed that Group A made a total of 732 points as against a total of 561 by Group B. In a similar experiment made on one hundred and fifty-six pupils from Grades VI–VIII, Group A made a total of 617 points as against 401 by Group B. In another experiment with two hundred and thirty-eight pupils from Grades VII and VIII Group A was given advance questions the answers to which constituted a summary of the piece. Group B, which had no advance questions, spent the same amount of time (twenty-five minutes) in reading and re-reading the assigned

selection. A comprehension test that followed and that included some of the same questions as the advance list showed a total score of 1415 points for Group A as against one of 1248 for Group B. In another selection the total in favor of Group A was 841 as against 704 for Group B. In a third experiment it was found that when the summary was not preceded by advance questions and was written by pupils, reading and summarizing were not so valuable as the same amount of time spent in reading and re-reading. In this case the summaries were too verbose and contained many nonessential items.

Advance Explanations of Content

How advance explanations of content increase the comprehension of a reading assignment was shown in an experiment by Grace Bird. She assigned to a class of one hundred normal students a chapter on the nervous system in Colvin and Bagley's "Human Behavior." The direction was simply to read the chapter. The next day the class was given an examination on content. The following semester another class of equal size and ability was given the same assignment, but this time more than half an hour was spent in explanation and demonstration with one brain model and a preserved human brain, the teacher making an effort to arouse interest. The written test which followed the next day showed an average grade of 74 as against 54 by the class without advance explanations.

Reading with the Intention of Finding and Retaining the Central Thoughts

Alderman made an extensive experiment of the value of directions that require pupils to find and retain the central thoughts in selections from textbooks. On two days a week the pupils spent fifteen minutes in reading a selection and in organizing the main thoughts around a certain topic, after

which the teacher spent fifteen minutes more in outlining the selection and in helping the pupils to make corrections and additions. On two other days a week the first half of the period was followed by a test of ten oral questions on the content of the assignment, and once a week a retention test was given on all the reading assigned for that week. One day a week the exercise was devoted to the explanation of new words for the purpose of enlarging the pupils' reading vocabulary. A total of seventy-five teachers, seventy-two classes, and nineteen hundred and thirty-three pupils from Grades IV–VIII participated in the experiment, and an average of thirty minutes a day for one semester was given to the work.

At the beginning of the experiment and at the end different forms of the Thorndike-McCall Reading Test were given to all the pupils. There were no control groups, but the gains made were compared with the standard gains for one semester. The effect of the instruction was that the pupils made an average standard gain of two semesters in one. In September only five of the seventy-five classes were up to the standard, but in February forty of them had reached that point. The totals were therefore very great, but in four hundred and two individual cases there was a loss. Most of these cases were in the brightest quarter of the pupils — a fact which showed that a type of instruction which is helpful to a large group may be harmful to some individuals.

Applying a Variety of Devices to a Group after Diagnosis

During a period of six months from November to May, Miss Geiger succeeded in raising the level of comprehension in a class of thirty-three third-grade pupils from 9 to 18 in the Monroe Standardized Silent Reading Tests. This was equivalent to a standard gain of a year and a half. She began by giving her class three standard reading tests: the Monroe Test, the Thorndike Visual Vocabulary Test, and the Gray Standardized Reading Paragraphs. After diagnosing the

principal weaknesses of the class she used the following devices in group work:

1. Dividing a story into thought units after the meaning has been acquired.
2. Visualizing and naming parts in a story.
3. Sentence-completion exercises based on the thought of a story.
4. Finding the relation of the title to the central thought.
5. Finding solutions to problems raised from pictures, from the title, or from the opening sentence.
6. Canceling extra words in sentences.
7. Seat work with the Thorndike Test on the understanding of sentences.
8. Applying a variety of devices to individuals with difficulties in interpretation.

Just as there are individuals who have peculiar difficulties in speed, so there are some who have special difficulties in interpretation. These require the same kind of careful diagnoses that was described with individual difficulties in the speed of reading. Miss Geiger, in the experiment described above, found individuals with such difficulties. One was a boy, No. 25, who read rapidly but failed to get the thought. He was given the following devices for developing his ability in comprehension.

1. Exercises in the reproduction of simple stories by (1) telling or writing, (2) pantomime or dramatization, (3) illustrating the main thought by a drawing, cutting, or painting, (4) answering questions on the story, and (5) working out the story on a sand table.
2. Reproducing flashed phrases from memory.
3. Reading in phrases separated by bars.
4. Building sentences from disarranged words.
5. Finding parts in a story that express specific qualities, such as honor, humor, fidelity, excitement, suspense, and the like.
6. Reading for a specific purpose; for example, finding out what the character of each person in the story is.

7. Supplying omitted words in sentences.
8. Illustrating lessons according to specific directions.

The results of the instruction were that in six months the boy made a gain of more than three years in comprehension and a gain of more than five years in rate.

W. S. Gray, who, in his "Remedial Cases in Reading," reports the diagnosis and treatment of a number of cases having difficulties in interpretation, summarizes the causes as follows:

(*a*) A lack of training in intelligent interpretation, (*b*) failure to direct attention to content while reading, (*c*) inadequate or ineffective habits of thinking, (*d*) a narrow range of experience concerning the things referred to in selections, (*e*) inadequate reading experience in certain types of selections, such as factual and problematic, (*f*) immature language habits which resulted in failure to grasp the meaning of many commonly used forms of expression, and (*g*) an uncultivated imagination which resulted in reading into passages things which were not there. Other causes of failure in interpretation: (*a*) difficulties in mechanics of reading, (*b*) lack of interest in reading, (*c*) inadequate learning capacity, (*d*) careless habits of reading, (*e*) inattention, (*f*) lack of feeling of responsibility for the content, and (*g*) ineffective application. It is significant that most of the causes of inadequate interpretation can be removed if effective methods of instruction are employed.

Effect of the Size of the School

Pupils attending large schools show better comprehension than those attending small schools. This was shown by comprehensive surveys made in rural schools of New York, Virginia, Indiana, and Iowa. The results found in New York are typical of those in other states. This survey was made by Haggerty, who used his reading tests, Sigma 1 and Sigma 3, both of which are tests in comprehension. The first was used in Grades I–IV inclusive; the second, in Grades V–XII inclu-

sive. In the one-teacher schools the average score of Grade IV was 29.2; in the four-teacher schools the average was 26.7 for Grade III and 34.3 for Grade IV. In the one-teacher schools the average score for Grade VIII was 65.8, whereas in the four-teacher schools, the average was 70.5 for Grade VIII and 80.7 for Grades VII and VIII. In the small high schools the average score was 111.7 for Grade XII, whereas in the large schools it was 111.5 for Grade XI and 118 for Grade XII. The results indicate that the small schools are about a year behind the large ones in comprehension. It is difficult to see how the size of a school would influence a child's comprehension except through such factors as the quality of the teaching and the amount of time devoted to reading. Haggerty reports that the four-teacher schools employ a much larger percentage of normal-school graduates than do the small schools. This would indicate that the remedy for this condition in the smaller schools lies in consolidation and in securing better-trained teachers.

Summary

Comprehension in reading can be greatly increased by training. This is the significant conclusion which may be drawn from the experiments that have been made on the improvement of comprehension. To develop comprehension the teacher should use meaningful materials which contain the pre-school child's spoken vocabulary. For the beginning school child in America, reared in an English-speaking home, this averages over eleven hundred words, a number that is ample to serve as a basis for learning to read. In the primary grades the major portion of the reading time should be given to oral reading, because spoken words are more meaningful to the young child. The teacher should also endeavor to create the proper mental set for each selection. The following devices have proved useful with groups of pupils:

Motivated drill with directions requiring a response.

Printed directions for paper-cutting.

Advance questions on content.

Advance explanations of content.

Reading with the intention of finding and retaining the central thoughts.

Dividing a story into thought units after the meaning has been acquired.

Visualizing and naming parts in a story.

Sentence-completion exercises based on the thought of a story.

Finding the relation of the title to the central thought.

Finding solutions to problems raised from pictures, from the title, or from the opening sentence.

Canceling extra words in sentences.

Seat work with the Thorndike Test on the understanding of sentences.

These devices cannot be used indiscriminately for any group, but must be adjusted to the age, grade, and special difficulties of a group. The following devices among many others have proved useful in remedying difficulties in interpretation in individual pupils whose cases had been carefully diagnosed (it must be understood that the effectiveness of the remedy depends on the specific nature of the difficulty):

Exercises in reproduction of simple stories by (1) telling or writing, (2) pantomime or dramatization, (3) illustrating the main thought by a drawing, cutting, or painting, (4) answering questions on the story, and (5) working out the story on a sand table.

Reproducing flashed phrases from memory.

Reading in phrases separated by bars.

Finding parts in a story that express specific qualities, such as honor, humor, fidelity, and the like.

Reading for a specific purpose; for example, finding out what the character of each person in the story is.

Supplying omitted words in sentences.

Illustrating lessons according to specific directions.

The causes of poor comprehension are numerous, the more important being free association, lack of training, inattention to content, narrow experience, difficulties in mechanics of reading, lack of interest, and lack of ability.

Pupils in one-teacher schools usually do not comprehend as well as those who attend four-teacher and larger schools.

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CHAPTER VII

READING: THE LAW OF SATISFACTION AND INDIVIDUAL DIFFERENCES

Probably no school subject has so many opportunities for making an activity satisfying as does reading, for there is almost no interest to which an appeal may not be made by it. In teaching beginners to read, however, the instinctive appeals which a teacher can make are somewhat restricted. They are imitativeness, curiosity, mastery, rivalry, desire for approval, and action. Imitativeness is taken in the sense of a desire for participating in the activities engaged in by others. Small children show this when, to play at reading, they pick up a paper, sit down, hold the paper up before them, and make babbling sounds in imitation of their elders. By the time they are old enough to enter the first grade they have observed that reading is an important activity of older children and adults, and they have a desire to participate in this activity for themselves. Curiosity refers particularly to the satisfaction which children get from the mental activity of naming and interpreting the black marks on the white paper. Later this develops into an interest in the progress and outcome of the story, and still later into an interest in the new information revealed by books. Mastery, the desire for approval, and rivalry are important impulses to appeal to when the completion of a task becomes monotonous. In learning to read there is a long period between the interest aroused by imitation and novelty and that which comes from the intrinsic values of meanings. This is the period when learning to read is a monotonous task. It is the period which gives the

teacher his greatest difficulty. But if he is ingenious in his appeals to mastery, the desire for approval, and rivalry, the wide gap between interest from novelty and interest from meaning will be successfully bridged. At this time oral-reading scores, scores for rate of silent reading, comprehension scores, and progress curves are effective devices for arousing mastery and rivalry and for keeping up a live interest in reading. Rewards of approval for success cost little, and a generous distribution of them will add to the satisfaction of success. Action refers to the instinctive interest which children have in moving about, in doing something, and in expressing their feelings and thoughts in gestures. This instinct gets expression in dramatization and is used in every system of teaching beginners to read. One of its great values is that it gives meaning to words by connecting them with definite reactions, but its value in keeping children alive and awake are quite important. After the children have once mastered the mechanics of reading, there is no kind of interest or instinct which may not be appealed to. Fighting, anger, escape from fear, adventure, novelty, love, sex, mother love, self-assertion, sympathy, hate, grief, mystery, and all other impulses which invade the soul may be aroused by stimulating the imagination through the printed word.

Although reading may appeal to any interest, nevertheless investigations show that children's interests in reading are rather well defined and that some are much stronger than others. The most effective way to make use of the law of satisfaction in teaching reading is to select materials that appeal to such interests. For example, if a boy has a special interest in domestic animals and pets, then books on these subjects will interest him. On the other hand, if his special interests are in school life or sports, then he should be given books on these subjects. The relation of the child's interests to the materials in reading will, however, be more fully discussed in our next chapter.

Varying Records of Achievement in Reading

One of the most important problems in reading, as in other school subjects, is the adjustment of the course to the individual capacities of the pupil. These vary greatly both in rate and in comprehension. An idea of how pupils vary in rate may be obtained from Stone's results from three hundred and twenty-four eighth-grade pupils in St. Louis who read a narrative entitled "The Spy," from Cooper. This test has the advantage of being a pure speed test. It does not require the pupils to stop and think while reading, and it allows each pupil to finish the entire story. Although it is a group test, Stone has made a device which enables each pupil to record his own time to the nearest five seconds. His results are given in Table XVII. He found that the reading rates of these pupils from Grade VIII varied all the way from a hundred words a minute to seven hundred and forty-three words. The slowest speed is about the proper speed for a third grader, and the most rapid is far beyond the average college senior.

Table XVII. Distribution of Three Hundred and Twenty-Four Eighth-Grade Pupils in Rate of Silent Reading. (After Stone)

Words per Minute	Number of Pupils	Words per Minute	Number of Pupils
100–149	17	400–449	11
150–199	71	450–499	6
200–249	95	500–549	5
250–299	52	550–599	4
300–349	36	600–649	3
350–399	21	650–699	2
		700–750	1

Comprehension is measured in Stone's test by a series of twenty questions on the content of the reading which the pupil is required to answer after he has finished the story. The score is the percentage of questions answered correctly.

For the pupils listed above, these scores varied all the way from 10 to 100. The differences in the degree of comprehension are as wide as those in the rate of reading.

That this is not an unreasonable assumption is indicated in the results obtained by Haggerty from his survey of the rural schools of New York. The results which he obtained from the upper four grades with his Sigma 3 test show this clearly. This test consists of three parts. The first part is a vocabulary test, in which the student is required to underscore that one of four words which has the same meaning as a fifth word. In the second part he indicates his correct reading of a large number of questions by writing either Yes or No. The third part consists of a series of paragraphs of increasing difficulty. After each paragraph appear questions on its content. The correct answer is printed among several false ones. The pupil indicates his comprehension by marking some which are false and some which are true. The total number of points made in the three tests is the pupil's comprehension score, the maximum score being 144. In the four-teacher schools which Haggerty surveyed he obtained scores from 739 pupils in Grade V, from 711 pupils in Grade VI, from 571 pupils in Grade VII, and from 814 pupils in Grade VIII. Table XVIII, on page 90, shows the number of pupils in each grade obtaining each score. It will be seen that in Grade V the scores vary from 0 to 120, and that in Grade VIII they vary from 15 to 135. The average second-grader can make a score above 10 in the test, whereas 135 is beyond the average college freshman.

Overlapping as a Result of this Variation

One consequence of these wide differences between individuals of the same grade is that in each grade there are a number of pupils who have equal abilities, or in any one grade there are a number of pupils who equal those in either higher or lower grades. This is called the overlapping of

TABLE XVIII. READING: SIGMA 3, FORM B. FOUR-TEACHER ELEMENTARY SCHOOLS, GRADES V–VIII. DISTRIBUTION OF SCORES BY GRADES; MEDIAN SCORE AND MEDIAN AGE FOR EACH GRADE [1]

SCORE	GRADE V	GRADE VI	GRADE VII	GRADE VIII
00	3	1		
1–5	11	2		
6–10	14	4		
11–15	30	10		1
16–20	40	20	1	1
21–25	47	20	4	
26–30	77	33	3	
31–35	63	53	13	3
36–40	74	57	25	12
41–45	84	54	39	22
46–50	68	52	47	27
51–55	54	62	28	35
56–60	36	58	39	41
61–65	29	58	37	60
66–70	29	50	54	67
71–75	29	44	61	65
76–80	23	31	49	77
81–85	7	35	42	75
86–90	7	20	39	67
91–95	5	15	39	77
96–100	7	13	20	54
101–105	1	5	7	46
106–110		5	7	34
111–115		7	11	22
116–120	1	2	5	20
121–125			1	5
126–130				2
131–135				1
Total	739	711	571	814
Median scores	42	55	71	81
Median ages	11.7	12.6	13.5	14.3

grades. The amount of this overlapping may be seen from the curves in Fig. 8, which show what percentages of the pupils in Grades V, VI, VII, and VIII, respectively, made each score. Curve No. 1 is for Grade V, Curve No. 2 for Grade VI, and so on. It will be seen that each curve covers almost the entire range of the scale. The amount of surface

[1] M. E. Haggerty, "Educational Achievements," 1922. One of a series of books under the general title of "Rural School Survey of New York State."

common to two curves indicates the amount of overlapping between the respective grades. The pupils falling within this common area have equal abilities in reading; that is, the scores made by the pupils in this area belonging to one grade are matched by those of the pupils in this area belonging

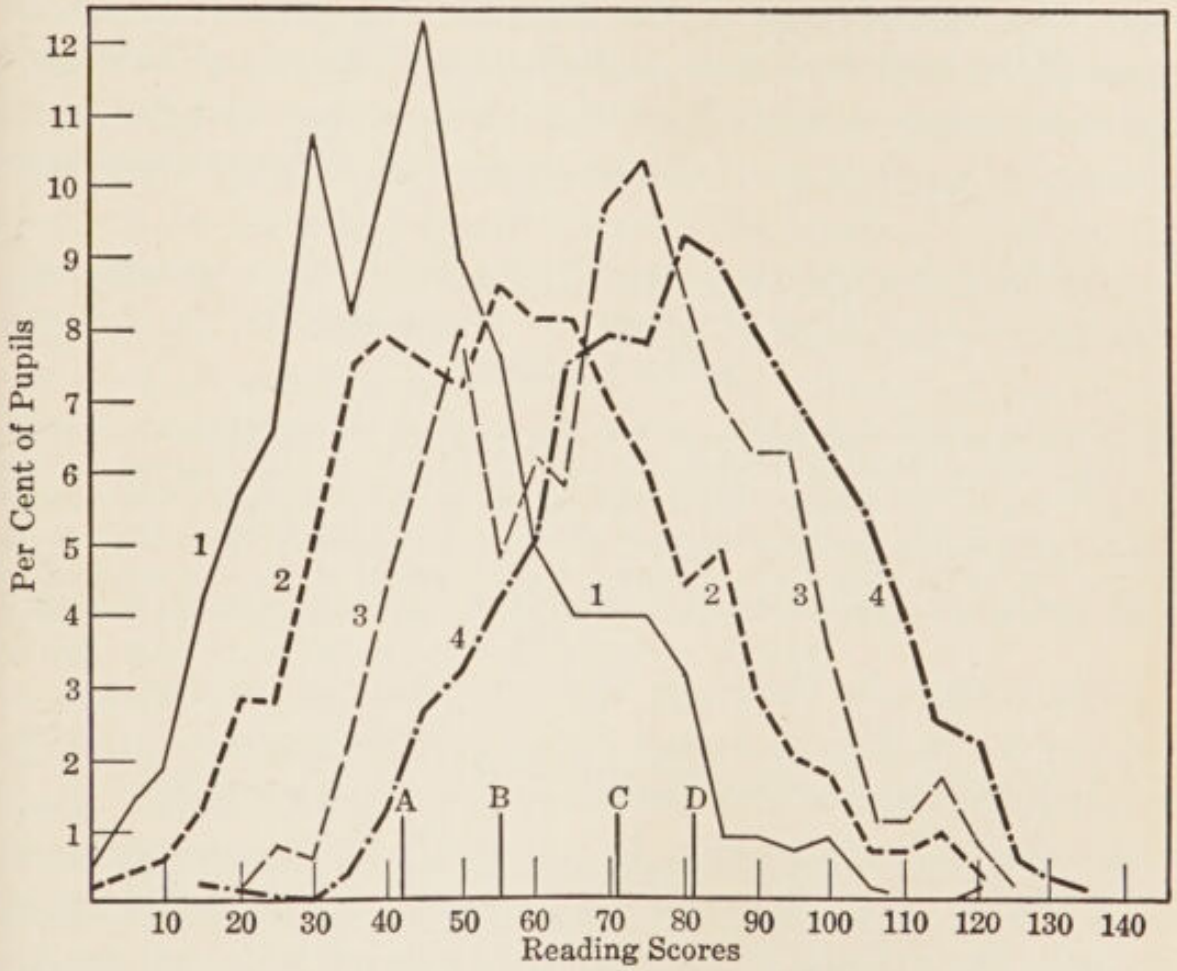


FIG. 8. Showing distribution and overlapping of pupils in grades V, VI, VII, and VIII in the comprehension of silent reading according to data in Table XVIII

Curve 1 is for Grade V; curve 2, for Grade VI; curve 3, for Grade VII; curve 4, for Grade VIII. A represents the median for Grade V; B, the median for Grade VI; C, the median for Grade VII; D, the median for Grade VIII

to other grades. The pupils in this area cover the same region of the scale, have the same average score, and differ from each other in the same way. It will be seen that this common area is greatest for adjacent grades and becomes less as the distance between any two grades increases. If there were no overlapping, the curves would come after each other

instead of over each other. The curve for Grade VI would begin where the curve for Grade V ends, the curve for Grade VII would begin where Grade VI ends, and so on. The extent of this overlapping between any two grades may also be expressed in percentages. This is done in Table XIX, which tells what percentage of the pupils in Grade VI equals or exceeds the median of each higher grade. The term "median" refers to the score made by the middlemost pupil in the grade when all the pupils are ranked in order from lowest to highest.

TABLE XIX. PERCENTAGE IN GRADE VI EQUALING OR EXCEEDING THE MEDIAN OF EACH HIGHER GRADE IN COMPREHENSION IN READING
(After Haggerty)

24.4 per cent of the sixth-grade pupils equal or exceed the seventh-grade median
14.6 per cent of the sixth-grade pupils equal or exceed the eighth-grade median
4.8 per cent of the sixth-grade pupils equal or exceed the ninth-grade median
2.5 per cent of the sixth-grade pupils equal or exceed the tenth-grade median
2.5 per cent of the sixth-grade pupils equal or exceed the eleventh-grade median
0 per cent of the sixth-grade pupils equal or exceed the twelfth-grade median

This table tells the same story in terms of percentages as the curves in Fig. 8, except that it continues into the high school and does not give the overlapping between each grade and those of lower grades. It is typical of the overlapping in each grade. If we take the results for all the grades we shall see that the amount of overlapping between adjacent grades varies from 18 to 40 per cent and that it is greater in high school than in the upper four grades. The smaller figure is the percentage for the overlapping between the eighth and ninth grades and is undoubtedly due to the large percentage of pupils who drop out of school at the end of the ninth grade. The larger figure is the amount of overlapping between the eleventh and twelfth grades. With such variations we can understand what a difficult problem the teacher has to adjust her instruction to the needs and abilities of each pupil. Within the sixth grade, for example, there are some who have no more than the average ability of a first-grader and some

who have the average ability of a college student. For those having first-grade ability the story of the "Three Little Pigs" is proper material; for those having the ability of a college student "Hamlet" is proper material, and for the average sixth-grader "Black Beauty" or "Hiawatha" is suitable. But the average material is a waste of time for those having the abilities of pupils of the first, second, and third grades and also for those having the abilities of high-school or college students. We also see how ill adapted the ready-made course of study for the sixth grade is for all the pupils in that grade. The same is true of the ready-made course of study for any other grade. Ready-made courses of study fit only about 30 per cent of the students falling in the middle of the total range of abilities in each grade, and even for those the fit is far from having a tailored effect. This is evident in Fig. 8 from the small differences between the medians of the different grades in comparison with the wide differences between the individuals of the same grade.

Reclassification the First Step in the Solution

With the classification remaining as it is the teaching problem is simply an impossible one. The first step in its solution is *reclassification*. In an ideal situation we should have only those in one grade who are above the middle of the adjacent lower grade and below the middle of the adjacent higher grade. This would reduce the total range within one grade from six or twelve grades, as is often the case at present, to two grades. If the pupils were to be classified according to only one subject, there would be no reasonable objections to such a contraction of the total ranges of abilities. But it might occasion many difficulties if a reclassification were to be made on the basis of all school subjects. To avoid some of these difficulties we might allow a total range of two grades within the abilities of one grade. If so, we should allow only

those in one grade who are above the median of the adjacent lower grade. This would give us such distributions as are represented in the curves in Fig. 9. These are not ideal, but they are a vast improvement on those in Fig. 8. How shall the reclassifications be made? This is a technical problem to be solved by specialists. It will be sufficient to point out here that it should be done on the basis of careful measurements made by well-selected educational and intelligence tests. All these tests have standard scores for each grade in which they are supposed to be used. We may assume that an individual child's grade position in a given test is determined by the standard, or norm, to which his score lies nearest. In this way we get his grade position in each test. We then find the average of all these positions and classify the child in that grade to which this average falls nearest. The teacher's judgment would have to be used for those averages that fall close to the middle between two grades. Specialists, however, would use a more refined method than this, and of course would get a truer classification.

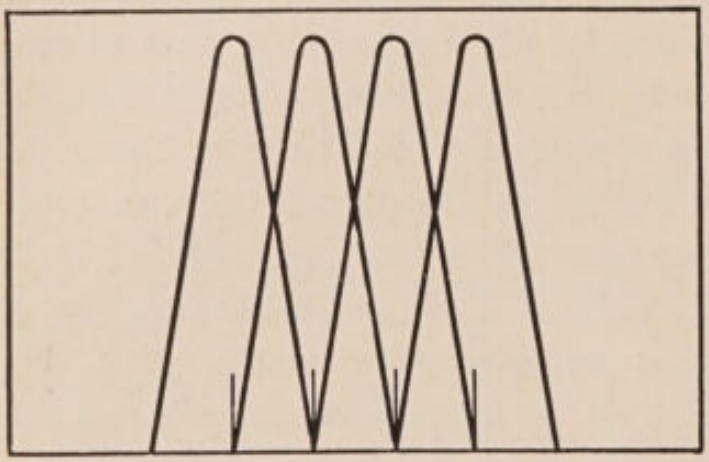


FIG. 9. Showing a more ideal form of distribution than Fig. 8, the forms which would result if all the pupils in one grade were above the median of the adjacent lower grade and below the median of the adjacent higher grade

DEVICES FOR INDIVIDUAL TEACHING

Having accomplished our reclassification we have greatly simplified the teacher's problem; but there are still plenty of difficulties, for the individual differences which remain are wide and important. The teacher could simplify her problem

of selecting proper content by dividing her pupils into three sections: superior, average, and inferior. Her adjustment to the individual interests and needs which will remain will depend largely upon her ingenuity. But there are some devices which she can use. Bright pupils who have much time for their work may be encouraged to do silent reading or voluntary reading during free periods, or home reading. Poor readers will need specific helps. It may be training in word recognition, or training in avoiding repetitions, or training in paying attention to content. Then there are special interests to be considered. Some will like animal stories; some, fairy stories; some, stories of adventure; and some will want a book telling the boy how to make a radio. Problem assignments can also be used to good advantage for those pupils who are weak in comprehension and for others who desire special information on one subject. In Winnetka the pupils are required to pass certain tests in order to be promoted from one grade to another. To prepare for these tests the pupil has the choice of a large number of books which are suitable for his grade. The only requirements are that a certain number must be read, that some of them must be chosen from specified fields, and that the pupils must pass a comprehension test on each book read. With these possible devices before her the teacher of reading has unusual opportunities for satisfying the individual requirements of her pupils.

Summary

Learning to read may be made satisfying by appealing to such impulses as imitativeness, curiosity, mastery, rivalry, the desire for approval, and action. After one has learned to read, there is no impulse, either native or acquired, to which an appeal may not be made by reading. Probably the most effective method of making reading satisfying is to select materials that appeal to the reader's interest.

The abilities of pupils in reading differ widely both in rate and in comprehension. For example, three hundred eighth-grade pupils were found to vary from 100 to 650 words per minute in rate of reading narrative prose, and, in percentage of correct answers to questions on content, from 10 to 100. Seven hundred and eleven sixth-grade pupils were found to vary from 0 to 125 words in Haggerty's scale Sigma 3, which allows a maximum score of 144 words. This would mean a difference as wide as that between an ability to comprehend the "Three Bears" and an ability to comprehend Shakespeare's "Hamlet." As a result of this variation there is a wide overlapping of the different grades; that is, there are a number of pupils in the different grades who are equal in ability with respect to the school subjects. In solving the teaching difficulties created by this situation the first step is reclassification based on a combination of scores for ability and scores for achievement. After this many adjustments must be made to meet the varying interests, attitudes, needs, and capacities of the pupils. Some devices which have proved useful for this purpose are voluntary reading during free periods, home reading, specific training for pupils' peculiar needs, voluntary selections of a certain number of books from prescribed fields, and promotion according to ability to pass specific goals.

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CHAPTER VIII

READING: WHAT READING HABITS SHOULD BE FORMED

Bobbitt's Program

What reading habits should be formed is just as important as how we should form them. Evidently before we can select the habits to be formed we must determine the purposes or uses of reading. Bobbitt, in his "Curriculum," gives us some stimulating ideas on the purposes of reading:

> New conditions demand adaptations, adjustment of proportions, the use of new and improved instruments, etc., but at bottom as indicated by all of our progressive recent movements in education, it is still felt that experimental education constitutes the best training for the individual. If the principle holds, then the purpose of reading is the *reconstruction of experience.* It is to be a *mode of living.* It is not to be didactic verbal presentation of unrooted facts and generalizations to be memorized, recited upon, examined upon, and then in due process forgotten; leaving little more than the unwholesome residue of disagreeable learning experience.
>
> If the purposes are to be accomplished for civilized man in the midst of civilized conditions as they were for primitive man among primitive conditions, then the readings from the beginning to the end of the course, to the end of life itself, need to be as wide and varied as earthly life and to give an adequate revelation of all major types of human experience, in all portions of the world, and with such historical perspective as is needed for each of the various regions. And what is more, it must look not merely to the tangible and easily apprehended things of sense, but also to the intangible forces, influences, and relations without a vision of which the more tangible things are often meaningless. The intangibles are also portions of reality.

The purpose demands catholicity of theme. The literature should reveal war, personal adventure, love, brigandage, philanthropy, religion, travels, poverty, family life, commerce, agriculture, industry, transportation, government, the struggle with nature and disease, conflicting social classes, the labors of science and technology, and the other major ingredients of human existence. As literature rings the changes upon these things for different historical periods and in different portions of the world, its field is interminable and presents material for a rich and satisfying life-long leisure occupation. It is the business of early education to start youth upon this inspiring program; to bring him to love it as he loves the simpler visual drama upon the stage or screen; to develop habits in this field that are satisfying and permanent for the intellectual illumination of a lifetime.

Objectives, in Order of Importance, for the Elementary School

We are not to suppose that the program here set forth is to be completed in the elementary school. Neither is it a program only for teachers of reading and literature. Rather is it a life-program for a complete education. The function of the elementary school is to start the youth on it and help him to develop a permanent interest in it. It cannot hope to create world-wide interests in all pupils nor expect all of them to care for an explanation of the universe in all its multiplicity of form and action. It will do as much of this as it can for those who are interested. But its more immediate objectives are to teach enough reading to assist pupils in earning a living: ability to read a "want ad.," a telephone directory, or simple directions for doing a job. Next it will try to develop enough ability in reading to enable pupils to discharge the duties of citizenship: ability to read and mark a ballot and to become informed about the minimum qualifications and requirements for public office. Thirdly, it will try to develop efficiency in interpreting the reading material used in the informational courses of the elementary curriculum.

Fourthly, it will endeavor to train pupils to use reading as a means of enjoyment, and fifthly to train those who are capable of it to enter into the serious thought-life of their communities and even of the world.

Adaptation of Current Materials to these Objectives

To what extent the materials in school readers are adapted to the objectives given above may be judged from investigations made by Starch, Vinal, and Herriott of the contents of readers extensively used in the grades.

Investigations by Starch, Vinal, and Herriott of School Readers

Starch classified the content in ten readers from each of the eight elementary grades and calculated the percentage belonging to each of the following classes: animals, boys and girls, folklore, fables, plants, elements (wind, water, etc.), fairy tales, plays and games, classics, geography and travel, history and patriotism, myths, conduct (manners), biography, adventure, poetry, and miscellaneous. He found a great difference between the content of the lower grades and that in the upper. In the first grade animals, boys and girls, folklore, and poetry constituted over three fourths (76.4 per cent) of all the material, and in the eighth grade classics, poetry, history and patriotism, and biography constituted over four fifths (81.7 per cent) of the material. In the intermediate grades fairy tales and fables occupied larger proportions than in the other grades. History and patriotism and adventure had their largest proportions in Grade VII. All the other classes were very small in nearly all the grades. Vinal examined thirty-three first readers published before 1918. He found that over half the stories were about animals, that of these only a third were true to life and the other two thirds were fairy tales or personifications, that the cat stories

were the most numerous, and that in three fourths of them the cats were either fairies or personified animals who talked like human beings. Herriott reports an investigation of five seventh-grade and eighth-grade readers that were popular in 1923. She classified 31.7 of the seventh-grade selections as stories and pure literature, 26.8 as history and social sciences, 17.8 as American life, and the remainder principally as miscellaneous and study helps. In the eighth grade all these decreased except the last two and pure literature of the "Gold Bug" type, which increased from 9.7 to 26.6 per cent.

Evaluation of Results

From the investigations it appears that those selections in school readers which are principally products of the imagination vary from about 90 per cent in Grade I to about 70 in Grade VIII, that the remainder is devoted largely to history and social science, and that in the average less than 5 per cent can be classified as giving information about existence. In other words, the material in school readers is well adapted to the use of reading as a means of enjoyment, but very poorly adapted to its use as an aid in earning a living, in discharging the duties of citizenship, and in entering into the thought-life of one's community or of the world. It is also poorly adapted for the development of skill in such reading as is required by the informational subjects in the elementary school, such as arithmetic, history, civics, nature study, geography, elementary science, and grammar. In view of the importance of these subjects in the education of a child this is a serious defect. Some recent series of "silent readers," it may be noted, are devoted entirely to material of this sort.

Two Principles of Selection

In selecting materials for reading there are evidently two principles of choice: those best adapted for learning to read and those best adapted for reading to learn. The first is

determined largely by children's interests; the second, by the necessary and practical uses of reading. Good pedagogy would start with the first and end with the second. A good procedure for finding the best materials for learning to read would be first to find out what the children's interests are, and then to find out to what extent they justify the selections now used. Scientific investigations for answering the first question have been made by Dunn, Jordan, and Uhl.

Dunn's Investigation of Children's Interests

Dunn investigated the reading interests of children in the first three grades. Forty pairs of samples were constructed from thirty-one selections chosen by a group of competent adults as the best out of two hundred and fifty selections for children. The pairs were read to the children, who were then asked to state the one they liked best. Out of these preferences a table was constructed showing the relative ranks of the different selections. The samples were then ranked by the judges according to the degree in which they possessed twenty qualities, such as verse form, style, humor, surprise, plot, etc. Summarizing her results, Miss Dunn says:

> Surprise, plot, narrativeness, liveliness, conversation, animalness, and moralness appeared more effective in arousing interest among both boys and girls. Fancifulness, repetition, children's poeticalness, same-sexness, humor, and verse form showed interest values of varying amounts, but none considerable. Adultness, style, other-sexness, and realism seemed to repel rather than attract. The importance of imagery and familiar experience was uncertain, slightly above or slightly below indifference, and different for boys and girls. In general there was high correlation between boys' and girls' reactions to the several interest elements.

The principal conditions in primary reading materials that are not justified by Dunn's investigation are the restriction of the selection to imaginative or literary compositions and the large proportion of poetry. Informational materials were

as acceptable as fiction, provided they possessed the qualities desired by children. Poetry is not liked by children, but according to Starch's investigation it occupies from 15 to 28 per cent of the space in the readers of all grades.

Jordan's Investigation of Children's Reading

Jordan investigated the reading interests of children from the ages of nine to eighteen and over, first, by a questionnaire method in which a child was required to state in order of preference eight books and five magazines that he liked best; secondly, by a library study in which a book was rated according to (1) the number of copies in circulation, (2) the number of times its reading was observed in the library by the investigator, and (3) the judgment of the librarian.

The results of the library study, which are supported by those of the questionnaire, showed wide differences between the interests of boys and girls. The major interests of boys were in four general types of fiction: (1) war and scouting, as in Altsheler's books; (2) schools and sports, as in Barbour's; (3) Boy Scouts, as in Burton's; and (4) strenuous adventure, as in Clemens's. In nonfiction the interest centered around what-and-how-to-do books, such as the Boy Scout Manual. The interest in biography and history was confined to authors who could write them in the form of an exciting story. Boys' interests in magazines were of the same type, except that *Popular Mechanics* and the *Scientific American* were popular. Little or no interest was shown in books on science. The instincts most often appealed to by these books are "mastery, fighting, love of sensory life for its own sake, original attention, and approval and scornful behavior." The interests of girls are principally concerned with fiction of four kinds: (1) stories of home life, like "Little Women," by Alcott, which is by far the most popular book among girls; (2) stories of school life, like "Peggy," by Richards; (3) fairy stories, like "Alice's Adventures in Wonderland," by Dodgson;

(4) love stories, like "In the High Valley," by Woolsey. Girls have almost no interest in nonfiction, except for a few books on cooking, crocheting, dramatics, and poetry. They rarely patronize the magazine table, and when they do, they choose *St. Nicholas*. The instincts appealed to most often by girls' books are "maternal, kindliness, attention to others, response to approval and scornful behavior, and, to a less degree than in the case of boys, to rivalry." This investigation justifies the large proportion given in school readers to imaginative composition and the small amount given to informational material. It agrees with Dunn's investigation in showing that the large proportion of space devoted to poetry has no foundation in children's interests. Although the large proportion given to imaginative composition has a basis in children's interests, yet when a comparison is made between the best books and selections chosen by children and those found in readers or those found in lists recommended by committees of experts, no common authors or titles are found except Stevenson and Clemens. This raises the question whether we should give children the reading that they like and voluntarily choose or whether we should give them what cultivated adults think they *ought* to like. It is interesting to notice that Jordan does not make any application of his findings to school conditions.

Uhl's Investigation of Used Selections: Purpose and Method

The purpose of Uhl's investigation was to find (1) the best selections among those appearing in school readers, (2) the qualities of desirable and undesirable selections, and (3) the proper placement of selections in the school curriculum. His sources of information were three questionnaires sent to teachers and two examinations of school children. The first questionnaire, to which 2253 teachers replied, asked the teacher to name two selections which her pupils asked to

read most, two which they discussed most, one which promoted the most independent thinking, one which was the most successful from every standpoint, two which the pupils disliked, two which provoked no discussion, one which was not understood, and one from which the poorest results were secured. The replies of the first questionnaire were made the basis of a second, to which 741 teachers replied. It named fifty selections for each grade and asked the teacher to rank fifteen of them in an order of merit for her grade, to name the most important qualities of these fifteen selections, and to give a detailed analysis of the one which the pupils liked most and the one which they disliked most. The third questionnaire, to which 59 teachers replied, made an inquiry of the use and success of informational selections taken from the Community and National Life Series. The first examination secured from 529 pupils in the upper six grades reactions to a number of selections which they read silently and then stated whether they liked or disliked them, and why. This was followed by a class discussion of the selections, after which they wrote answers to a series of comprehension questions. The second examination secured the reactions of 92 pupils to informational selections in the Community and National Life Series.

The Most Approved Selections

From the replies to the first and second questionnaires Uhl made up for each grade a list of from eighteen to forty selections which were approved by 90 per cent or more of the teachers judging them. Table XX gives the types of these and some examples of each. Teachers should find these helpful in improving their choice of new selections by comparing them in difficulty, vocabulary, subject matter, and style. If a new selection compares favorably with a successful one in these respects, the chances are that it will be enjoyed by the children for whom it is intended.

TABLE XX. TYPES OF READING SELECTIONS FOR THE RESPECTIVE GRADES AND EXAMPLES OF EACH TYPE. (After Uhl)

Types of Selections for Grades I–II

Animal stories: The Three Little Pigs; Three Billy Goats Gruff.
Cumulative tales: The Little Red Hen; The Old Woman and her Pig.
Nursery rimes: Tom, Tom, the Piper's Son; The Swing.
Fairy tales: Cinderella; The Elves and the Shoemaker.
Child life: My Shadow; Little Boy Blue.
Humorous tales: The Gingerbread Boy; The Bremen Band.
Adventure: The Three Bears; Little Red Riding-hood.
Interesting information: The Little Steam Engine; The Flag.
Nature: What does Little Birdie Say; The Magpie's Lesson.
Dramatization: The Three Bears; The Bremen Band.

Types of Selections for Grades III–VI

Fairy tales: Pandora's Box; Aladdin and his Wonderful Lamp.
Child life: Dick Whittington and his Cat; Cosette.
Adventure and heroism: The Leak in the Dike; Robinson Crusoe.
Knighthood: The Knights of the Silver Shield; How Cedric became a Knight.
Animal stories: Black Beauty; Patrasche.
Humor: The Wishing Gate; The Tar Baby.
Interesting information: Washington's Boyhood.
Nature: Daffy-down-dilly; Hiawatha.
Dramatization: The Pied Piper of Hamelin.
Poetry: The Village Blacksmith; The Pied Piper of Hamelin.

Types of Selections for Grades VII–VIII

Adventure: Horatius at the Bridge; Fitz-James and Roderick Dhu.
Description: The Day is Done; Snowbound.
Romance: Evangeline; The Courtship of Miles Standish.
Knighthood: Stories about King Arthur.
Humor: Mr. Pickwick's Slide; The One-Hoss Shay.
Supernatural: Rip Van Winkle; The Legend of Sleepy Hollow.
Biography and history: Paul Revere's Ride; The Courtship of Miles Standish.
Interesting information: Before Coins were Made; Paper Money.
Nature: The Birds of Killingworth; The Sandpiper.
Dramatization: William Tell; The Merchant of Venice.
Child life: The Barefoot Boy.
Poetry: Evangeline; To a Waterfall.
Travel may be mentioned in this connection. There were, however, no selections telling of travel.

Desirable and Undesirable Qualities

The qualities of desirable selections in order of frequency of mention were found to be *dramatic action, adventure and heroism, interesting action, humor, fairy and supernatural* [*conceptions*], *interesting characters, interesting problems* (*character study*), *kindness and faithfulness, animals and personification, dramatization, interesting repetition,* and *interesting information.* The order, however, varied in relation to grade. Some remained the same, some increased, some decreased, and some both increased and decreased. *Dramatic action* is high in all grades and *interesting information* is low. Those which increase are *humor* and *interesting problems,* those which decrease are *interesting repetition* and *dramatization,* and those which both increase and decrease are *fairy tales, kindness and faithfulness,* and the *supernatural,* which have their highest positions in Grades III and IV. The undesirable qualities in order of frequency of mention were *too mature, hard words, unfamiliar subject matter, no story, lacks action, unreal, too long, too scrappy, too sad, too childish, tired of it, monotonous,* and *not well told.* Examples are King Alfred and the Cakes, An Evening at Home, The Cricket on the Hearth, The Whistle, The Blessings of Poverty, Education, The Character of Columbus, To a Skylark, and Poor Richard's Almanac. One striking difference between Uhl's findings and Jordan's was the close agreement between the judgment of teachers and pupils in regard to both good and bad qualities. Of course Jordan made no study of qualities; but since the children whom he studied made choices radically different from those ordinarily recommended by teachers, we should expect a corresponding difference in the ranking of qualities. The reasons for Uhl's agreements may be the fact that both teachers and pupils judged the same selections, that the qualities were listed, and that no precautions were taken not to have children express judgments which are not considered in good taste by teachers.

Placement of Selections

In regard to the placement of selections Uhl found that it was rare for a selection to be a success in only one grade, although some selections were judged to be more successful in one grade than in any other. Some selections, such as "Horatius at the Bridge," were approved in all grades above the fourth; others, such as "The Pied Piper of Hamelin," were approved in all grades above the first. Reasons for this are differences in levels of comprehension of the same grade in different schools and differences in methods of teaching. Uhl found that the former may be more than two grades in the same city.

Interest and Comprehension; Interesting Information

Two other important findings from Uhl's investigation were the high correlation between children's interests in selections and their comprehension of them and the fact that such selections as "Before Coins were Made" and "Paper Money" were liked by over 95 per cent of pupils reading and judging them. The first shows us the value of interest for comprehension; the second, that informational selections are not necessarily uninteresting. The lack of interest which children have in such selections is due to their form rather than to their content; but just what other selections are useful in developing the much-needed efficiency and interest in informational reading this investigation does not show.

Summary

The purpose of reading is the reconstruction of experience. The more immediate objectives for the elementary school in order of importance are (1) to develop enough ability in reading to assist pupils in earning a living (for example, ability to read simple directions for doing a job), (2) to develop so

much ability in reading that they can discharge the duties of citizenship, (3) to develop efficiency in interpreting the informational reading of the elementary curriculum, (4) to use reading as a means of enjoyment, and (5) to use reading as a means of entering into the thought-life of one's community and of the world.

Selections in school readers are best adapted for the purpose of using reading as a means of enjoyment. The percentage of compositions which are imaginative varies from 90 in Grade I to 70 in Grade VIII. On the average less than 5 per cent of these give information about the world of reality; hence from this standpoint they are poorly adapted for developing ability in acquiring scientific information. Dunn's investigation showed that the restriction of selections in primary readers to literary compositions and poetry was not justified by children's interests, and that informational materials were as acceptable as fiction provided they possessed the necessary qualities. On the other hand, Jordan found that the reading interests of both boys and girls from nine to eighteen years of age were principally in fiction, although in different types. The major interests of boys were in books about war and scouting, schools and sports, and strenuous adventure; the major interests of girls were in stories of home and school life, fairy stories, and love stories. Jordan also found that, with the exception of Stevenson and Clemens, boys and girls do not choose authors or books found in lists recommended for schools by committees of experts.

Uhl's investigation showed that *dramatic action* was the most frequently mentioned of the desirable qualities in the used selections. On the other hand, *too great maturity* and *not well told* were, respectively, the most and least frequently mentioned of the undesirable qualities. However, the desirability of a certain quality or its undesirability depends upon the grade in which a selection is used. In most cases a selec-

tion can be used successfully in more than one grade, although there is generally one grade in which it is the most successful. If a selection is interesting, it is usually well comprehended. Informational selections of the type "Before Coins were Made" are liked by over 95 per cent of the pupils reading and judging them. This shows that it is possible to write informational articles which make interesting reading.

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CHAPTER IX

ARITHMETIC

Aim

The aim of the elementary school in teaching arithmetic is the development of such accuracy and speed in arithmetical processes as are required in the usual transactions and activities of life. Among these are the four fundamental operations with integers, small fractions, decimals, United States money, and denominate numbers. Besides these there should be mastery of the processes required to solve simple problems with areas, interest, and investment, and mastery of the terms, the language, and the symbols used in arithmetic.

The Complexity of Habits in Arithmetic

An economical achievement of these aims cannot be accomplished without an understanding of how many habits are required to solve comparatively easy problems. Consider, for example, the number of habits which must be mastered to acquire mastery of addition. According to Osburn there are 100 combinations with the ten digits, including the zeros. There are, in addition, 225 combinations in the higher decades, 135 of which consist of sums that do not require bridging the tens, such as $43 + 4$, and 90 that do, such as $43 + 8$. Then, too, the child must learn to read an example when it is in equation form, as, $4 + 2 = \ ?$; when it is in column form, as, $\begin{array}{r} 4 \\ \underline{2} \end{array}$; and when it is in the form of words, as, 4 plus 2 or 4 and 2. He must also be able to read

the problem when the figures are in words, as, *four plus two* or *four and two*, or when they are in the form of pictures, as in a picture of four sticks and two sticks. In adding problems that do not require carrying he must be able to add one digit to another, two digits to another, two or more digits to two or more digits, and two or more digits to two or more digits when some of the digits are zeros. He must also be able to do each of these with carrying and, in addition, he must learn how to carry when one column consists of zeros and to put down properly the sum of the last column to the left when it is greater than nine. Then, too, he must learn to proceed from right to left, to keep his place in the column, to add unseen sums to seen numbers, to ignore empty spaces and zeros, and to record only the units of each column at its foot except in the last column. Hence the ability to add means that the pupil must acquire and organize about 260 elementary habits. The total number in each of the other fundamental operations is still greater. In the case of fractions the pupil can make use of his combinations with integers, but he must learn all the way from 60 to 125 new forms and procedures in each of the fundamental operations. If a teacher is mindful of all these things, she ought not to be surprised that pupils make mistakes in arithmetic or that a large percentage of their school time for a period of seven years is required in order to obtain a reasonable mastery of the subject.

Factors Influencing Speed and Accuracy

Skill in arithmetic depends on many factors, such as age, intelligence, sex, amount of drill, distribution of drill, and extent of interpretation or association.

The influence of age and grade on speed and accuracy in the fundamental operations is shown clearly in the norms of standardized tests. Table XXI, on page 114, gives

TABLE XXI. STANDARD SCORES

GRADE MEDIANS, COURTIS STANDARD RESEARCH TESTS, SERIES B

GRADE	ADDITION		SUBTRACTION		MULTIPLICATION		DIVISION	
	Speed	Accuracy	Speed	Accuracy	Speed	Accuracy	Speed	Accuracy
IV	7.4	64	7.4	80	6.2	67	4.6	57
V	8.6	70	9.0	83	7.5	75	6.1	77
VI	9.8	73	10.3	85	9.1	78	8.2	87
VII	10.9	75	11.6	86	10.2	80	9.6	90
VIII	11.6	76	129.0	87	11.5	81	10.7	91

STANDARD SCORES FOR THE WOODY MIXED FUNDAMENTALS TEST

	GRADE III	GRADE IV	GRADE V	GRADE VI	GRADE VII	GRADE VIII
Addition . .	14.5	18.3	23.1	29.8	32.4	34.0
Subtraction .	11.2	15.7	20.4	25.0	28.5	31.7
Multiplication	4.7	11.1	18.3	26.1	30.6	32.9
Division . .	5.8	9.9	16.5	23.8	27.4	30.1

STANDARD SCORES FOR THE MONROE DIAGNOSTIC TEST IN ARITHMETIC, PART II

TEST NUMBER	GRADE IV		GRADE V		GRADE VI		GRADE VII		GRADE VIII	
	Rate	Accuracy	Rate	Accuracy	Rate	Accuracy	Rate	Accuracy	Rate	Accuracy
7	3.8	63.2	4.2	65.1	5.5	75.9	5.3	76.3	6.3	81.6
8	3.0	30.4	4.1	52.9	5.5	66.9	6.1	79.8	6.6	78.5
9	4.8	75.0	5.9	86.3	8.2	91.2	8.6	93.1	9.8	100.0
10	2.8	35.2	3.2	58.4	5.3	72.1	5.3	72.3	6.7	81.9
11	1.6	22.4	2.2	35.5	2.2	53.4	2.9	65.0	3.7	68.2

the standard norms for the Courtis, the Woody-McCall, and the Monroe Diagnostic tests.

The Courtis tests have twenty-four examples in each of the four fundamental operations with integers: those in addition consist of nine three-place numbers, those in subtraction have eight or nine places in the minuend and eight in the subtrahend, those in multiplication have four places in the

multiplicand and two in the multiplier, and those in division have four or five places in the dividend and two in the divisor. The Woody-McCall Test consists of thirty-five examples in the fundamental operations with integers, fractions, and decimals, some of which are in column form and some in equation form. The Monroe Diagnostic Test consists of twenty-one tests in operations with integers, fractions, and decimals. The five tests whose norms are given in Table XXI consist of difficult fundamental operations with integers.

The increase in the arithmetic scores with the grade depends in part on the amount of training or schooling, in part on age or maturity, and in part on the degree of intelligence or mental age. The scores in relation to age may be seen in Table XXII. These results were obtained by giving Test 4 of the Army Examination *a* to eleven hundred and sixty-two California children from Grades III to IX. The scores represent the median numbers of problems out of twenty solved in five minutes.

TABLE XXII. MEDIAN NUMBER OF PROBLEMS SOLVED IN TEST 4, ARMY EXAMINATION *a*, IN RELATION TO AGE AND SEX

	AGES								
	8–8.9	9	10	11	12	13	14	15	16
Boys . .	2.4	4.3	4.1	6.7	7.2	8.8	9.0	8.8	9.9
Girls . .	1.9	3.1	4.6	5.7	6.7	7.6	8.9	9.7	8.7

The influence of sex on skill may be seen from Table XXI. From the ages of eight to sixteen the boys make the better scores, excepting at ten and fifteen. After the age of sixteen the superiority of boys and men to girls and women becomes greater. This appears in the scores which the writer obtained by giving Alpha Test 2 to 414 college students and 171 high-school students. Table XXIII, on page 116, gives the results.

TABLE XXIII. MEDIAN NUMBER OF PROBLEMS SOLVED BY MEN AND WOMEN COLLEGE AND HIGH-SCHOOL STUDENTS IN ARMY ALPHA TEST 2

	NUMBER	SCORE	SUPERIORITY OF MALES, PER CENT
Men (college)	245	12.50	23.5
Women (college)	169	10.12	
Boys (high school)	78	10.80	16.1
Girls (high school)	93	9.30	

These differences are confirmed by other investigations. For example, Terman found that boys were 33 per cent superior to girls in the arithmetical test for the year XIV of his Binet scale. Undoubtedly these differences are large enough to be significant, and indicate that skill in arithmetical problems which require reasoning is to some extent linked with sex. With problems in computation this is not always true, however. Hollaway found that girls learn the simple combinations with more ease.

The influence of intelligence is more marked in the solution of reasoning problems than in the fundamental operations or the more mechanical skills of arithmetic. This was shown in a study made of forty-two VII–B pupils by France and

TABLE XXIV. AVERAGE SCORES AND GAINS MADE BY BRIGHT AND DULL PUPILS. (After France and Stevenson)

TEST	BRIGHT			DULL		
	Trial 1	Trial 2	Gains	Trial 1	Trial 2	Gains
Fundamentals	44	79	35	38	71	33
Problems	54	93	39	40	78	38
Problem analysis	68	94	26	53	85	32

Stevenson. The pupils were given the Illinois Intelligence Examination, the Monroe General Survey Scale II, and the Stevenson Arithmetic Analysis Test both at the beginning

of the semester and at the end. Table XXIV shows the average scores of the ten brightest pupils in the class and the ten dullest. The average I. Q. of the former was 119; of the latter, 75.

It will be seen that the number of problems solved by the ten brightest pupils is much greater than that solved by the ten dullest, but that the relative amounts of gain by the two groups are nearly equal.

Buckingham found that the correlation between intelligence and ability to do easy problems with fundamental operations in whole numbers was 0.41. This was obtained from the intelligence test and the arithmetic test in the Illinois Examination, which was given to three hundred and fifty pupils in Grades VII and VIII. Ability in computation is so largely a matter of practice rather than of insight that it is less influenced by intelligence than is ability in reasoning problems.

The influence of intelligence on ability to solve reasoning problems may be seen from the results obtained with Test 2 of Army Alpha, or Test 4 of Army Examination *a*, which is the same test with slight modifications in phrasing. Table XXV shows the median scores obtained with the first test from a large number of officers, from the white draft, and from the colored draft.

TABLE XXV. MEDIAN SCORES IN ARITHMETIC, TEST 2 OF ARMY ALPHA, IN RELATION TO TOTAL SCORE (INTELLIGENCE) AND MENTAL AGE

	TEST 2	ALPHA SCORE	MENTAL AGE
White officers	12.89	139.2	18.14
White draft	8.32	58.9	13.70
Colored draft, North		38.6	12.40
Colored draft, South	4.92	12.4	10.14

TEST 2, ARMY ALPHA

Get the answers to these examples as quickly as you can. Use the side of the page to figure on if you need to.

SAMPLES. How many men are 5 men and 10 men?
If you walk 4 miles an hour for 3 hours, how far do you walk?

1. How many are 30 men and 7 men?
2. If you save $7 a month for 4 months, how much will you save?
3. If 24 men are divided into squads of 8, how many squads will there be?
4. Mike had 12 cigars. He bought 3 more and then smoked 6. How many cigars did he have left?
5. A company advanced 5 miles from their trenches and retreated 3 miles. How far were they from their trenches then?
6. How many hours will it take a truck to go 66 miles at the rate of 6 miles per hour?
7. How many cigars can you buy for 50 cents at the rate of 2 for 5 cents?
8. A regiment marched 40 miles in 5 days. The first day they marched 9 miles, the second day 6 miles, the third day 10 miles, the fourth 8 miles. How many miles did they march the last day?
9. If you buy 2 packages of tobacco at 7 cents each and a pipe for 65 cents, how much change should you get from a two-dollar bill?
10. If it takes 6 men 3 days to dig a 60-foot trench, how many men are needed to dig it in half a day?
11. A dealer bought some mules for $800. He sold them for $1000, making $40 on each mule. How many mules were there?
12. A rectangular bin holds 400 cubic feet of lime. If the bin is 10 feet long and 5 feet wide, how deep is it?
13. A recruit spent $\frac{1}{8}$ of his spare change for post cards and 4 times as much for a box of letter paper, and then had 90 cents left. How much did he have at first?
14. If $3\frac{1}{2}$ tons of coal cost $21, what will $5\frac{1}{2}$ tons cost?

15. A ship has provisions to last her crew of 500 men 6 months. How long would it last 1200 men?

16. If a man runs 100 yards in 10 seconds, how many feet does he run in a fifth of a second?

17. A U-boat makes 8 miles an hour under water and 15 miles on the surface. How long will it take to cross a 100-mile channel, if it has to go two fifths of the way under water?

18. If 241 squads of men are to dig 4097 yards of trench, how many yards must be dug by each squad?

19. A certain division contains 3000 artillery, 15,000 infantry, and 1000 cavalry. If each branch is expanded proportionately until there are in all 20,900 men, how many men will be added to the artillery?

20. A commission house which had already supplied 1897 barrels of apples to a cantonment delivered the rest of its stock to 29 mess halls. Each mess hall received 54 barrels. What was the total number of barrels supplied?

It will be seen that the arithmetic scores of these groups are in close proportion to their intelligence scores and mental ages. The influence of mental age appears more clearly from the scores of school children when calculated in relation to their mental ages. Terman and his students have made this calculation on scores obtained from eleven hundred and sixty-two California children in Grades III to IX. Table XXVI gives the results.

TABLE XXVI. MENTAL-AGE NORMS FOR TEST 4 OF ARMY EXAMINATION *a*

	Mental Age											
	8–8.9	9	10	11	12	13	14	15	16	17	18	19
Score	1.5	2.6	3.5	5.5	5.9	7.4	7.8	9.5	9.5	10.2	11.5	13.4

As calculated by the psychological staff of the army the correlation of Test 4 with mental age is 0.79; with the total weighted score of Examination *a* it is 0.826. These are as high correlations as two good intelligence tests will usually

give. We may therefore assume that one's ability to solve reasoning problems in arithmetic depends very greatly upon his intelligence. The practical significance of this is that the difficulty of problems in arithmetic must be very carefully adjusted to the mental level of the pupils.

SUMMARY

The aim of the elementary school in teaching arithmetic is the development of such accuracy and speed in arithmetical processes as are required in the usual transactions of life. Its accomplishment requires the mastery and coördination of many hundreds of habits. During the period of growth speed and accuracy increase with age, with grade, and with the amount of intelligence. Intelligence appears to increase the amount of work done per unit of time rather than the rate of improvement, although there are cases when it also increases the latter. It plays a greater part in problems which require reasoning than in computation problems; so great a part, indeed, that in the former it is a matter of utmost importance to adjust the difficulty of problems to the mental level of pupils. Sex differences in arithmetic are rather small. Boys usually make better scores in reasoning problems, and girls in computation problems, but the differences are not large enough to justify segregation for purposes of instruction.

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CHAPTER X

ARITHMETIC: THE LAW OF REPETITION

Arithmetic lends itself readily to training by repetition. The elementary bonds are simple and definite. The teacher can tell at once whether they are right or wrong, and she knows exactly what to do to correct an error. Scores and records of improvement are easily kept, and simple drill materials can be easily and quickly provided. Under such circumstances we should expect very favorable results from drill in this subject.

Influence of Amount of Schooling on Skill in Arithmetic

According to the law of repetition we should expect one's skill in arithmetic to depend largely on the amount of his schooling. How it does so was shown by Kolstad in an investigation of the arithmetic scores of 2500 soldiers in Test 2 of Army Alpha. For comparative purposes he also gave the same test to 632 school children from Grades IV to VIII, to 424 normal-school juniors, and to 301 normal-school seniors. Table XXVII, on page 123, gives the median scores obtained from both groups, excepting those for the high school, which are hypothetical. The scores for the army men are placed under the last grade in school which they passed; for example, the score 6.9 for army men in Grade V means the median score of those who left school at the end of Grade V.

The correlation found between the scores made by the army men and the last grade they passed in school was 0.571. The corresponding correlation for the school group was 0.578.

TABLE XXVII. SCORES OF ARMY MEN IN TEST 2 OF ARMY ALPHA IN RELATION TO GRADE AT WHICH THEY QUIT SCHOOL COMPARED WITH SCHOOL CHILDREN FROM CORRESPONDING GRADES. (After Kolstad)

	GRADES									HIGH SCHOOL				COLLEGE			
	0	I	II	III	IV	V	VI	VII	VIII	1	2	3	4	1	2	3	4
Army men . . .	6.5	5.2	2.5	4.7	5.8	6.9	6.8	7.5	8.9	10.1	10.6	11.7	12.4	12.2	12.3	12	13.5
School group . .					5.8	6.5	8.0	8.5	9.8	10.0	10.4	10.8	11.0	11.67	12.46		

In the case of another group of 653 English-speaking soldiers this correlation was 0.74. These facts show the importance of schooling for skill in arithmetic. Every year of schooling up to the end of Grade VI makes a valuable increase in a pupil's efficiency in his adult life. Beyond that the gains are smaller but are still noticeable.

DRILL

Drill is the most important of the factors that determine speed and accuracy in arithmetic. Experiments showing the influence of this factor were made by J. C. Brown. In the first experiment 51 children from Grades VI–VIII were used. For thirty recitations half the children received in each recitation five minutes of drill on the four fundamentals. These were called the experimental group. The other half received the regular instruction without the drill. These were called the control group. The procedure was the same in the second experiment, but 222 pupils were used. Before and after the drill period the Stone Arithmetic Tests were given to all the pupils. Table XXVIII, on page 124, shows the percentage of improvement made by both groups in the two experiments.

Here we see that the pupils who had five minutes of drill for thirty recitations made more than twice as much improvement as pupils who did not have that drill. The key to speed and accuracy, therefore, is drill.

TABLE XXVIII. EFFECT OF DRILL ON GAINS IN SKILL IN FUNDAMENTALS
(After J. C. Brown)

	First Experiment		Second Experiment	
	Experimental Group	Control Group	Experimental Group	Control Group
Number of problems worked	21.2	9.8	16.9	6.4
Addition	33.4	11.8	18.5	6.8
Subtraction	36.9	13.1	32.0	11.9
Multiplication	30.0	13.7	24.1	10.9
Division	28.0	19.3	34.2	15.4
Total number of points made	32.0	14.7	24.2	9.4

VALUE OF SPECIAL METHODS OF DRILL

Experimenters have found that certain special methods of drill are very valuable. Among these the Courtis Practice Pads and the Studebaker Economy Practice Exercises are important. Experiments to test their value were conducted by Miss Flora Wilbur for the former and by Evans and Knoche for the latter.

Miss Wilbur worked with two classes, one from Grade V and one from Grade VI. There were fourteen pupils in each class. She divided each class into two sections: an experimental section and a control section. The experimental section received from four to four and one-half minutes of daily drill with the Courtis Practice Pads from September to May; the control section received the traditional instruction without the drill. Before and after this period all the sections were given the Courtis Standard Research Tests, Series B. Table XXIX gives the percentage of gain for the two groups in the fifth grade.

It will be seen that the gains in speed are considerably greater than those in accuracy, and that the practice group gained all the way from –1 to 144 per cent more than the no-practice group.

TABLE XXIX. PERCENTAGE OF GAINS FROM SEPTEMBER TO MAY WITH COURTIS PRACTICE PADS. (After Wilbur)

OPERATION	SPEED		ACCURACY	
	No Practice Group	Practice Group	No Practice Group	Practice Group
Addition	30	40	30	37
Subtraction	27	54	29	49
Multiplication	12	148	26	31
Division	0	144	43	42

Evans and Knoche gave a class from Grade VI B in the city of Columbus forty-three periods of drill with the Studebaker Economy Practice Exercises. Before and after the training the children were given both the Woody and the Courtis arithmetic test. At the same time these tests were given to a VI-A class which received the usual instruction in arithmetic without drill. Table XXX shows the percentages of gain made by both classes.

TABLE XXX. PERCENTAGES OF GAIN WITH THE STUDEBAKER ECONOMY PRACTICE EXERCISES: VI A, WITHOUT DRILL; VI B, WITH DRILL. (After Evans and Knoche)

OPERATION	GRADE VI A	GRADE VI B
Addition	5.7	17.5
Subtraction	− 6.1	18.1
Multiplication	5.0	12.2
Division	4.3	16.4

It will be seen that during the same period the class that received the drill gained nearly eight times as much as the class that had only the usual instruction.

Mead, in an extensive experiment with nine hundred pupils from Grade V of the schools of Cincinnati, compared the gains in fundamental operations from equal amounts of practice with Thompson's Essentials and the Courtis Practice

Pads. The special training continued from February to June, fifteen minutes daily. Before and after this practice the Courtis Standard Research Tests, Series B, were given to both groups. Improvement was measured by the increase in speed and in accuracy between these tests.

TABLE XXXI. PERCENTAGES OF GAIN IN ACCURACY WITH COURTIS PRACTICE PADS AND WITH THOMPSON'S ESSENTIALS. (After Mead)

	ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
Courtis Practice Pads	9.7	8.1	8.9	18.2
Thompson's Essentials	2.5	4.0	2.9	15.7

The Courtis group does noticeably better in accuracy, but both groups are approximately equal in speed. A part of the gain in accuracy may be due to the fact that the Courtis materials were used in both the drill and the tests. The more important fact, however, is that because of this special drill during the second half of the fifth grade both groups reached the performance of the average class at the end of the sixth grade. Fifteen minutes of daily drill for four and one-half months added as much gain in speed in the fundamentals as is ordinarily obtained in a year from the usual instruction.

SPECIAL METHODS IN ADDITION

Addition by thinking results only is much more rapid than addition by thinking both results and numbers. In adding the numbers 6, 9, 5, 7, 8 by the first method the pupil thinks the cumulative sums only, as 15, 20, 27, 35; in adding by the second method he proceeds thus: 6 and 9 are 15, and 5 are 20, and 7 are 27, and 8 are 35. Conard and Arps studied the value of these two methods with two equal classes of high-school students, there being thirty-two pupils in each class. Both classes received eight periods of drill in rapid work in each of the fundamental operations. One class added by

thinking results only, and the other by thinking both results and numbers. Table XXXII gives the percentage of gain for operations combined for both classes in the Courtis tests, which were given at the beginning of the experiment and at the end.

TABLE XXXII. PERCENTAGES OF GAIN IN ADDITION BY TWO METHODS
(After Conard and Arps)

METHOD	ATTEMPTS	RIGHTS
Thinking results only	34.4	30.9
Thinking both results and numbers	8.5	− 2.5

The class which thought only results made far greater gains both in attempts and in rights than the class which followed the ordinary procedure.

SPECIAL METHODS IN SUBTRACTION

Subtraction may be done by different methods: (1) the take-away-borrowing, (2) the take-away-carrying, (3) the additive-borrowing, and (4) the additive-carrying. In subtracting 27 from 42 according to the first method, 7 is taken from 12, the 10 being borrowed from the 4, which then becomes 3; in the second method 7 is taken from 12, but 1 is carried to the 2, which then becomes 3, the 4 remaining unchanged; in the third method 5 is added to 7 to make 12, the 1 being borrowed from 4, as in the first method; in the fourth method 5 is added to 7 to make 12, and 1 is carried to the 2, which then becomes 3, as in the second method. The third method is never used, but the other three are.

Which of these methods is the best is a question on which some people have very definite opinions, but one to which experimental evidence does not as yet give a clear answer. In a test given to 61 schools in England Ballard found that 38 of them used the take-away-borrowing method and that 23 of

them used the take-away-carrying method. The latter was found from 10 to 40 per cent superior to the former. The amount of superiority depended upon age of the child, being greatest for young pupils and least for older pupils. Ballard's explanation of the superiority of the take-away-carrying method was that it produced less forgetting. Borrowing is made in advance of subtraction, and in the meantime the child must keep in mind the changed form of the number, a thing which is often not done. But carrying occurs after subtraction, and so the change in the subtrahend comes to the child's mind just when it is needed. Ballard's findings were confirmed in an investigation made by McClelland and in two experiments made by Winch. McClelland investigated the method of subtraction used by 143 children aged twelve and thirteen and found 63 who used the take-away-carrying method and 80 who used the take-away-borrowing method. In a ten-minute test he found that those who used the take-away-carrying method solved 161 problems with accuracy of 93.3 as against 141 solved with accuracy of 90.3 by those who used the other method. Winch made an experiment on 38 children aged eleven years eleven months, all of whom had been taught the take-away-borrowing method. On the basis of tests in subtraction he divided the children into two equal groups and then gave drill in the take-away-borrowing method to one group and drill in the take-away-carrying method to the other. In a few weeks those who used the latter method equaled those who used the former, and in some cases were superior to them. In Winch's opinion, however, the superiority was insufficient to justify a change at this age of the pupils. The same experiment repeated on a group of pupils eight and one-half years old showed decided advantages in favor of the take-away-carrying method for both superior and inferior pupils.

Mead and Sears conducted an experiment in which a comparison was made between the efficacy of the take-away

and addition methods for two equal groups of second-grade pupils who were trained for a period of five months. One group was trained in the combinations by the additive method, and the other group by the take-away method. Neither method apparently involved either "carrying" or "borrowing." The take-away class made a gain of 140 per cent in the number of combinations solved in one minute as against a gain of 65 per cent by the additive class. In a test with larger examples, given after the test in combinations, the take-away class was only 0.7 of an example ahead of the additive. "The pupils of the additive class," say Mead and Sears, "showed over and over again a confusion of the two processes, a skipping into the habit of adding the lower figure to the top one. The take-away class showed almost no confusion in this." Since the training was apparently limited to the simple combinations, it tells us little about the value of the two methods in complicated subtraction, and it tells us nothing about the advantages of "borrowing" or of "carrying." Surveys made in districts in New York and San Francisco where the additive-carrying method had been taught for some years showed that in spite of this instruction the majority of pupils in the upper grades used the take-away-borrowing method. Further experiments are necessary before we can decide which is the best method of subtraction; but, so far as present experiments go, there is no reason for favoring the additive methods. As between the take-away-borrowing and take-away-carrying methods, the evidence favors the latter. Theoretically there are points in favor of each method, but there is little reason for believing that one should be much superior to another when the amount of practice in favor of each is kept the same. To avoid interference and confusion it is more important that a school system should select one method and stay by it.

Special Methods in Multiplication

Kirkpatrick made an experiment in which the efficiency of three methods of multiplication was determined. The three methods were (1) memorizing tables and then using them, (2) beginning at once to multiply with the aid of a key containing the products, and (3) finding products by the aid of knowledge already acquired. In the problems used the multiplier was 7, and the multiplicands were all the prime numbers between 17 and 53. These factors were used because the experiment was tried on normal-school students and grade pupils who already knew the tables to 9×9. A practice, or test, sheet was prepared; it contained the prime numbers named above, with a smaller figure of 7 beneath them, arranged in ten lines of ten groups of figures each. Another sheet, known as the key sheet, indicated the products that could be substituted for each group of numbers. The efficiency of each method was measured by the number of products that could be given in two minutes at the end of the experiment. Table XXXIII gives the methods and results for adults.

Table XXXIII. Gains in Multiplication by Memorizing Tables versus Learning it by using Key and Computation
(After Kirkpatrick)

Men who practiced 4 and 5 days, then practiced with key 5 days	40.9
Men who practiced with key 10 days	46.2
Men who practiced with key 8 days	25.4
Women who practiced computing 8 days	44.3
Children who memorized 10 minutes a day for 5 days, practiced 1 day, memorized 3 more days, then after 3 weeks took final test	10.1
Children who practiced with key for 10 days	18.9
Children who memorized 4 days, then practiced 8 days	27.4
Children who practiced computing 10 days	27.7

Kirkpatrick concludes that memorizing unassociated from practicing is a wasteful method of learning. After learning to count, pupils should learn the combinations by derivation and computation.

Henry studied the effect of practice in multiplication on unselected children of Grades V and VI and on two classes of gifted children from these grades. The drill consisted of ten minutes' work each day for ten days with Sheet A 15 of Thompson's "Minimum Essentials in Arithmetic." Before and after this practice all the pupils were tested from Sheet A 16, by the same author. Improvement was measured by the percentage of average accuracy and by the average time for doing the work on Sheet A 16 at the initial and final tests. Table XXXIV gives the results.

TABLE XXXIV. EFFECT OF DRILL AND OF NO DRILL IN SELECTED AND UNSELECTED GROUPS. (After Henry)

CLASS	PERCENTAGE OF ACCURACY		TIME IN SECONDS		RATIO OF TIME TO ACCURACY		PER CENT GAINED	AVERAGE I. Q.
	Initial	Final	Initial	Final	Initial	Final		
Practiced unselected Grade V	97.0	97.4	956	608	10.4	6.5	37.5	100.0
Practiced unselected Grade VI . . .	93.9	96.0	744	527.7	7.33	5.3	27.7	100.0
Practiced selected Grade V	98.5	98.9	999	531	10.1	5.3	47.6	119.8
Practiced selected Grade VI . . .	98.0	97.8	685	355	7.01	3.6	50.0	115.9
Unpracticed unselected Grade V .	96.9	97.4	989	897	10.2	9.2	9.9	100.0
Unpracticed unselected Grade VI .	98.2	97.3	835	714	8.51	7.4	13.1	100.0

It will be seen that this short amount of practice produced from two to five times as much gain in the practice groups as in those with no practice and nearly twice as much gain in the superior groups as in the average groups.

SPECIAL METHODS IN DIVISION

In division should a pupil say "5 into 20 how many times?" or "5 times what equals 20?" Mead and Sears trained two third-grade classes by these methods. The class that was trained by the first, the so-called "into method,"

made in five months a gain of 21 per cent as measured by the number of combinations solved in one minute; the class that was trained by the multiplicative method made a gain of 45 per cent during the same interval. The authors concluded in favor of the multiplicative method; but in this experiment only the simpler combinations in short division were used, therefore the results tell us little about the best method in the more difficult combinations and nothing at all about the best method in long division. Theoretically, however, the multiplicative method should prove the easier because of the pupils' previous training in the multiplication combinations. Since the form of the division problem is unique, the multiplicative method of division could not easily be confused with another fundamental operation as in additive subtraction. Therefore it probably would not be a source of error, and so has nothing against it except the force of habit. As in the methods of subtraction we must wait for further experiments before we can make a decision. Here, again, the best method is likely to be the one most consistently used and practiced.

Distribution of Drill in Relation to Time

The effectiveness of drill depends on the length of the drill periods and of the intervals between them. Experiments on the time arrangement of drill have been made by Kirby, Hahn and Thorndike, Wimmer, and the author. Kirby studied the value of four distributions of drill on improvement in addition and of three distributions on improvement in division. In the work on addition a forty-five-minute period was split into two, three, seven, and twenty-one intervals, respectively, for four different groups of children; in the work on division a forty-minute period was split into two, four, and twenty periods, respectively, for three different groups. Improvement was measured by the gain in the number of examples in the test period before and after the drill. The results are shown in Table XXXV.

TABLE XXXV. EFFECTS OF DISTRIBUTED DRILL IN ARITHMETIC
(After Kirby)

ADDITION

GROUP	NUMBER OF SUBJECTS	DISTRIBUTION OF 45 MINUTES	MEDIAN GAIN	RATIO
1	194	2 × 22.5	9.5	100.0
2	104	3 × 15	11.0	121.0
3	205	7 × 6 plus one 3-minute period	9.6	101.0
4	229	21 × 2 plus one 3-minute period	12.6	146.5

DIVISION

GROUP	NUMBER OF SUBJECTS	DISTRIBUTION OF 40 MINUTES	MEDIAN GAIN	RATIO
1	204	2 × 20	22.6	100.0
2	209	4 × 10	23.5	110.0
3	193	20 × 2	40.4	177.0

The experiment on division suggests the rule *The more distributed the practice, the more rapid the improvement.* However, the experiment in addition has one exception to this rule.

Hahn and Thorndike repeated the addition part of Kirby's experiment on children of Grades V–VII. Those in each grade were divided into two sections, A and B, of equal ability, Section B having just half as long a drill period as Section A. All received ninety minutes of drill, which was preceded and followed by a fifteen-minute test in arithmetic. The A sections from Grades VII, VI, and V received drill periods of twenty-two and one-half minutes, twenty minutes, and fifteen minutes, respectively. The B sections had periods just half as long. If the rule stated above is true, the B sections should have made greater gains than the A sections; but, as a matter of fact, the A sections — those having the long drills — made greater gains in Grades V and VII than

the B sections, whereas in Grade VI the gains made by the two groups were equal. In an experiment performed by Wimmer a comparison was made of the value of five-minute drills each week for six weeks, with one fifteen-minute drill each week for six weeks. Three fifths of each drill period was devoted to reasoning problems and two fifths to fundamentals. The long period produced the greater gains — 3.4 per cent in the fundamentals and 26.2 per cent in the reasoning problems. This experiment indicates that short drill periods are more profitable for fundamental operations than for reasoning problems. In the former little time is lost either in starting or in stopping, whereas in the latter most of a five-minute period may be spent in starting.

The experiments of Hahn and Thorndike and of Wimmer make it difficult to draw any general rule to be followed in the distribution of practice periods in arithmetic. Kirby's experiment shows that a drill period as short as two minutes is profitable for fundamentals; Hahn and Thorndike's, that a period of twenty-two and one-half minutes long is equally profitable. But evidently there is a point where fatigue sets in and beyond which further drill is unprofitable. An experiment made by the writer shows that a sixty-minute period is not nearly so profitable for adults as an equal amount of time split into ten-minute or twenty-minute periods. He divided a group of two hundred and three first-year and second-year college students into four approximately equal groups. They were given problems of five three-place numbers to add. The time was distributed among the four groups as follows:

Group 1, sixty minutes continuously.
Group 2, twenty minutes a day for three days.
Group 3, ten minutes a day for six days.
Group 4, ten minutes every other day for twelve days.

The gains of all the groups were measured by the percentage of improvement in the last ten minutes over the first ten

both in the number of examples attempted and in the number added correctly. Table XXXVI gives the results.

TABLE XXXVI. PERCENTAGES OF GAIN IN ADDITION IN RELATION TO TIME DISTRIBUTION OF DRILL

GROUP	ATTEMPTS	RIGHTS	GROUP	ATTEMPTS	RIGHTS
1	10.9	12.2	3	33.1	33.6
2	35.9	43.4	4	28.6	35.1

It will be seen that twenty minutes a day for three days produced the greatest gains, yet not much greater than those obtained from the ten-minute periods; but all three are far superior to the gains produced by an hour's continuous work, which indicates fatigue effects. This experiment suggests that the drill periods be short enough to avoid fatigue and close enough together to avoid forgetting from one period to the next. They should also be long enough to get some work done and be far enough apart for one period to give the next the benefit of stimulated nutrition and exercise. Within these limits there appears to be a comparatively wide range within which one length of practice is just as valuable as another.

DISTRIBUTION OF DRILL IN TEXTBOOKS WITH RESPECT TO THE DIFFICULTY OF EACH COMBINATION

If drill is distributed according to the difficulty of each basic combination, then difficult combinations, such as $7 + 9$, $16 - 7$, and 6×8, should appear more frequently than easy ones, such as $3 + 2$, $4 - 3$, and 2×2. Counts of the frequency of basic combinations have been made by Thorndike, Clapp, and Osburn.

Thorndike and Clapp each analyzed two texts. Osburn analyzed one text for all the combinations and six texts for those in long division. All their findings agree in showing a

tendency to reduce the frequency of a combination in proportion to its difficulty — a procedure which is just the opposite of what the law of habit requires. The results found by Osburn in the simple combinations show the character of the results of these investigations and are given in Table XXXVII.

TABLE XXXVII. ANALYSIS OF DRILL IN ONE OF THE MOST WIDELY USED TEXTS IN ARITHMETIC. (After Osburn)

KIND OF COMBINATION	NUMBER OF COMBINATIONS	EXAMPLE	AVERAGE FREQUENCY	RANGE IN FREQUENCY
Simple addition				
Easier	55	3 + 2	98.1	5–335
Harder	45	7 + 8	34.2	14–109
Simple subtraction				
Easier	55	7 − 2	71.4	8–293
Harder	45	18 − 7	35.5	9–218
Simple multiplication				
Easier	67	2 × 2	83.0	17–323
Harder	63	9 × 9	38.6	11–64
Simple division				
Easier	57	4 ÷ 2	30.3	1–133
Harder	33	63 ÷ 9	13.4	4–35

Such a distribution causes overlearning in the easy combinations and underlearning in the difficult ones. Underlearning produces a high percentage of inaccuracy and a consequent waste of time in connecting. Overlearning does little harm except that it wastes time which might be more profitably spent in strengthening the more difficult bonds. To give each bond its proper strength the teacher cannot slavishly follow the text. He must make some omissions and a good many supplementations. Adequate training can only be assured, however, if he makes frequent measurements of the child's progress and gives special drill on those operations which are shown to be below the standard, adjusting the amount of drill in proportion to the relative difficulty of the basic combinations.

Relative Difficulty of the Combinations

A number of investigations have been made to determine the relative difficulty of the combinations. For the most part these are limited to three methods: (1) the number of errors made in each combination, (2) the time required to respond to each combination, and (3) the teacher's opinion of the difficulty of each combination. The difficulty of a combination, according to the number-of-errors method, is assumed to be proportional to the number of errors made in it by a large group of pupils. According to the reaction-time method the difficulty is assumed to be proportional to the time required to respond to a combination. The assumptions underlying the teacher's-judgment method are uncertain, but presumably they must be based on observation of pupils' mistakes and reaction times. The first method was used by Phelps, Hollaway, and Clapp; the second, by Heilman and Shultis, and by Smith; the third, by Lennes. Of these the most extensive investigation is that by Clapp, who presented the combinations singly to about seven thousand pupils in four school systems, and in problems with a time limit to three thousand five hundred pupils in forty-five school systems. The orders of difficulty for the two conditions were not the same, but correlated fairly high except in the case of division. Clapp found the order of difficulty for each grade from Grades III to VIII inclusive and also for all these combined. Table XXXVIII, on pages 138–139, gives the order of difficulty for all grades combined.

Distribution of Review Drills

Not only is the rate of forming habits increased by the proper distribution of drills, but the permanent retention of them is greatly improved by a proper distribution of the reviews. In this connection we meet such problems as the following: How often should a topic be reviewed? How

TABLE XXXVIII. ORDER OF DIFFICULTY OF THE BASIC COMBINATIONS IN THE FOUR FUNDAMENTAL OPERATIONS. (After Clapp)

Addition

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

Subtraction

14 − 9	11 − 4	8 − 3	7 − 2	7 − 1
13 − 4	11 − 6	7 − 0	12 − 6	4 − 3
16 − 9	16 − 8	12 − 9	10 − 7	5 − 5
14 − 5	18 − 9	10 − 5	8 − 6	8 − 4
17 − 9	11 − 9	10 − 6	11 − 2	6 − 5
15 − 9	11 − 7	8 − 0	10 − 1	9 − 8
17 − 8	13 − 6	2 − 0	6 − 2	4 − 4
15 − 7	15 − 8	9 − 7	10 − 2	9 − 1
13 − 9	8 − 5	9 − 4	7 − 6	9 − 9
13 − 5	11 − 5	4 − 0	9 − 5	5 − 3
16 − 7	11 − 8	3 − 0	8 − 7	5 − 4
13 − 7	9 − 2	5 − 0	4 − 1	1 − 1
13 − 8	10 − 3	9 − 6	2 − 2	8 − 1
11 − 3	10 − 9	8 − 2	7 − 5	4 − 2
14 − 6	14 − 7	10 − 4	6 − 4	6 − 6
12 − 3	12 − 4	8 − 8	6 − 1	3 − 3
15 − 6	10 − 8	9 − 3	2 − 1	3 − 2
14 − 8	7 − 4	7 − 3	5 − 2	7 − 7
12 − 5	12 − 8	6 − 0	6 − 3	5 − 1
12 − 7	1 − 0	9 − 0	3 − 1	0 − 0

TABLE XXXVIII (*Continued*)

Multiplication

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

Division

2 ÷ 2	45 ÷ 9	18 ÷ 9	27 ÷ 3	49 ÷ 7
9 ÷ 9	30 ÷ 6	16 ÷ 8	16 ÷ 4	40 ÷ 8
28 ÷ 4	3 ÷ 1	4 ÷ 1	7 ÷ 1	72 ÷ 8
1 ÷ 1	35 ÷ 7	20 ÷ 4	12 ÷ 4	18 ÷ 6
36 ÷ 4	18 ÷ 3	6 ÷ 1	40 ÷ 5	24 ÷ 3
8 ÷ 8	7 ÷ 7	32 ÷ 8	21 ÷ 7	72 ÷ 9
3 ÷ 3	5 ÷ 5	35 ÷ 5	21 ÷ 3	20 ÷ 5
6 ÷ 6	4 ÷ 4	27 ÷ 9	30 ÷ 5	8 ÷ 2
56 ÷ 8	63 ÷ 9	5 ÷ 1	12 ÷ 3	12 ÷ 2
54 ÷ 6	0 ÷ 5	0 ÷ 3	15 ÷ 5	15 ÷ 3
9 ÷ 1	0 ÷ 9	64 ÷ 8	12 ÷ 6	14 ÷ 2
24 ÷ 6	54 ÷ 9	48 ÷ 8	36 ÷ 6	10 ÷ 5
0 ÷ 1	0 ÷ 2	0 ÷ 4	16 ÷ 2	6 ÷ 2
6 ÷ 3	0 ÷ 7	0 ÷ 6	14 ÷ 7	81 ÷ 9
32 ÷ 4	0 ÷ 8	42 ÷ 7	24 ÷ 8	9 ÷ 3
18 ÷ 2	8 ÷ 1	36 ÷ 9	48 ÷ 6	10 ÷ 2
8 ÷ 4	45 ÷ 5	28 ÷ 7	24 ÷ 4	25 ÷ 5
56 ÷ 7	42 ÷ 6	63 ÷ 7	2 ÷ 1	4 ÷ 2

much time should intervene between successive reviews? How long should each review be? Should a new operation be introduced with a long or with a short drill period? Should it begin with a long drill period and be reviewed with short drills which decrease in length and frequency as the learner proceeds through the book? It is needless to say that we have no basic facts which enable us to answer these questions. All that we can report at present is the actual distribution of certain operations in some widely used texts. Thorndike counted the distribution of some one-place by one-place, two-place by two-place, and three-place by three-place numbers in multiplication in the first two books of five widely used three-book texts in arithmetic. Knight did the same problem for examples in the division of fractions for five sixth-grade textbooks. These investigations agree in showing the absence of any systematic time distributions for reviews. Thorndike divided his books into sections of eight pages each, and then counted the frequency of certain combinations in each section. He found that many sections do not contain the combination in question at all, that the frequency in those sections which do contain it varies greatly, and that the highest frequency may occur in any part of the book. In text E, for example, 5×5 occurs four times in section 1, twenty-one times in section 19, and thirty-two times in section 43, near the end of Book II; 7×7 occurs twelve times in section 1, eight times in section 19, and six times in section 43; and 6×7 or 7×6 occurs twenty-seven times in section 1, twenty-six times in section 18, twice in section 19, twenty-one times in section 42, and four times in section 43. Knight divided his books into thirty-six sections, one for each week of the school year, and then counted the number of examples provided for each week. Text A had examples in the division of fractions for only seven of the thirty-six weeks (namely, weeks 3, 12, 21, 22, 23, 34, and 35), the number of examples per week for the seven weeks varying

from one to sixty-four. Text E had some examples for each week, the number varying from one to five. The distribution in texts B, C, and D were similar to those in text A. It is certain that texts A and E cannot both be right, but which one is the better is as yet a matter of opinion, for neither appears to be psychological. Applying the laws of learning and forgetting to this matter we should say that a new operation should be introduced with a long drill. The pupil should practice it until the habit is well formed. Then he should be allowed to rest several weeks or at least until a partial forgetting has set in. A second drill should then be given. After this time the reviews should decrease in length and should be given at increasing intervals. Nothing more specific than this can be said until we have actual experience to guide us.

Applying Repetitions at the Point of Error

By using standardized tests and also informal tests it is possible to analyze the errors made by the pupils in arithmetic and to devise a type of drill adapted to their correction. Such a procedure has the advantage of saving many useless and misapplied repetitions and of making those used more effective. A number of studies have been made of pupils' errors in arithmetic, most of which are analyses of errors in fundamental operations with integers. Two of them, however, analyze errors in fractions, and one analyzes errors in reasoning problems. The procedure in most of the studies is simply to analyze errors made by groups of children in standardized test papers, but several investigators have found it more profitable to supplement this analysis by observations of the methods actually used by pupils while solving problems orally. The studies by the first method show that most of the errors are not peculiar to the individual, but rather fall into a comparatively small number of types or classes; whereas studies by the second method show that many of

the devices used by pupils having difficulty in arithmetic are peculiar to the pupil and require specific treatment. The most extensive study of analysis of errors in test papers has been made by Osburn, who classified 21,548 wrong answers obtained from 3000 to 4000 pupils. He classified the typical sources of error into thirteen groups, as follows:

1. Trouble with zero combinations in each of the four processes.
2. Failure to deal with number facts when presented in equation form.
3. Difficulties in column (higher decade) addition.
4. Trouble in subtraction when a digit in the subtrahend is greater than the digit just above it in the minuend.
5. Interferences between what is required and what is already known (harmful transfer).
6. Ignorance of the combinations in all the processes.
7. Estimating the quotient in long division.
8. Carrying in addition.
9. Carrying in multiplication.
10. Borrowing.
11. Copying.
12. Bringing down in long division.
13. Failure to complete the exercise when the time is sufficient.

This list would be more helpful if we had the percentage of errors falling in each group, but presumably the sources are stated in the order of their importance and therefore suggest special emphasis on drill with zero combinations, equation forms, and combinations in the higher decades. Osburn also classified 716 errors made in long division by 500 children in rural schools and 30,000 errors made in reasoning problems in the Buckingham Problem Test by 6000 children in eighteen counties and one large city. The results are given in Tables XXXIX and XL.

Analyses of this sort are a long step forward in enabling us to direct our attention to the field in which we shall find the real trouble, but they are scarcely specific enough to enable

TABLE XXXIX. DISTRIBUTION OF 716 ERRORS IN LONG DIVISION
(After Osburn)

	PER CENT
Errors in estimating the quotient	39
Errors in multiplication combinations	21
Errors in subtraction combinations	21
Errors in carrying, borrowing, copying, bringing down, and failure to complete the exercise	19
	100

TABLE XL. DISTRIBUTION OF 30,000 ERRORS IN REASONING PROBLEMS
(After Osburn)

	PER CENT
Total failure to comprehend the problem	30
Procedure partly correct but with the omission of one or two essential elements	20
Failure to respond to fundamental quantitative relations	10
Errors in fundamental processes	20
Miscellaneous errors	2
Errors whose causes could not be discovered	18
	100

us to devise corrective remedies. For example, failure to comprehend the problem may mean many things. It may be a result of difficult words, of failure to discriminate the known from the unknown, of failure to perceive what is to be found, of failure to select the proper processes, or of other causes, each of which should be investigated before remedies are prescribed. But this information can usually not be found from wrong answers in tests. This is particularly true of reasoning problems. The specific causes of errors in computation are usually more evident, and drills devised to correct such errors are helpful.

The value of drill designed to correct errors in test papers in common fractions was shown by Martin, who analyzed 1029 errors made by thirty-six eighth-grade pupils in twelve informal diagnostic tests which were given in November. After this seventeen practice tests were devised for the correction of the errors in the four fundamental operations. In April the diagnostic tests were again given for the purpose of

measuring the effect of the drill. The improvement is shown in the reduction of the number of errors in addition from 268 to 82. In subtraction the errors were reduced from 112 to 77, in multiplication from 130 to 86, and in division from 157 to 141.

Observing how individual pupils actually solve problems was introduced as a method of diagnosis by Uhl, who reported a number of peculiar methods used by pupils. One of these was to break up a difficult combination into simple combinations. For example, a fourth-grade boy in adding 9, 7, and 5 said $9+2+2+2+1=16$ and 21. This method was further developed by Brueckner, who devised a diagnosis sheet which contained a test of twenty-four wrong procedures in the fundamental operations and eight general difficulties. Such a list is helpful not only in making possible an easy record but also in directing the teacher's attention to difficulties which might otherwise remain unnoticed. The type of information obtained by this method is illustrated by Dorothy's record in addition. Dorothy is a child in the second grade.

ADDITION

Starts backwards. Counts with head and fingers. Taps out results to herself with her tongue. Movements barely perceptible. Cadet teacher had never observed this before, but the child claims she always counts in this way. She is unable to tell how she keeps track of these taps. She skips around, sometimes beginning at the top and sometimes at the bottom of the column. She has roundabout methods of adding.

47	7 and 7 = 14	87	5 and 5 = 10
9	+ 2 = 16	5	+ 2 = 12
56	4 and 1 = 5	92	8 and 1 = 9

She points to the figures in adding, saying:

7	5 and 5 = 10	7	2 and 6 = 8
4	+ 1 = 11	7	
5	+ 4 = 15	2	7 and 7 and 7 = 21
6	+ 7 = 22 tapped it out,	6	and 1
22		22	22

She always taps out the larger numbers or separates them, as, 8 = 6 and 2, and 9 = 6 and 3. She is able to keep track of about 5 taps in her mind, and then she says "and 1" or "2," or whatever the number may be. When it comes to two-column addition, it is hard for her to remember what she has to carry.

Information of this sort is much more revealing than are mistakes in test papers. It enables us to see that Dorothy evidently needs speed drills and needs to be taught to add systematically upward and from right to left.

The best work by the method of individual observation has been done by Buswell, who, with the coöperation of Lenore John, has succeeded in working out a refined technique of diagnosis. The first step was to work out a set of examples that involved the principal unit habits in each of the fundamental operations in arithmetic. These were then given to about 515 pupils from Grades III–VI in the form of a test for the purpose of finding out the frequency of the errors per example. The results were used to place the examples in order of difficulty, beginning with the easiest. In doing this it was assumed that this order was inversely proportional to the frequency of the errors. The outcome was a so-called Pupils' Work Sheet that contained the examples in order of difficulty and a list of the principal types of errors upon which the kind of errors made by a pupil might be checked. The work sheet was then given in a preliminary trial by one examiner to each of two hundred and fifty pupils in Grades III–VI. The examiner analyzed one fundamental operation in each pupil. In doing so he observed the pupil's methods of work and asked questions when they were not clear. The pupil's comments were recorded verbatim. At the end of the day each of the cases was reviewed and summarized, and any additional items which were thought to be significant were included. This procedure resulted in a partial standardization of the method of diagnosis as well as in discovering the principal types of error and the frequency of

each. Thirty-three typical errors were discovered in addition, twenty-seven in subtraction, forty-one in multiplication, and forty-one in division. Having found the technique of diagnosis and the principal types of error, the experiment was extended into seventy-nine classes taught by seventy-three teachers in twelve schools. The general plan of diagnosis was explained in detail to the principals and coöperating teachers, who were instructed to find from five to ten pupils having difficulty in arithmetic, to diagnose them, and then to apply suitable remedial measures. As a result three hundred and three new cases were found, and a ten weeks' experiment was made on these for the purpose of testing the value of instruction based on careful diagnosis. The diagnostic records obtained from this experiment were useful in establishing the order of frequency of the principal types of error more accurately than did the records obtained from the preliminary trial of the work sheet. Since these are helpful in directing practise given by teachers of arithmetic, it is worth while to give in order of frequency, from high to low, the types of error that were made by one fifth or more of the pupils.

Addition:

1. Errors in combination.
2. Counting.
3. Added carried number last.
4. Forgot to add carried number.
5. Retracted work after it was partly done.
6. Added carried number irregularly.
7. Wrote number to be carried.
8. Carried wrong number.
9. Irregular procedure in column.
10. Grouped two or more numbers.
11. Split numbers.

Subtraction:

1. Errors in combinations.
2. Did not allow for having borrowed.
3. Counting.

4. Errors due to zero in minuend.
5. Said example backward.
6. Subtracted minuend from subtrahend.

Multiplication:

1. Errors in multiplication combinations.
2. Error in adding carried number.
3. Wrote rows of zeros.
4. Errors in addition.
5. Carried a wrong number.
6. Used multiplicand as multiplier.
7. Forgot to carry.
8. Error in single zero combinations; zero as multiplier.
9. Errors due to zero in multiplier.
10. Used wrong process.

Division:

1. Errors in division combinations.
2. Errors in subtraction.
3. Errors in multiplication.
4. Used remainder larger than divisor.
5. Found quotient by trial multiplication.
6. Neglected to use remainder within example.
7. Omitted zero resulting from another digit.
8. Used wrong operation.
9. Omitted digit in dividend.
10. Counted to get quotient.

At the beginning and end of the ten weeks' experiment the pupils were given the Cleveland Survey Arithmetic Test in order to measure their amount of improvement. Although no control groups were used, the actual gains were compared with the usual amount of gain for a period of ten weeks. The results showed that the actual gains exceeded the expected gains by 120 per cent in addition, 149 per cent in subtraction, 213.5 per cent in multiplication, and 63.5 per cent in division. The favorable results justify Buswell's conclusion that "arithmetic must be taught in terms of the pupil, not simply in terms of the subject itself, and not until teachers under-

stand intimately the nature of the difficulties which children encounter in arithmetic can the school expect very much change in the high percentage of failures in this subject."

How Strong should the Bonds be made for the Demands of Practical Life?

This question may be answered either theoretically or on the basis of the accuracy which successful business men display under test conditions. Theoretically the accuracy should of course be 100 per cent. An addition is almost worthless unless it is correct, and in most business firms there are enough checks on the operations in computation to make possible the correction and detection of all the errors. An accuracy of 100 per cent would have the practical advantage of saving all the labor that ordinarily is spent in checking. Thorndike holds the opinion that an adder would save enough time in checking to raise his accuracy from 96 out of 100 additions to 199 out of 200. He says also that "a reasonable defense could be made for requiring 996 or 997 out of 1000." The basis of this opinion is a calculation which shows that in adding one thousand examples having five three-place numbers a man with an accuracy of 960 out of 1000 would get 700 wrong answers in his first attempt and would have to make over 4500 checkings in order to have two sets of agreeing answers, and that if he had an accuracy of 999 per cent he would get only 19 wrong answers in the first attempt and would have to make only 40 checkings to get all correct. In this calculation Thorndike considers that adding one number to another is one addition, and that an example having five three-place numbers would involve 19 additions, "counting each act of holding in mind the number to be carried and each writing of a column's result as equivalent in difficulty to an addition." A thousand examples of five three-place numbers would therefore have 19,000 additions. If the accuracy is 96 per cent, the number of errors would be 760. If there were about

an even distribution among 1000 examples, there would be at least 700 examples wrong in the first attempt. On this basis an accuracy of 96 per cent would have little commercial value. Among eighth-grade pupils the Courtis tests usually have an average accuracy of not over 75 or 80 per cent; that is, 75 or 80 per cent correctness in examples having nine three-place numbers. Although this is much higher than the same percentage in adding examples of two digits, yet the discrepancy between actual attainment and theoretical ideal is very wide and leads us to the conclusion that the schools fall far short in developing ability in arithmetic that has commercial value.

However, if we set our standards with reference to the actual accuracy which business men show under test conditions we see that the graduates of the eighth grade approach more closely the accuracy of business men. This was shown in Kolstad's investigation of the addition of two thousand five hundred army men. He calculated the scores made in the Army Alpha Test 2 by officers classified according to their pre-war occupation, and obtained the results given in Table XLI, on page 150.

It will be seen that the average child from Grade VIII is about 25 per cent below the average business man in speed and about 8 per cent below him in accuracy in solving reasoning problems. In the fundamental operations it appears that business men are superior to eighth-grade pupils in speed and accuracy of addition and in speed of multiplication but not in accuracy of multiplication. This was shown in Courtis tests given by Woody to 203 adults belonging to the Rotary and Kiwanis clubs. The average number of attempts was 19.5 in addition and 13.7 in multiplication. The corresponding averages in accuracy were 82 per cent and 71 per cent. The standards for the eighth grade in speed are 11.6 for addition and 10.2 for multiplication; in accuracy they are 76 per cent for addition and 81 per cent for multiplication. The

TABLE XLI. SPEED AND ACCURACY OF ADULTS IN REASONING PROBLEMS, IN RELATION TO PRE-WAR OCCUPATION. (After Kolstad)

PRE-WAR OCCUPATION	MEAN NUMBER RIGHT	ACCURACY PER CENT
Real estate and insurance	14.9	90.3
Business manager	14.1	86.2
Clergyman	13.7	91.6
Clerk	13.7	87.2
Engineer	13.5	89.4
Salesman	13.5	86.6
Lawyer	13.3	86.9
Student (college)	13.2	88.6
Teacher	13.0	80.7
Chemist and pharmacist	12.9	88.0
Accountant	12.8	85.3
Farmer	12.8	84.2
Merchant	12.3	90.4
Surgeon	12.1	89.6
Physician	11.2	83.5
Banking	11.1	88.1
Soldier	10.5	82.4
Dentist	10.1	82.7
Averages	12.8	86.2
School children of Grade VIII A	9.3	78.8

fact that business men are above the standard in accuracy for addition and below it for multiplication is probably due to the fact that they have much more practice in addition than in multiplication. If teachers in schools would merely put in practice the idea of more systematic drill applied at the right points, eighth-grade pupils would easily attain the standards of business men and even surpass them.

SUMMARY

The secret of high speed and accuracy in arithmetic lies in adequate drill. Some kinds of drill are much better than others. Such types of drill as have been devised by Courtis and Studebaker have proved more efficient than those improvised by the teacher. There are also special drills that have peculiar value for each of the fundamental operations.

Thinking only results in column addition is better than thinking both results and numbers. The best method of subtraction is still a matter of dispute, but the evidence favors subtractive methods rather than additive methods. The take-away-carrying method has been found to be superior to the take-away-borrowing method. The probable reason is that in the former there is less opportunity to forget the changed number. Memorizing multiplication tables disassociated from practice has been found to be less economical than learning them through use and computation. Multiplicative division (4 times what equals 20?) has been found to be more economical than the traditional method (4 into 20 how many times?).

Distributed drill is much more profitable than concentrated drill, but just how long drill periods should be and how long the interval between them depends on the subject matter and on the age and grade of the child. In computation problems drills as short as two minutes and as long as twenty minutes have proved profitable in the grades, but in reasoning problems it is better to have them fifteen or twenty minutes long.

In textbooks there is often a tendency to reduce the frequency of a combination in proportion to its difficulty — a procedure which is just the opposite of what the law of habit requires. Teachers using a textbook in which this tendency is apparent should keep in mind the defect and devise corrective drill. The order of difficulty of fundamental combinations has been determined with great accuracy and should be used to determine the amount of drill.

Drill in arithmetic is effective when it is applied at the point of error. The technique for finding pupils' errors has not yet been fully developed. Standardized diagnostic tests are helpful for discovering errors in computation, but for finding errors in reasoning problems close observation of the child's actual methods of work is necessary. Elementary schools do not develop enough speed and accuracy in the

fundamental operations in arithmetic to meet the demands of business life. In reasoning problems they are about 25 per cent below the average business man in accuracy. The remedy for this situation is more drill.

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CHAPTER XI

ARITHMETIC: THE LAWS OF ASSOCIATION AND SATISFACTION

The law of association has reference to making arithmetic meaningful and rational, to integrating it with useful activities instead of segregating it as a group of dull and mysterious processes which have little relation to the day's work.

Memorizing and repeating tables without end; long drills on number combinations; endless problems in multiplication or division, in canceling fractions, in reducing fractions, in reducing denominate numbers, in factoring for the least common multiple, and in finding roots and powers of numbers, — all these operations inevitably tend to segregate arithmetic from the rest of experience and divert it from the vital interests of the learner and so make it a formal activity which is done only under compulsion. In integrating arithmetic we must always keep in mind that it is a tool, a means to an end, or a habit which functions in relation to the vital interests of the learner. This may be done in many ways: connecting arithmetic with concrete objects, explaining operations inductively rather than deductively, applying the operations to interesting situations and connecting them with interests coming within the child's experience, using arithmetic to solve real problems, using simple language, and by training in analyzing all the steps in problems.

Connecting Arithmetic with Concrete Objects

In teaching multiplication by twos, for example, a possible procedure would be first to count by twos, then learn a table of the twos, and solve simple exercises such as 5×2, 3×2,

7×2. In contrast with this the twos might be developed out of problems with concrete objects. Thorndike's Book I develops the twos as follows:

Take the pint and the quart measure. Which is larger?

Will a pint of water fill about one glass or two glasses?

Will a quart of water fill about two glasses or about four glasses or about eight glasses?

Will a quart measure fill one pint measure or two pint measures?

Will two quart measures fill four pint measures or five pint measures?

Find out how many pint measures three quarts of water or sand will fill?

Find out how many pint measures four quarts of water or sand will fill?

Find out how many glassfuls three pints will make.

Find out how many glassfuls five pints will make.

Which of these do you think means quart or quarts?

qt. pt. yd. ft. in.

Which do you think means yard or yards? Which means foot or feet? Which means inch or inches?

Read these lines. Say the right numbers where the dots are. Say "are equal to" for =

2 qt. = . . . pt.	3 pt. = . . . glassfuls
5 qt. = . . . pt.	2 pt. = . . . glassfuls
3 qt. = . . . pt.	4 pt. = . . . glassfuls
4 qt. = . . . pt.	5 pt. = . . . glassfuls

In a similar manner the threes are developed from problems with feet and yards, the fours from problems with quarts, gallons, pecks, and bushels, the fives from a bean-bag game, the sevens from problems with days of the week, and the nine's from problems with square yards. This not only makes arithmetic concrete but also enables the child to see its uses, gives him a motive for learning it, and aids in the formation of independent bonds with each of the basic combinations.

Inductive Teaching more Meaningful than Deductive Teaching

In teaching a new process some textbooks follow the procedure of giving a number of abstract definitions, a description of the processes in agreement with these definitions, and illustrations of the processes; others give a number of problems from life situations and then explain an arithmetical process for solving these, omitting all abstract definitions. The former may be called a deductive method; the latter, an inductive method. In explaining multiplication with carrying, a widely used text which uses the deductive method begins by defining multiplication as "the process of taking a number as many times as there are units in another number." Then follow equally concise definitions of multiplicand, multiplier, product, multiple, factors, and the symbol of the oblique cross. Then the process is illustrated and described in connection with the problem 687×6. Below this are statements explaining that the product is the same whatever the order of the factors, that $3 \times 4 = 4 \times 3$, that the multiplier is always abstract, that the multiplicand may be either abstract or concrete, and that it and the product are always like numbers.

From the standpoint of learning multiplication we ask "What background of experience has a ten-year-old child for understanding these definitions, and how do they help in mastering and using the process?" Even after the process is well illustrated, can the child understand that multiplication is a process of taking one number as many times as there are units in another? Even if he does understand it, how does this idea add to the speed and accuracy of multiplication? The psychological moment for analyzing and explaining the concepts involved in multiplication would appear to be after the child has had abundant experience with it. Then it will be meaningful and at least satisfying to curiosity if not helpful in the functioning of the habit. An example of the way

another book introduces the same process by the inductive method is given below:

The second-grade rooms A, B, and C had these supplies:

3 boxes of pencils, 144 pencils in a box.
6 boxes of chalk, 144 pieces in a box.
3 big boxes of inch cubes, 1728 cubes in a box.
5 boxes of play money, 250 pennies in a box.
75 pads of paper, 96 sheets in a pad.

1. How many pencils did they have in all?
2. How many pieces of chalk did they have in all?
3. How many inch cubes did they have in all?
4. How many play pennies did they have in all?
5. How many sheets of paper did they have in all?

Here is a quick way to find out:

96 Think "two 6's = 12." Write the 2 under the 2 of 72 in the ones
72 column. Remember the 1.
192 Think "two 9's = 18. 18 and 1 = 19." Write the 19.
672 Think "seven 6's = 42." Write the 2 under the 7 of 72 in the tens
6912 column. Remember the 4.
Think "seven 9's = 63. 63 and 4 = 67." Write the 67.
Add. Remember that the 672 counts are 6720 in adding.

This procedure is more meaningful than the deductive, because it avoids all definitions that do not function in the process, it avoids the manipulation of numbers as such apart from the objects numbered, the numbers are related to familiar objects, the new process is used in solving practical problems, and it is introduced as a quick way of solving them. All of this means something to a child. If, however, by understanding multiplication we mean that a child sees how the process follows from the definition, then we must admit that the inductive method does not supply this meaning. But if understanding multiplication means ability to use it in practical life-situations, then the inductive method develops it.

For the authors of the deductive procedure explanation means seeing how a particular process follows from general

definitions and principles; but for the author of the inductive procedure it is seeing how a process gets one the result that he wants. The deductive explanation is for the mature mind. It satisfies the college professor's curiosity to see things in their logical relationships. But a ten-year-old child has no such curiosity, and for him the deductive process is only a source of confusion and mystery. It is a waste of time and contributes little to the perfection of his habits in multiplying. But he is interested in getting results and may be said to understand multiplication when he can use it for that purpose.

Make Full Explanations

Making full explanations is a valuable device for making arithmetic meaningful. The lack of these is probably the most conspicuous fault in arithmetic texts, present and past. Authors of school arithmetics apparently pride themselves on brevity of statement. The following introduction to the addition of mixed numbers is typical of the prevailing custom.

Find the sum of $2\frac{2}{3}$ and $3\frac{2}{3}$.

$2\frac{2}{3}$	$\frac{2}{3} + \frac{2}{3} =$ how many thirds?
$3\frac{2}{3}$	$\frac{4}{3} = 1$ and how many thirds?
$6\frac{1}{3}$	$5 + 1\frac{1}{3} = 6\frac{1}{3}$.

An adult familiar with arithmetic might get the process from this amount of explanation, but it is doubtful if even he would infer the necessity of using a common denominator in another problem not having it in the fractions. But it is a rare ten-year-old child who would get the idea of the following steps in mixed numbers: finding a common denominator, adding the fractions, reducing them to a mixed number, and then adding the number to the integers. In fact, all these steps would have to be clearly explained and illustrated by the teacher in advance of the lesson. Why should not the explanations be full enough so that a child can get a clear idea of these steps by unassisted silent study? This idea has

been incorporated in a new series of arithmetics by Knight, Studebaker, and Ruch in the following introduction to the addition of mixed numbers:

PRACTICE IN ADDING MIXED NUMBERS

(A Study Period)

Study these examples before the oral recitation begins. Be ready to answer any question your teacher may ask.

See if this example is done correctly.

1. Add:

$$\begin{array}{r} 3\frac{3}{4} \\ 4\frac{7}{8} \\ \underline{4\frac{1}{2}} \end{array}$$

First add the fractions. The denominators must all be 8; so we get:

$$\begin{array}{r} \frac{6}{8} \\ \frac{7}{8} \\ \underline{\frac{4}{8}} \\ \hline 1\frac{7}{8} = 2\frac{1}{8} \end{array}$$

Now we must add $2\frac{1}{8}$ to the whole numbers, thus:

$$\begin{array}{r} 3 \\ 4 \\ 4 \\ \underline{2\frac{1}{8}} \\ \hline 13\frac{1}{8}, \text{ answer} \end{array}$$

Did we forget to change the improper fractions?

Did we forget to add the whole number part of $2\frac{1}{8}$ to $\begin{array}{r} 3 \\ 4 \\ \underline{4} \end{array}$

2. See if this is right:

Add: $\begin{array}{r} 2\frac{2}{3} \\ \frac{1}{4} \\ 2\frac{8}{12} \end{array}$ (Work $\begin{array}{r} \frac{8}{12} \\ \frac{3}{12} \\ \underline{\frac{8}{12}} \\ \hline \frac{19}{12} = 1\frac{7}{12}) \end{array}$

The answer is $5\frac{7}{12}$. How did we get $5\frac{7}{12}$ instead of $4\frac{7}{12}$? Remember about improper fractions in results.

Remember about carrying the whole part of the mixed number that is the sum of the fractions.

3. Are these done correctly?

A	B	C
$2\frac{2}{3}$	$4\frac{1}{2}$	$4\frac{2}{3}$
$\frac{1}{2}$	$3\frac{4}{5}$	$2\frac{1}{2}$
$3\frac{1}{6}$	$2\frac{4}{10}$	$4\frac{3}{12}$
$6\frac{1}{3}$	$10\frac{7}{10}$	$11\frac{5}{12}$

Rules for adding mixed numbers. Study the example below. How would you do the addition?

$$\begin{array}{r} 4\frac{1}{2} \\ 3\frac{3}{8} \\ 2\frac{1}{4} \\ \hline \end{array}$$

In examples like the one above, it is wise to use the following rule: Add the fractions by themselves. Then add the whole numbers. Never forget to add the sum of the fractions to the sum of the whole numbers.

Avoid Trifling Problems

Arithmetic cannot be integrated by using it to solve problems about which nobody cares. Too many problems are like the following:

In a stable were twelve horses. All were driven in spans. How many spans were there?

Twelve little rubbers stood in a row. To how many children did they belong?

How many pairs of boots are twelve boots?

How many feet have two cats and a chicken?

Twenty peaches were on the table and they were divided equally among five people. How many peaches could each one have?

How many legs have three house flies?

How many wings have three spiders and three house flies?

A wasp has a pair of large wings and a pair of small wings. How many wings have three wasps? How many large wings have nine wasps?

Compare the following in contrast:

Mary is going to have a party for Alice, Nell, and herself. How many sandwiches does she need if each of the three girls is to have three sandwiches?

How many cakes does she need if each of the three girls is to have three cakes?

How many pieces of candy does she need if each of the girls is to have four?

Five children are coming to a party. How many pieces of candy do you need to give each child two?

If only three children come, how many cakes will you need to give each child two?

The second list of problems has just as much arithmetic in it as the first, but it has the very great advantage of being used for something in which the child is interested rather than for something which is repulsive or indifferent to him.

Use Simple Language

The importance of using the language of the child as a means of integrating arithmetic can scarcely be overestimated. His language represents his interests and concepts and is the best single expression of his level of thought. If the problems in arithmetic are put in the child's language, the associations for connecting arithmetic with his interests and activities are there, ready for the assimilation of the new content. But if arithmetic speaks a new language, then it becomes a mechanical system segregated from life. Thorndike counted the children's words which occurred in the first fifty pages of eight beginning texts in arithmetic and found a very slight use of them. He says:

Help, fork, knife, spoon, jump, sing, and *tag* did not appear at all. *Toy* and *grow* appeared each once in the four hundred pages. *Baby* did not appear as often as *buggy*. *Family* appeared no oftener than *fence* or *Friday*. *Father* appeared as often as *farmer*.

Some of our new books in arithmetic have paid attention to this matter, but they are rare. The following examples taken from a page of a widely used primary arithmetic illustrate the prevailing type of language:

Mrs. Brown buys a sideboard for $25, a table for $15, and 6 chairs at $2 each. How much money does she spend?

A farmer has in his orchard 3 rows of peach trees, 2 rows of cherry trees, and 4 rows of apple trees. How many trees in the orchard if there are 11 trees in each row?

There are 24 boys in each class. How many boys are there in 3 classes?

I spent 68 cents for dry goods, and have 20 cents left. How much money had I at first?

There are 90 eggs in a box. How many will there be left after a dozen are sold?

Our reader has 87 pages. We read 45 pages last month. How many pages have we yet to read?

Such words as *sideboard, spend, farmer, orchard, peach, goods, money, dozen, pages, reader,* and others are new and difficult for children in the second or third grade. But a more serious objection is that the content is interesting only to an adult mind. The total cost of a dining-room set, the number of trees for planting an orchard, the size of classes, the number of eggs left in a box after a certain number have been sold, and so on, are rather of interest to the housewife, the farmer, the teacher, and the groceryman but hardly appeal to a child in the second or third grade. The same arithmetic would be learned much better from interesting content. Consider the following problems from one of the new books:

How many 3-cent apples can Jane buy if she has a nickel and a dime?

Three children came to play with Louise, each bringing the same number of dolls. There were 12 dolls. How many dolls did each girl bring?

Joseph has 3 rabbits. Last week he fed them 21 carrots. How many did he give to each rabbit?

Mary brought the teacher 18 roses. The teacher put them into 3 vases, with the same number of roses in each vase. How many were there in each?

Toy balloons cost 3 cents each. John has 30 cents to spend. How many balloons can he buy?

Here are some problems taken from a widely used text for the intermediate grades:

A butcher buys an ox weighing alive 1200 pounds at 6 cents per pound. When killed and dressed its weight is $\frac{2}{3}$ of the live weight. What is the butcher's profit if he sells the meat at an average of 15 cents per pound?

From a piece of muslin containing $37\frac{1}{2}$ yards, three pieces, each measuring $7\frac{1}{8}$ yards, were sold. How much remained in the piece?

A farmer distributed 15 bushels of corn among several persons, giving them $1\frac{2}{3}$ bushels apiece. Among how many persons did he divide it?

A man bequeathed to his son $3500, which was $\frac{5}{7}$ of what he left to his wife. How much did he leave to his wife?

Subtract the following without rearranging them. Find the sum of the minuends, the sum of the subtrahends, and the sum of the remainders. Measure the top of the desk, disregarding fractions of an inch, and calculate the surface in square inches. (Then follow examples.)

A cargo of potatoes was discharged in tubs containing 250 pounds each, which were filled 1785 times. The bushel of potatoes is estimated at 80 pounds. How many bushels were landed?

Such words as *butcher, weighing, weight, average, containing, measuring, remained, bequeathed, bushels, minuends, subtrahends, remainders, disregarding, calculate, cargo, discharged, estimated, landed,* are comparatively rare for adults and are rarely known by a fifth-grader. Besides, the problems are not even interesting to an adult. They would not be solved in the manner required here. What butcher would find the weight of a dressed ox by taking two thirds of the live weight, and what clerk would find the number of yards in a remnant by subtracting from the original length of the piece the number of yards already sold from it?

In contrast, compare the following problems taken from a new book for the intermediate grades:

1. Alice, Nell, Bertha, Mary, Kate, and Louise are to be in charge of the candy counter at the fair. They plan to dress all alike. How many yards of ribbon do they need to make hair ribbons, each $\frac{5}{8}$ yard long?

2. Check your answer to 1 by adding

$$\frac{5}{8}\ \frac{5}{8}\ \frac{5}{8}\ \frac{5}{8}\ \frac{5}{8}\ \frac{5}{8}$$

3. If it takes $\frac{7}{8}$ yard to make 1 belt, how many yards do they need to make 6 belts?

4. Check your answer to 3 by adding.

5. How much ribbon do they need to make 6 badges, each $\frac{1}{6}$ yard long?

6. They plan to sell fudge in $\frac{1}{4}$-pound boxes at 10 cents a box. How many pounds of fudge will be required to make 2 dozen $\frac{3}{4}$-pound boxes?

7. Check your answer to 6 by finding $\frac{3}{4}$ of 24.

Improve the Ability to Read

If the use of simple language and of interesting content is helpful in learning arithmetic, it follows that improvement in ability to read should produce gains in arithmetic. That this is the case was shown in an investigation made by Lessenger, who gave the Stanford Achievement tests to the pupils of the schools of Radcliffe, Iowa, in order to measure the gains made from a year's special effort to improve reading ability. In calculating the gains made in the tests he was struck by the fact that the gains made in computation equaled those in reading. The effect of improvement in reading was measured by calculating the loss due to faulty reading. If a pupil used a process in computation correctly but

selected the wrong process, it was assumed that this was due to misreading the directions. The loss in arithmetic age due to faulty reading in the test, when given in September, was 10.1 months, but in the final tests at the end of the year this loss was only 1.0 month, thus showing a gain of 9.1 months due to improvement in reading. The same fact was shown by comparing the average gains in arithmetic age made by sixty-seven poor readers and forty-four good readers. The former gained 29.7 months and the latter 21.2 months, or 8.5 months less, which is another measure of the amount of gain due to improvement in reading.

The effect on arithmetic of improving the ability to read was shown also in an experiment by Estaline Wilson, who devoted ten minutes a week for five weeks to training a sixth-grade class in increasing its comprehension of verbal problems. Three devices were used: (1) asking a series of questions, the answers to which would make the meaning of a problem clear; (2) making a story out of a problem; and (3) dramatizing it or indicating its answer in pantomime. The effect of this training was measured by giving the Stone Reasoning Test both before it and after it. Table XLII gives the results.

Although no control groups were used, the fact that nearly a year's gain was made in six weeks shows a very favorable effect for the type of training used.

Give Training in Problem Analysis

That a systematic and logical procedure is better for solving problems than an undirected one was shown in an experiment by Newcomb, who tried the former on four classes from Grades VI and VII and compared their gains with two control classes. In the logical procedure the pupils were instructed to (1) understand each word in the problems, (2) read the problem intelligently, (3) add, subtract, multiply, and divide with speed and accuracy, (4) determine what is

TABLE XLII. EFFECT OF TRAINING TO INCREASE COMPREHENSION IN VERBAL PROBLEMS. (After Wilson)

	APRIL 4	MAY 11
Standards for Grade VI	6.5	6.5
Average for 17 boys	5.5	6.8
Average for 17 girls	3.8	8.1

given in the problem, (5) determine what is required, (6) select the different processes to be used, (7) plan the solution wisely and systematically, and (8) check readily. The method was tried in connection with "twenty carefully prepared lessons of graded difficulty," and its effect was measured with the Stone Reasoning Test 2, which was given before and after the experiment. It was found that the experimental group had improved 22.8 per cent in speed and 5.5 per cent in accuracy, whereas the controls improved only 5.1 per cent in speed and 2.9 per cent in accuracy. The excess gains by the experimental group are enough greater to justify further trials with the logical procedure.

Another experiment in problem analysis was directed by Stevenson, who used a variety of devices during three fifteen-minute periods a week for twelve weeks. For the first quarter of the period pupils from Grades V–VIII were drilled in finding what facts were given in the problems, what question was asked, what process or processes were to be used, and what the answer was in round numbers. During the second quarter, drill was given in solving problems taken from life situations, many of which were collected from pupils' parents. During the third quarter the pupils solved problems without numbers by indicating the processes to be used. During the fourth quarter they studied difficult words, stated the problems in their own words, and analyzed their meanings. At the beginning and end of this instruction the pupils were tested by the Buckingham Scale for Problems and the

Stevenson Problem Analysis Test. The results showed that the average gain for all the grades amounted to about four fifths of a year. Another interesting fact revealed was that the amount of gain varied inversely with the brightness of the children. Those that had an I. Q. of 110 and above made an average gain of 2.63, those with I. Q.'s 90 and 109 made an average gain of 6.9, and those with I. Q.'s below 90 made an average gain of 7.20, indicating that the types of training here used are most helpful to the duller pupils.

Both these experiments point to the value of training in careful reading and in a logical procedure for the solution of reasoning problems. Authors of textbooks will do well to insert materials for this purpose. In fact, our newer books contain some lessons of this kind. A good example is the following page from the Smith-Burdge Arithmetics, "Primary Book":

A SILENT-READING LESSON

We have solved many simple problems in arithmetic. We shall now learn how to solve harder ones.

Suppose that an automobile dealer bought 7 touring cars at $1450 each and 12 roadsters at $975 each. How much did he pay for them all?

First we have to see exactly what is given; then exactly what we wish to find; and, finally, how we shall go to work to find it.

In this case, what is first given? The number of touring cars and the cost of each one.

What is first required? The cost of 7 touring cars.

What are the next two things to find? The cost of the roadsters and the total cost of all the cars.

How shall we proceed to find this? We write our work in some such form as this, arranging it neatly:

$1450	$975	$10,150	
7	12	11,700	
$10150	$11700	$21,850	*Ans.*

To be sure that we understand the solution, we read these statements:

The cost of 7 touring cars is 7 × $1450, or $10,150.
The cost of 12 roadsters is 12 × $975, or $11,700.
The total cost is $10,150 + $11,700, or $21,850. *Ans.*

Use the Project Method of Teaching

Another important method of integrating arithmetic is the project method of teaching. If problems in arithmetic help to solve a larger problem which the child has set for himself, he will take more interest in it, pay more attention to the facts, and be more strongly impressed with the usefulness of arithmetic than if the problems appeal merely to curiosity or are done as a part of a day's work. Our failure to connect arithmetic with practical projects and activities is responsible for the vagueness of many arithmetical and business terms among both pupils and teachers.

Our newer arithmetics for the seventh and eighth grades now contain many terms used in business. Sometime ago the writer became interested in finding out how these business terms were being assimilated by teachers. He made out a questionnaire in which he asked a hundred experienced teachers to define fifteen terms frequently used in business. The returns were so interesting that he undertook to construct a dictionary from the teachers' definitions. The following portion of it illustrates the character of the definitions received:

Dividend
- The number to be divided. 12 divided by 4 = 3. 12 is the dividend.
- Return on stock.
- Amount left after expenses are paid.
- Payment on stock.
- Interest on investment.
- Sum invested.
- Amount charged on rates.
- Something you get in installments.

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The fundamental reason for the failure of teachers to understand terms which are common in business and which occur frequently in our newer arithmetics is that the teacher's life and work is largely segregated from the real commerce of the day. The remedy is more contact with life. Teaching arithmetic by practical projects is one way of making contacts. An interesting illustration of how this may be done is found from a paper by Mary Reese of Winnetka, Illinois:

The children are taught banking by running an imaginary bank. They all receive check books which are printed in the school print shop by the boys and, following directions found in their practice books, they make out checks to each other and fill out their stubs in their books. The checks received are indorsed according to directions and with deposit slips made out are deposited in the bank, the children taking turns as tellers. If any error is made the check has to be rewritten. After all the checks are written correctly and deposited, they balance their accounts and take a test which covers the essentials. If any mistake is made they take a second test.

They have studied stocks and bonds by forming a stock company. They appoint incorporators who, after deciding on the amount of capital stock and the cost of a share, solicit stock from other members of the class, which is paid for by check. Meetings are held at which directors and officers are elected and the subject studied, learning the meaning of preferred and common stock and other important terms used. At the end of the first imaginary year, dividends are declared, the children receiving their dividends in checks made out by the treasurer. The corporation then borrowed money by issuing bonds.

This year the plan was changed somewhat. A real corporation was formed with capital stock amounting to $300, the incorporators selling shares of preferred stock yielding 7 per cent interest at 10 cents a share, in lots from one to 50 shares, to not only the eighth grade but also to lower grades, parents, and teachers. Up to date $150 has been paid into the treasury by subscribers who have received regular certificates with the seal of the corporation. At the end of the first month, business being

prosperous, a quarterly dividend was declared, each stockholder holding 5 or more shares receiving his pennies from the treasurer.

The company known as the Skokie Finance Corporation has under its control the school paper which is edited and printed by the boys in the school shop.

The Law of Satisfaction

The sources of the principal satisfactions coming from the learning of arithmetic lie in the instincts of curiosity or mental manipulation, in self-assertion, in mastery, and in the desire for approval and play. The ten digits used in arithmetic can be made into so many combinations and can be used for describing so many relationships that something new is constantly found in them by one who manipulates and studies them. They are full of discoveries and surprises for the inquisitive mind, and for that reason have unusual attraction for many pupils. An interesting example of this applied in arithmetic is found in Sophia Court's description of her son's play with numbers at the age of six years and eight months.

Relating to me an incident in school, he said, "J. did not know how much is 2 from 8 — no, eight from two — no, which is it? let me see. Ah, it is two from eight." "Can you take away eight from two?" I asked. "No," he laughed, "you can't — well, it would be zero; no, less — it would be six below zero: that is it, six below zero!" This idea of "six below zero" pleased him greatly, and he came back to it several times the next evening and the next day. On one of these occasions I told him that this is the way to count in similar cases, and that we don't say, "six below zero," but "minus six." From then on he began to delight in using negative quantities, and for several days after that I would find on sidewalks, steps, barns, walls, etc., $4 - 3 = 1$, $3 - 4 = -1$, and other problems of this sort.

After a long interruption in the use of negative quantities, he once, at the age of seven years seven months, said, while picking up his blocks and getting ready to go to bed, "Mamma, ask me subtractions, will you? Say, suppose, how many are 8 from 13?" I agreed, but after one or two problems he said in a lower tone

of stage directions: "But put in minuses too. You know, when the answer is 'minus five,' for instance."

I asked him; 13 − 7; 15 − 9; 23 − 15; 11 − 6; 6 − 11; 15 − 8; 8 − 15.

A., in a lower tone: "You make it too easy: not that the numbers are easy, but you arrange them so easy. You shouldn't ask 15 − 8 and right away 8 − 15, see?"

I complied with his request, and found that he had decidedly more difficulty with the combinations themselves than with the pluses and minuses in the answers.

Now at the age of eight years and two months, he still considers it a great joke to use negative quantities, and sometimes uses his own term "below zero," but usually says "minus." He likes the negative quantities; they belong to the fascinating realm of "tricks."

Sometimes his father or I show him other "tricks" — arithmetical jokes. He delights in them. Once, when he was seven years seven months old, his father showed him that 12345679 × 9 gives 111111111; then after A. verified this and showed it to others with glee, his father told him the next evening to multiply 12345679 by 18. The answer was 222222222. When, after having performed the multiplication, A. came to his father with the answer, he said: "Next, I guess, you will make me multiply the same number by 27." "Why?" asked his father, taken aback, "and what would come of it if I did?" "I would get all threes, I guess, and by thirty-six it will come out all fours."

The practical value of the curiosity motive in arithmetic is open to question. It probably does not have a value equal to drill on combinations or to exercises in the solution of reasoning problems, but any operation with numbers that interests the child is not without some value. Many of the number relationships that have the appearances of "tricks" to the child are important and practical. In any case, they supply an interesting diversion and show the child that not all work with numbers is monotonous and humdrum.

The appeal to the mastery motive has greater practical value. The certainty of the correctness of the results is one of

the satisfying conditions for this motive. But one of the most effective appeals to this motive is the child's record of his own progress. The standardized practice exercises devised by Studebaker and by Courtis, and the standardized tests in arithmetic, make effective use of the mastery motive. These have time limits, and after each exercise the pupil counts the number of attempts and the number of rights done during that interval. The results are plotted daily on a chart. Nothing interests the child more than to see this curve go upward from day to day and finally reach perfection. The same device may be applied to the scores made in the standardized tests. In these tests an increase in the score indicates real progress. The perception of that progress from semester to semester and from year to year supplies the best incentive that the child can have for attacking new problems. Not only are the individual charts of progress effective appeals to the mastery motive but a chart conspicuously displayed before the class showing increase in its average score from month to month is an important device for stimulating the morale of the class. It takes some time to make such a chart, but the results are quite worth while.

The value of appeals to the mastery motive through systematic drill charts is appreciated by the authors of our newer textbooks in arithmetic. Thus the Smith-Burdge Arithmetics, "Primary Book," which consists of three hundred and thirty pages, has nearly one third of the space devoted to drill charts in fundamental operations. Each chart contains from fifty to seventy-two examples that give exercise in the important bonds to be formed. This may be done either with pencil or orally, as the teacher directs. Scores of progress may be kept by counting the number of examples done correctly in a certain time limit or the number of practices required to do all the examples in the chart correctly, or the length of time required to reach this standard for each chart. A healthful rivalry will be stimulated by any of these methods.

Individual efforts as well as class efforts would also be effectively appealed to if we knew the difficulty value of each example in a textbook and how many examples from each list could be solved by the average child for the grade for which the book is intended. Such features have proved valuable in spelling. They should be equally valuable in arithmetic.

Play is the next most important motive to be appealed to in teaching arithmetic. Drill in the number combinations can be effectively motivated by such games as those described below.

BEAN BAG

Take a large cardboard or a light board, and make nine holes in it, numbering them from 1 to 9 inclusive. Leaning it against a support of some kind, the children toss small bean bags through the holes. Each child throws twice and gives the sum or product (depending upon the drill) of the numbers hit if he calls them correctly. After a few throws, the teacher may merely point to the numbers on the target, asking a pupil to name the score. If correct, it is added to his other scores. After a pupil can perform written additions, he may add his score every five turns, or chances, and thus the same game may motivate the written addition.

KING OF THE CASTLE

A child, the king, sits on a chair in front of the room. The other children try to dethrone him by giving him number combinations which he cannot answer. As long as he gives the correct answers, he remains on the throne in his castle; but when he fails, the child who gave the combination becomes king in his place.

SUMMARY

The law of association has reference to making arithmetic meaningful and rational and to integrating it with useful activities instead of segregating it as a group of dull and mysterious processes which have little relation to the day's work. Arithmetic may be made meaningful by connecting it with

concrete objects, by teaching it inductively from concrete situations, by making explanations of new processes full and detailed, by avoiding abstract definitions and trifling problems, by using simple language, by giving training in problem analysis, by improving the ability to read, and by using the project method of teaching.

Types of training which have proved useful for increasing the comprehension of verbal problems are (1) asking a series of questions, the answers to which would make the meaning of a problem clear; (2) making a story out of a problem; and (3) dramatizing or indicating its answer in pantomine.

Methods of training in problem analysis which have produced large gains are (1) specific directions for following a logical procedure; (2) finding the facts given, the question asked, the processes to be used, and estimating the answers in round numbers; (3) solving problems collected by pupils from life situations; (4) solving problems without numbers by indicating processes to be used; (5) analyzing the meaning of words used in problems.

Although these types of training have proved useful, an effective training technique for increasing ability in solving reasoning or verbal problems still remains to be developed.

One great value of the project method of teaching arithmetic is that it connects arithmetical processes with life situations.

From a scientific standpoint most of our information on methods of training for making arithmetic more meaningful is as yet in an undeveloped stage and is in great need of further experimentation.

The principal sources of satisfaction in learning arithmetic are its appeals to mental play and mastery. Numbers furnish excellent material for mental play because of the innumerable relationships and puzzles that may be discovered among them. They appeal to mastery because success with them is so easily noticed. Effective appeals may be made to the

mastery motive by keeping scores made in standardized tests and practice exercises. Numerous number games also provide the means for effectively using the play interest in teaching arithmetic.

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CHAPTER XII

ARITHMETIC: THE PROBLEM OF INDIVIDUAL DIFFERENCES AND THE SELECTION OF THE HABITS TO BE FORMED

The range of individual differences in arithmetic is as wide as that in reading. Table XLIII, on page 178, shows the distribution of 424 fifth-grade pupils in the four fundamentals. This was obtained from the results of the Courtis tests, Series B, given by Mead in the schools of Cincinnati.

It will be seen that the scores range all the way from 0 to 20. This represents all degrees of ability from the baby to that of the trained clerk in the city gas company. The number of children having the average abilities in the other grades may be seen from the following summary, which classifies the January scores according to the standards of Grades III–VIII:

57 have the third-grade standard or less.
136 are between the third-grade and the fourth-grade standard.
138 are between the fourth-grade and the fifth-grade standard.
59 are between the fifth-grade and the sixth-grade standard.
14 have the seventh-grade standard.
11 have the eighth-grade standard.
11 are above the eighth-grade standard.

The teaching problem is just the same as in a similar situation in reading — that of satisfying the needs and abilities of each one. As a matter of practice all the fifth grades get approximately the same course of study and kind of teaching, but much can be done to improve this condition.

If the group is large, the first step will be reclassification according to ability in arithmetic. By this is meant putting

TABLE XLIII. CHANGES IN DISTRIBUTION MADE BY TWELVE CLASSES OF FIFTH-GRADE CHILDREN USING THE COURTIS PRACTICE PADS FOR ONE SEMESTER. (After Mead)

(January scores in column I and June scores in column II, under each operation.)

SCORE	ADDITION		SUBTRACTION		MULTIPLICATION		DIVISION	
0	I	II	I	II	I	II	I	II
0			1		3		4	3
1			1		8		30	1
2	9		7	1	21	2	49	11
3	11	4	7	1	34	10	99	38
4	37	5	26	5	53	18	83	63
5	67	24	59	12	84	51	73	62
6	69	34	64	43	82	68	29	51
7	76	48	63	36	53	43	22	33
8	62	65	77	56	37	51	9	43
9	39	48	40	50	14	55	7	19
10	18	47	38	50	16	33	3	21
11	14	36	20	32	8	19	1	8
12	11	27	13	29	3	13	6	10
13	2	16	4	25		11	1	3
14	3	10	1	18	2	2	1	4
15	2	8	1	6	1	4		6
16	2	6	3	5				1
17	2	2		2				
18		1		3				
19		1		3				
20		1		3				
	424	383	425	380	419	380	417	377
Median	7.2	9.3	7.8	9.7	6.1	7.9	4.3	6.2

each child in that grade which has ability nearest to his own. In a large system this will put into the same grade many of like attainments in arithmetic but of unequal abilities to learn it. The next step would then be to section these according to ability to learn. After this point two procedures are possible: to give all sections in the same grade the same course of study, varying the time required to learn the material according to the ability of the group, or to enrich the course of study for the superior sections and reduce it for

the inferior ones. In the latter method the usual policy is to offer to the slow sections only the minimum essentials, to the average sections the minimum essentials plus an additional amount of desirable operations, and to the superior sections not only all that the inferior and average sections get but also opportunities to cover these materials more intensively and to permit reading and study according to the interests of each. Solving hard problems, working arithmetical puzzles, studying the history of mathematics, and reading the biographies of mathematicians are some suitable topics for these special interests.

In both procedures there are general methods for adapting the work to the needs of the individual. First, there is supervised study, for which the class time is divided into two periods — one for study and one for recitation. For the study period the class may be divided into two or three groups according to ability. The teacher not only varies the assignment for each group but also helps each pupil to meet his difficulties as these arise. In this work the teacher's problem should be to help pupils to help themselves rather than to do the difficult work for them.

Secondly, there is the monitorial-group plan. In this plan the class is usually divided into three groups according to ability. Each group has a student monitor, or leader, who leads the work of the group under the direction of the teacher. Each group is allowed to move at its own rate.

Thirdly, there is individual study. In this plan a specific goal is set to be attained in a given operation, and then the student practices on problems leading to this goal until he attains it. Courtis, Studebaker, and others have devised practice exercises which are intended to develop skill in the fundamentals. A given number of problems of a certain kind are printed on a card. The pupil must do these in a certain time limit and with an accuracy of 100 per cent. He keeps a record

of the number of problems attempted and of the number solved correctly for each time limit until the goal is achieved. The rise of the curve furnishes the incentive for effort. The cards are adapted for meeting individual differences, as no pupil need work on a problem which he already has mastered. As soon as he has mastered one type of problem he is given a new type. Each pupil thus works toward a goal which he has not yet attained. The pupils of a class can all work on different types of problems at the same time.

Although the practice exercises of the type designed by Courtis, Studebaker, and others have these advantages, they also have certain disadvantages for individual instruction. They are limited to operations in the fundamentals; even in these the distribution of the amount of drill is by no means proportional to their difficulty, and some of the combinations are omitted. They also require all pupils, regardless of ability, to finish with an accuracy of 100 per cent at the same time. This fits only those close to the average; it is too difficult for the poor ones and too easy for the bright ones. If errors are made, all the examples on a card must be done over again for the purpose of correcting the wrong ones. This wastes a good deal of time on examples already mastered, and fails to divert specific attention to the errors. There are also no exercises in verbal problems with the fundamentals. A drill service arranged to overcome these weaknesses has recently been designed by Professor Clapp. It is still too early to tell whether it will work out successfully according to the excellent purpose of its author, but theoretically it meets all the requirements of a scientific drill. In this connection the practice exercises developed by the Winnetka schools under the direction of Dr. Carleton W. Washburne should also be mentioned. These exercises are intended to cover all the goals in arithmetic and are so arranged that a child can master all the essentials at his own speed. In the Winnetka schools they enable the teacher to dispense with recitations and to spend

his time in giving tests and exercises to each pupil as he needs them, in helping him in his difficulties, and in checking up the record of his progress.

What Habits should be Formed?

The answer to this question depends upon whether the public schools shall teach arithmetic as an activity for developing the mind or as a skill for meeting some of the demands of life. Possibly no other school subject shows the influence of these two views on the content better than does arithmetic. Authors of texts who favor the first view select problems and operations because they are difficult, complex, and long. Such problems are supposed to give some real exercise to the powers of the mind and to be useful for developing them. Authors of texts who take the second view select materials because of their probable usefulness in practical life. They emphasize those operations which are used by the majority of adults engaged in gainful occupations, and they aim to select such types of problems as are actually used. Our new books in arithmetic are practically all written on this theory. Real and practical problems are just as good material for developing the mind as unreal and impractical ones. While we are developing the mind we might as well develop it usefully as uselessly. The problems of life are always sufficiently hard and varied to demand the exercise of our best abilities. If our education trains us to meet these demands well, it accomplishes its true function.

How shall we find those Parts of Arithmetic which have the Greatest Social Value?

Investigators have used different methods and standards for answering this question. Some have sent questionnaires to school superintendents calling for their opinions on what should be eliminated or emphasized. Some have studied the

occupational distribution of the working population and have then examined arithmetics from the standpoint of whether each occupation is adequately represented. Some have made collections of problems used by the parents of school children in their various activities and have then classified these according to their operations. Others have analyzed the arithmetic used in advertisements, pay rolls, cookbooks, hardware catalogues, and store bills for the purpose of finding the operations and kinds of problems to be taught. Still others have tried to get hold of these same facts by sending questionnaires to business men and working people.

TABLE XLIV. PERCENTAGE OF SUPERINTENDENTS FAVORING ELIMINATION OF, OR EMPHASIS ON, CERTAIN OPERATIONS IN ARITHMETIC
(After Jessup and Coffman)

OPERATION	PERCENTAGE FAVORING ELIMINATION	OPERATION	PERCENTAGE FAVORING MORE EMPHASIS
Longitude and time	8.0	Stocks and bonds	20.0
Cases in percentage	20.0	Levies	35.0
Aliquot parts	21.0	Borrowing	37.0
Metric system	20.0	Banking	39.0
Root	20.0	Interest	39.0
Least common multiple	22.0	Investments	44.0
Reduction	22.0	Building and loan	48.0
Partnership	25.0	Profit	46.0
Comp. fractions	26.0	Percentage	50.0
Foreign money	28.0	Taxes	53.0
Greatest common divisor	35.0	Insurance	55.0
Paper-folding	35.0	Public expenditure	55.0
Interest, annual	41.0	Public utilities	57.0
Troy weight	42.0	Saving money	61.0
Cube root	46.0	Fractions	65.0
Surveyor's table	47.0	Subtraction	69.0
Discount, true	47.0	Division	70.0
Compound proportion	52.0	Multiplication	72.0
Apothecaries' weight	53.0	Addition	75.0
Dram	60.0		
Progression	67.0		
Quarter	68.0		
Furlong	72.0		
Unreal fractions	74.0		

Jessup and Coffman in 1915 published a statistical study of the opinions of eight hundred and thirty city superintendents secured by the questionnaire method. They calculated both the percentage favoring the elimination of certain operations and the percentage favoring greater emphasis on certain operations. Table XLIV, on page 182, gives the results.

This study shows that school superintendents are very conservative about eliminating anything. If we consider only those operations which over half are in favor of dropping, we find compound proportion, apothecaries' weight, dram, progression, quarter, furlong, unreal fractions, — surely a safe list to be omitted. But it is doubtful if the usefulness of any of the topics in the left column could be justified by our criterion. It is interesting to notice the large percentage in favor of more emphasis on the fundamentals.

W. S. Monroe published a study of the proportions of the working population engaged in each occupation. He then calculated the average percentage of problems in four arithmetics devoted to each of these occupations. Out of 1023 practical problems, 720, or 72 per cent, were devoted to occupational activities. These were distributed as shown in Table XLV.

TABLE XLV. PERCENTAGE OF WORKING POPULATION IN EACH OCCUPATION AND PERCENTAGE OF PROBLEMS IN TEXTBOOKS RELATING TO EACH OCCUPATION. (After Monroe)

OCCUPATIONS	PERCENTAGE OF WORKING POPULATION IN EACH OCCUPATION	PERCENTAGE OF PROBLEMS RELATING TO EACH OCCUPATION
Agriculture	33.0	10.8
Extraction of minerals	2.5	0.2
Manufacturing and mechanical	27.9	18.1
Transportation	6.9	9.9
Trade	9.4	21.9
Public service	1.2	6.2
Domestic and personal	9.8	0.8
Clerical occupations	4.5	0.4

It will be seen that the discrepancies are wide. Thirty-three per cent of the population is engaged in agriculture, but only 10.8 per cent of the problems relate to that field. Only 9.4 per cent of the population is engaged in trade, but 21.9 per cent of the problems relate to trade. There is some justification for such discrepancies. Any one would estimate that trade activities involve figures to a greater extent than do agricultural activities. Such a study, however, gives us valuable suggestions as to what should be emphasized, although it would not be a safe guide to follow for discovering what kinds of problems are most used.

Mitchell made a more practical attack on the problem of discovering the most useful parts of arithmetic by studying the kinds of operations and of numbers that are used in cook-books, pay rolls, advertisements of mark-down sales, and a general hardware catalogue. He found that only small numbers were used. In fractions the largest denominator found was 12, and the largest mixed number was $19\frac{2}{3}$. The use of the dozen was very frequent; this was because in the factory whose pay rolls he studied wages were paid for production units of dozens. Almost no use was made of decimals. Most discount rates were in terms of per cent, notable exceptions being the fractional forms "$\frac{1}{3}$ off" and "$\frac{1}{2}$ off."

In 1917 Wilson tried to find the minimum essentials by having school children collect the examples used by their parents in doing their day's work. In this way 5036 problems were collected from many communities. Wilson classified them as to both operation and content. The following summary gives the more important facts:

1742 were in addition, only 65 over four places.
2279 were in multiplication, only 3 over four places.
1085 were in subtraction, only 65 over four places.
839 were in division, only 5 over three places.
534 were in fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.
12 were in fractions $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$.

4 were in fractions $\frac{1}{11}$ etc.

86 were in fractions with numerators above 1 and denominators not above 5.

60 were in fractions with numerators above 1 and denominators above 5.

3128 were in buying.

646 were in selling.

217 were in percentage.

251 were in accounts.

56 were in cubic measure.

41 were in discount.

66 were in interest.

27 were in square measure.

26 were in cancellation.

From 1 to 25 were in other problems studied in arithmetic.

In 1919 Wise published the results of a survey in which he used the same method as Wilson and found similar results. He collected 7345 problems representing 148 occupations from adults in Texas, Iowa, Wisconsin, and Illinois. The tabulation of the results showed that 6275, or 85 per cent, were problems involving fundamental operations with whole numbers. Less than 3 per cent and more than 1 per cent of the problems were in each of the following: cubic measure, fractions, interest, and percentage; less than 1 per cent were in bank discount, board measure, carpeting, compound interest, commission, cord or wood measure, dry measure, fencing, hay in mow, hay in stack, insurance, linear measure, lumber, masonry, mensuration, mill testing, painting, papering, plastering, proportion, roofing, shingling, square measure, and trade discount. There were no problems in taxes nor in investments, stocks and bonds, equation of payments, foreign exchange, apothecaries' weight, alligation, annual interest, compound and complex fractions, folding paper, troy weight, or the metric system. Over 93 per cent of the fractions used were $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{5}$, and $\frac{1}{8}$. Since both these investigations were collections of problems actually used, they are among

the most reliable sources of information for the basis of a curriculum. They indicate that the arithmetic which is actually used is for the most part very simple, and suggest the possibility of eliminating a great deal which is now emphasized in our textbooks. Textbooks, however, will quickly make the eliminations when once there is an organized effort to change the course of study, and when the recommended changes have proved their value in the school communities.

In 1923 a committee of California teachers directed by Myrtle Collier and E. C. Moore published the results of an investigation of the minimum essentials in arithmetic, made by the questionnaire method. Three questionnaires were sent out. The first tried to find out how much arithmetic was actually used in everyday life. It inquired specifically about the height and width of the columns used in addition, the number of figures used in multiplication and division, the size of the fractions used, the use of decimals, and the computations made in percentage. The second required the respondent to check the arithmetical topics used during a period of ten days. The third was sent to leading business firms in Los Angeles and inquired how much arithmetic young employees should know when they entered these firms, in what arithmetic work employees were weak, how the employers would correct these weaknesses, and in their opinion what work was being taught that was of no value in their business. Seventy-nine persons replied to the first questionnaire, three hundred and fourteen to the second, and twenty-four firms replied to the third. The replies from business firms indicated that over half of them want their entering employees to know addition, multiplication, division, decimals, subtraction, percentage, and fractions. Their entering employees were reported weak in accuracy, decimals, multiplication, and fractions. From three to nine firms recommended more stress on accuracy, short cuts, mental arithmetic, and "teach the why."

On the basis of these replies and of their knowledge of the needs of the child the committee recommended the following as the minimum essentials in arithmetic:

A high degree of accuracy in

1. Addition of addends, five digits wide.
2. Subtraction, five digits wide.
3. Multiplication, with a multiplicand of five digits and a multiplier of four digits.
4. Division, with a dividend of five digits and a divisor of four digits.
5. Addition, subtraction, multiplication, of the following fractions: halves, thirds, fourths, fifths, eighths, and tenths.
6. Decimal fractions of three places.
7. Simple interest.
8. Cash accounts and children's and family expense accounts.
9. Cash, checks, and bills.
10. Banking.

Eliminations

1. Apothecaries' weight.
2. Troy weight.
3. Longitude and time.
4. Furlong in linear measures.
5. Hand.
6. Dram in avoirdupois weight.
7. Surveyor's table.
8. Fathom.
9. All problems in reduction, ascending and descending, involving more than two steps.
10. Greatest common divisor as a separate topic.
11. All initial common fractions, except halves, thirds, fourths, fifths, sixths, eighths, ninths, tenths, twelfths, sixteenths, hundredths, thousandths (by "initial fraction" is meant the fraction given for the solution of the problem).
12. All work with the least common multiple (except of very low denominations) as a separate topic.
13. Complex fractions.
14. Compound proportion.
15. Cases in percentage.

16. True discount.
17. Compound interest, except (as reinvested money) in simple savings accounts.
18. Problems in partial payments.
19. Commission and brokerage as applied to stocks and bonds.
20. Profit and loss as a special topic.
21. Knot.
22. Partnership.
23. Cube root.
24. All algebra, except such simple use of the equations as is directly helpful in arithmetic and other subjects met within the school life of the pupil.
25. Brackets, braces, vincula.
26. Cancellation as a special topic.
27. Finding the whole when a fractional part is given.
28. Paper tables.
29. Gross and great gross.
30. Square (100 square feet used in roofing).
31. Carpeting, lumber, measuring, papering, plastering, painting, as separate subjects.
32. Surveyor's land measure.
33. Foreign money.
34. Indirect problems in simple interest. Use the equation.
35. Bank discount.
36. Pyramids, cones, spheres.
37. Metric system.
38. Initial decimal fractions of more than three places.
39. All problems the content of which is outside the experience and comprehension of the child.

Summary

Individual differences in ability in arithmetic are so wide that among four hundred and twenty-four fifth-grade pupils we find some representing the average attainments of every other grade. Grouping those of like attainments into classes and then sectionizing these according to ability to learn are steps which help to adjust the work according to the needs of pupils either in the way of an enriched or restricted curriculum

or in the way of rate of promotion. More specific methods which have been found useful for meeting the needs of individuals are (1) supervised study, in which the teacher spends a part of the class period in helping each pupil to study; (2) the monitorial-group plan, in which a class is sectioned according to ability, each section having a student leader and being allowed to progress at its own rate; (3) individual study, in which practice exercises are provided to enable the pupil to reach prescribed goals at his own rate and by his own efforts.

Standardized practice exercises having a fixed time limit for completing the work with an accuracy of 100 per cent make adjustments for individual needs in that they allow each pupil to work at his own problem, but they are objectionable in that they are limited to fundamental operations, require all pupils to finish in the same time, and cause a waste of time in overlearning problems done correctly in order to correct the wrong ones. However, these weaknesses are now corrected by new drill services.

The problems in the older textbooks on arithmetic were selected for their supposed usefulness in disciplining the mind; the content of the new books is selected for its social value. Methods which have been used for finding useful problems are questionnaires to school superintendents; comparison of vocational problems in textbooks with the vocational activities of the working population; collection of problems used by parents of school children; analyses of the arithmetic used in pay rolls, advertisements, cookbooks, and store bills; and questionnaires to business men and working people. Of these the best one is probably the collection from the parents of school children, which shows that the arithmetic used consists principally of fundamental operations with whole numbers. The fractions rarely have denominators larger than 8. It should be possible to develop an accuracy of 100 per cent in such essentials by the end of Grade VI.

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CHAPTER XIII

HANDWRITING

The aim in handwriting is to develop in the child sufficient skill so that he can record facts or ideas either for permanent keeping or for communication. It is useful both in school and out of school. In school it enables the pupil to record the important items of information that he gets from his teachers and from his reading and preserve them against the losses of forgetting. An equally important matter is that it forces him to clarify and organize his thinking. A pupil is often unaware of his lack of information or of the haziness of his ideas until he attempts to write them down. This discovery often forms an adequate incentive for getting clear and definite information. Outside of school the chief uses of handwriting are for recording and correspondence. As an instrument for recording, the housewife finds it useful for keeping recipes, the workman for keeping account of his instructions and time, the salesman for keeping account of his sales, and the preacher and the poet for keeping account of their inspirations. For correspondence everyone needs handwriting; even those who have typewriters must depend upon it for signatures and corrections. Efficiency in work in which handwriting is used depends upon legibility and speed; this is true not only for the student but also for the man of affairs.

From the teacher's standpoint it is important to know how rapidly and to what degree these qualities can be developed and upon what factors they depend. Again we have to reckon with age, sex, intelligence, and heredity, all of which influence efficiency in all school subjects. But there are also

factors peculiar to handwriting itself. Among these are position, movement, rhythm, and (in some cases) character.

The results obtained from handwriting scales enable us to judge the rate and amount of improvement made by the average child in speed and quality of handwriting. Some years ago Freeman made a survey of the speed and quality of handwriting in the grade schools of forty-six cities. Speed was measured by the number of letters written per minute, and quality was measured by the Ayres Scale. The average scores obtained are given in Table XLVI.

TABLE XLVI. GRADE AVERAGES FOR SPEED AND QUALITY OF HANDWRITING IN FORTY-SIX CITIES. (After Freeman)

	Grades						
	II	III	IV	V	VI	VII	VIII
Speed	30.6	43.8	51.2	59.1	62.8	67.9	73.0
Quality	39.7	42.0	45.8	50.5	54.5	58.9	62.8

That some schools get much better results than the average is shown by the average rate obtained in seven schools selected from the best fourth of the forty-six cities. The rates are given in the following table:

TABLE XLVII. AVERAGE RATE OBTAINED FROM SEVEN SCHOOLS SELECTED FROM THE BEST FOURTH OF THE SCHOOLS IN FORTY-SIX CITIES (After Freeman)

	Grades						
	II	III	IV	V	VI	VII	VIII
Speed	45.4	53.1	60.4	68.1	71.7	79.6	94.2

The rate of growth represented by the scores of Table XLVI may be seen from Figs. 10 and 11. Fig. 10 gives the quality curve for the approximate averages in the forty-six cities and

that for the averages of the upper half of these. Fig. 11 gives the curve for the average rates in all these cities and that for the average for seven schools selected from the upper fourth. Looking at the curve for the standard, or average, results on quality we see that the rate of growth is steady and constant from the second to the eighth grade, being a little greater from the fifth to the eighth grade than from the second to the fifth. In speed, however, improvement is more rapid from the second to the fifth grade than it is from the fifth to the eighth. This is the usual condition in all school subjects, but that it is not a necessary condition in handwriting may be seen from the progress made in the upper three grades by the seven selected schools.

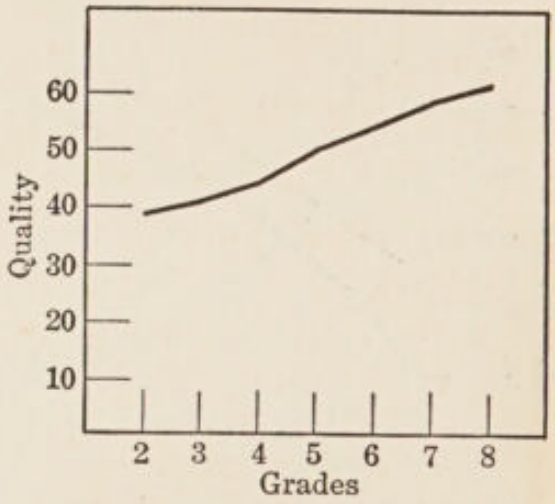


FIG. 10. Average quality in handwriting (Ayres Scale) of forty-six cities in relation to grade. (After Freeman)

SEX DIFFERENCES

On the average, girls are superior to boys both in speed and in quality. The amount of difference may be seen from the curves in Figs. 12 and 13. The curve for the girls is slightly above that for the boys, for all the grades except the third, where they coincide. There is more difference in form than in speed, and this difference is greater during the upper four grades than during the first four. The results for speed are contrary to what we should expect from the results which have been obtained from other motor tests on boys and girls, particularly the reaction tests, in which the difference in favor of the boys is greater than in all other traits excepting strength and weight. The superiority of the girls in handwriting in both speed and form is probably due to a superior ability to make fine coördinations rather than to a difference

in reaction time. The superiority in form might be due in part to a superior æsthetic sense on the part of the girls or to their more rapid physiological growth; but since the difference apparently increases with age, neither of these factors offers an adequate explanation. The differences between the two sexes in both speed and form are too small, however, to be pedagogically significant; that is, they do not justify different instruction or different standards for the two sexes.

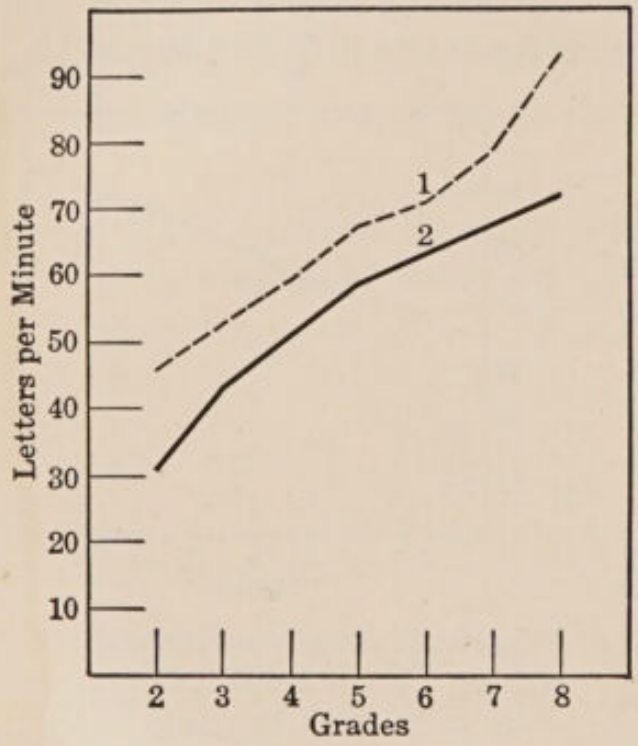


FIG. 11. Average letters per minute in handwriting of (1) seven selected schools and of (2) forty-six cities in relation to grade. (After Freeman)

INTELLIGENCE

Brightness is favorable to handwriting, but it is not necessary for success in learning it. Gesell found a positive correlation of 0.30 between accuracy of handwriting and intelligence; Starch, a positive correlation of 0.31 between quality of handwriting and scholarship. Both correlations were obtained from school children. Thorndike did not find this to hold true for adults. He says that the records of our adults add to the evidence that ability in thought and ability in movements are only slightly related in adults. The correlation between scholarship, grade, and quality of handwriting is zero. For twenty-one individuals taken at random from the best third of the writers, the median grade in scholarship was about C+; for twenty-two individuals taken at random from the worst third in writing, the median grade in scholarship was a little above B−.

The fact that there is a positive correlation in children but none in adults suggests that the former may be due to the factor of age or maturity. Evidence of this was found by Gates and Lasalle, who, during a period of twenty months, gave repeated writing and other scholastic and mental tests to seventy-eight pupils from Grades III to VI. The average of twelve correlations between writing and mental age according to the Binet tests was 0.55; of six correlations between writing and age, 0.82. But the partial correlation between writing and Binet mental age, with age eliminated, was only 0.01, or nothing. The same correlation when mental age was determined by the National Intelligence Test was pretty high, 0.48. The investigators think that this correlation is due principally to the use of a common technique in writing and group mental tests, although differences in educational opportunities, attitude, zeal, and the like may be in part responsible. At all events they conclude that for average and superior children the association between writing and intelligence is approximately zero.

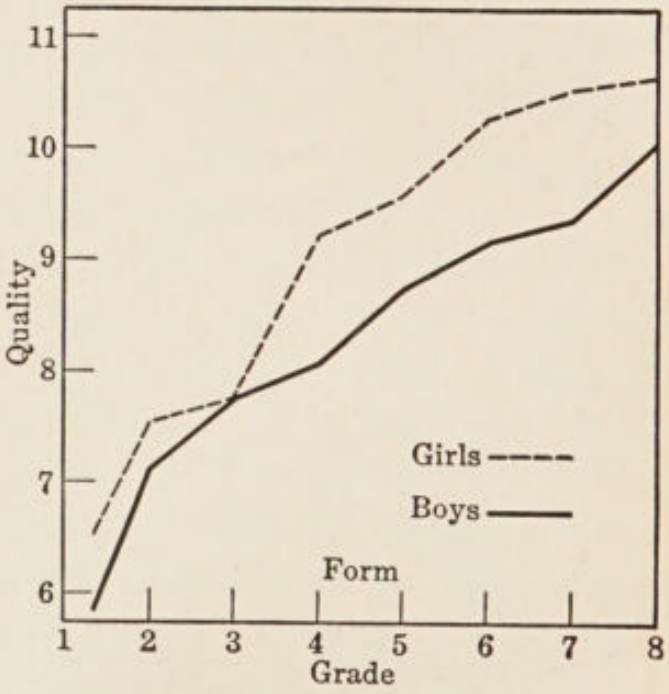


FIG. 12. Sex differences in quality of handwriting (Thorndike Scale) in relation to grade. (After Starch)

CHARACTER

Some persons claim that a relationship exists between handwriting and character and that a man's character can be read from his handwriting. One writer goes so far as to assert that he can tell from the handwriting of a pair of lovers

whether they would make an agreeable husband and wife. Binet, a French psychologist, became interested in this subject and made some experimental tests of the reliability of the judgments of graphologists. In one experiment about two hundred envelopes having the addresses of men and women and written by members of both sexes were submitted

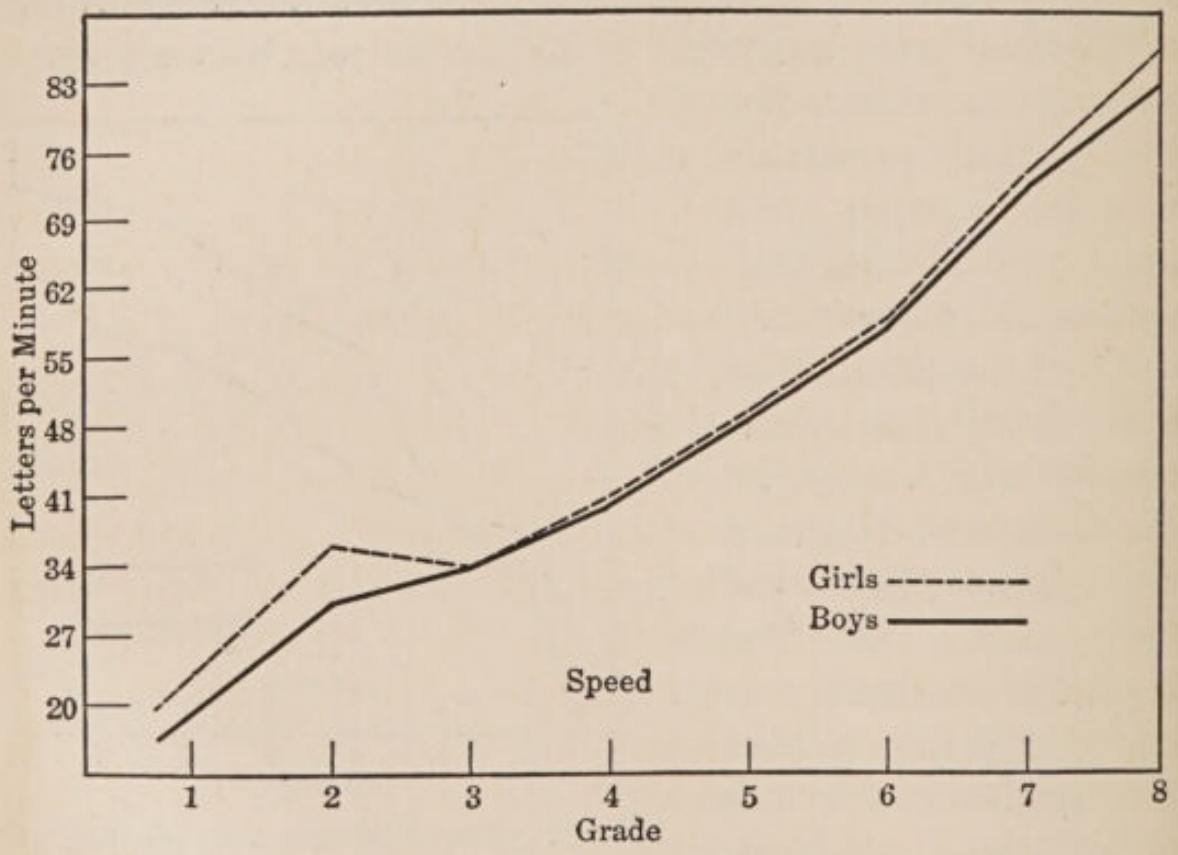


FIG. 13. Sex differences in rate of handwriting in relation to grade (After Starch)

to a group of graphologists to be sorted according to sex. Their judgments were correct in nearly 80 per cent of the cases. Downey repeated this experiment, using two hundred envelopes, all of which were addressed to a woman but were written by members of both sexes. Thirteen persons untrained in graphology were asked to sort these according to sex. The percentage of correct judgment varied from 60 to 77.5, with a median of 68. Both these experiments show a tendency in handwriting to express a sex characteristic, but it is slight.

In a second experiment Binet paired the samples of the handwriting of thirty-seven individuals of recognized intellectual standing, such as Renan and Bergson, with samples from persons of similar education but of lesser intelligence. Seven graphologists were asked to select from each pair the more intelligent writer. The percentage of correct judgments varied from 61 to 92. Binet concludes that intelligence shows in the quality of handwriting. In a third experiment Binet paired the samples of handwriting of eleven murderers with those of eleven honest citizens and asked the graphologists to select the samples written by the honest writers. The errors among the different judges varied from 3 to 5. Binet concluded that honesty also shows in handwriting.

Hull and Montgomery tested the validity of the relationship which graphologists claim to exist between traits of handwriting and traits of character. Seventeen fraternity brothers were asked to rank each other in the following traits: ambition, perseverance, and reserve. Samples of handwriting were taken from each brother, and then the seventeen were ranked in each quality that was alleged to be an indication of a trait of character. For example, the slope of the letters is supposed to indicate the amount of ambition. Each of the seventeen samples was thus ranked according to degree of slope. This ranking was then correlated with the ranking for ambition. The same procedure was followed for each of the other traits. The average of all correlations found in this way was -0.016, which means that there is no correspondence between traits of character and traits of handwriting.

Position

Every manual of handwriting emphasizes position as one of the fundamental elements in handwriting. One of the well-known systems advocates spending three or four weeks on this factor alone, and asserts that there is just one correct position. Teaching of this sort, however, is not confirmed by

scientific studies such as those made by Freeman, who tried to find the position most favorable to good writing by analyzing the positions used by both good and poor writers. In order to make the analysis exact he made use of a moving-picture camera and photographed the positions and movements of fifty good and poor writers while they were writing at a table. These photographs were then thrown on the screen, where they could be studied in detail. The most striking discovery resulting from the study was the variety of positions used by both good and poor writers.

The first subject was a professional writer. He used a nearly orthodox position: the penholder was grasped in an easy manner by the thumb and the first two fingers, the first finger rested on the top of the penholder and the thumb pressed slightly against the side at a point farther from the pen point than the end of the first finger, the wrist was inclined at an angle of about thirty degrees from the horizontal, and the hand rested on the first joint of the third and fourth fingers, on which it slid.

The second writer's position was nearly the same except that the thumb and the first finger were drawn in more. A third had his hand resting on the side and his first finger drawn up so that it rested at a point just opposite the thumb instead of below it. A fourth had his hand turned far toward the side and the penholder turned far to the right; it was raised nearly to the second joint of the second finger, but in spite of this the hand was supported on the third and fourth fingers and slid along the paper easily. A fifth had his hand turned far to the side but nevertheless partly supported by the fingers.

The poor writers had also a great variety of positions. The first grasped his pen lightly, but rotated it to the left at the end of the line. He varied the angle and the direction of his penholder. A second one held his pen in nearly standard position, but the movement across the page was made by

means of the arm as a whole. The hand was turned palm downward as it moved toward the right. A third had his hand resting on the side and moved it intermittently across the page. He changed the direction of his penholder radically during the writing of a line. The writing of a single word was accompanied by a backward turning of the wrist and by a change in the angle of the penholder. A fourth had his hand resting on the side, and his hand moved with difficulty across the page. A fifth held his hand level but did not slide it easily. The hand was also turned over to the right and drawn backward somewhat at the wrist.

Freeman supplemented his photographic study of position in handwriting by a statistical study of the handwriting of a large number of children, both good and poor writers. Drawing his conclusions from both studies, he says:

> It is significant that the features of hand position which are most clearly indicated to be favorable to good writing — the support of the hand upon the fingers, a position of the forearm perpendicular to the line on writing, and, to a less degree, an amount of pronation such that the wrist is not tilted more than 45 degrees from the horizontal — are intimately connected with one of the major handwriting movements, namely the movement of the hand from left to right across the page. Upward and downward movements of the pen can be made easily enough with the hand resting on the side, but this position impedes movement across the page from left to right. The impeding of this movement either causes the hand to be cramped after one or two letters have been written or makes it necessary to interrupt the letter formation to lift the hand or to slide it along. The hand cannot readily slide along while the letters are being formed because it is too firmly planted.
>
> Furthermore, it is necessary to secure the relation between the position of the arm and of the paper which is indicated by our study to be the best. When the writer faces the desk and bends his arm so that his hand is directly in front of him, his forearm makes an angle of about 60 degrees with the edge of the desk. In order that the forearm shall be at right angles to the line of writing it is necessary to place the paper so that the bottom edge is at an

angle of about 30 degrees to the edge of the desk. The plainest way to state this requirement is to say that the line of writing should be approximately parallel to the diagonal from the lower left corner to the upper right corner of the desk.

In order to insure that the pupil shall keep this position of the arm, and that the arm shall be able to move freely, the body must face the desk and must be kept erect, so that its weight does not rest on the writing arm. The weight of the arm rests upon the right forearm, but the weight of the body should not. A little more weight should rest upon the left arm, since it steadies the body, but the right arm should be kept free.[1]

Movement

The type of movement used has an important effect on the speed and quality of handwriting. The manual for a widely used system of handwriting defines movement as follows:

> Muscular movement as applied to writing is the movement of the muscles of the arm from the shoulder to the wrist, with the larger part of the arm below the elbow on the desk, the fingers not being held rigid but remaining passive, and neither extended nor contracted in the formation of letters. In this movement the driving power is located above the elbow in the upper muscles of the arm.

Freeman's statistical and photographic studies of the handwriting movements of good and poor writers do not confirm the necessity of this movement for good writing. His photographic studies showed that the formation of the letters may be accomplished chiefly by the fingers or the arm, or by a combination of the two, and that in respect to relative amount of finger or arm movement there is no clear contrast between good and poor writers. The greatest difference in movement between good and poor writers is in its organization: the good writers divide the movement pretty definitely into units, separate them by pauses, and make them conform to the natural units of the letter forms; the poor writers do

[1] F. N. Freeman, Handwriting Movement, pp. 105–106. 1918.

not organize the movement into speed units so clearly, and these units do not conform to the forms of the letters.

With reference to the arm-movement theory Freeman says:

> The results of the study do not support the exclusive arm-movement theory which is prevalent among the authors of present-day writing systems. In the first place, there is scarcely a writer, so far as this investigation indicates, who uses solely the arm movement in the production of the letters. When we confine our examination to elementary school pupils, with whom alone we are concerned in public-school teaching, we find relatively small per cent in any system or any grade who use the arm movement chiefly. The fingers always co-operate to a greater or less extent, in the formation of the letters. Efforts to develop an exclusive arm movement are not successful. . . .
>
> In the second place, there is not that closeness of relationship between the degree of arm movement which is used and the excellency of the writing which is implied in the extreme emphasis which is put on this type of movement. Good writers use the finger movement as frequently as do poor writers. The chief difference between the good and the poor writers appears to be that poor writers use the other varieties of movement, such as the hand and the wrist movements, with greater frequency than do the good writers. The indications are that the fingers and the arm should be the chief components of the writing movement.
>
> While training in arm movement is beside the point in its aim, it does have indirect consequences which are of value. The comparison between the public-school children who had been trained in arm movement and the University Elementary School children indicates that the former had developed a better organization of the movement from the point of view of speed. We shall defer the detailed consideration of this for a moment, but here simply comment upon the fact that the writing drill which has as its primary, avowed aim the development of the arm movement does, as a secondary consequence, develop a type of speed organization which is valuable. The contention of this report is that it would be more economical to aim directly at the proper type of speed organization, and not to attempt the well-nigh impossible task of developing exclusive arm movement in all children.

The fact that the training class in the University Elementary School developed a fair amount of arm movement supports these conclusions. It indicates that a moderate amount of arm movement is useful. It indicates, further, that for the development of the degree of arm movement which is desirable no direct specific drill, in which the child's attention is called to arm movement, is necessary. The degree of arm movement which is desirable will come as a by-product of the adoption of a favorable position and of drill in fluent lateral movement and in rhythmic writing.

Rhythm

Rhythm refers to the relatively equal duration of the time units used in making unit movements. Freeman found that the organization of writing movements into units which conform to the letter forms is an important difference between good and poor writers, but that the development of rhythm had little or no effect on the quality of writing.

The importance of the former is shown in analytic studies of the rate and kind of movements used by poor writers. In writing the word *fox* a good writer had four primary pauses and six secondary pauses. In a primary pause the pen comes to a momentary stop or rest; in a secondary pause it comes to a temporary retardation or slow speed, but does not stop. The good writer had primary pauses at the end of the letter *f*, at the end of the downward stroke in the *o*, at the end of the upward stroke of the *o*, and at the end of the downward stroke in *x*, after which the cross mark was made. The secondary pauses were at the turning points, such as the ends of the loops in the *f*, the end of the connecting stroke between the *f* and the *o*, the end of the connecting stroke between the *o* and the *x*, and at the turning point in the downward stroke of the *x*. The poor writer writes the word with only one primary pause and two secondary pauses. The single primary pause does not come until the end of the word, just before the cross mark; the two secondary pauses come at the ends of the lower loop in the *f* and of the downward stroke in the *o*

respectively. These two cases illustrate the differences between good and poor writers in regard to organization of movement. The good writer organizes his units of movement to correspond with the forms and natural divisions of the letters, whereas the poor writer writes complete words in unbroken movements with little regard to the forms and natural divisions of the letters.

The development of rhythm in units of movement was found to be correlated with age in a statistical study made of two hundred and seventy-three children by Freeman and Nutt. They found that it had little or no correlation with speed or quality in handwriting and was therefore a mark of maturity rather than of accuracy. From this it would follow that the value of counting lies not in developing rhythm, but in the formation of speed units or unit movements according to the natural divisions of the letter. It is also an important device for controlling the rate of writing.

Length of Class Period

Does the amount of improvement made in handwriting depend at all on the length of the class period, and what length of class period is sufficient for getting good results? The surveys made upon this question by Thorndike and Freeman fail to show any consistent relationship between the amount of time a week devoted to handwriting and the quality of the product obtained. The results obtained by Thorndike from seven school systems are shown in Table XLVIII, on page 204.

Systems C, D, and E, which give an average of seventy-five minutes a week to handwriting, get no better results than do systems A and B, which give no time to it in Grades VII and VIII; system G gets no better results from ninety minutes a week than C, D, and E do from seventy-five; system F gets 25 per cent better results than do C, D, and E from the same amount of time.

TABLE XLVIII. QUALITY OF HANDWRITING AT THE RATE OF FROM FORTY TO FORTY-NINE LETTERS PER MINUTE IN SEVEN SCHOOL SYSTEMS
(After Thorndike)

SYSTEM	MINUTES PER WEEK	QUALITY (THORNDIKE SCALE)	
		Grade VII	Grade VIII
A	0	11.0	11.5
B	0	11.8	12.0
C	50–60	11.3	12.0
D	75–100	11.7	11.8
E	60–90	11.0	12.3
F	75	13.3	14.4
*G	90	11.8	15.3

* 30 minutes in Grade VIII

Freeman made a study in forty-six cities of the relation of the quality of handwriting to the length of the class period and found the variation in quality for each time period as shown in Fig. 14.

Here the horizontal line indicates the rank for a particular city in quality of handwriting, and the vertical line the length of the class periods. Two cities giving from forty to forty-nine minutes per week have an average rank of 18, and ten cities giving from eighty to eighty-nine minutes per week have an average rank of 20.7. Cities giving relatively the same time per week rank in quality all the way from 5 to 46. Both these investigations thus fail to show any correlation between the length of the class period and the quality of handwriting. It is difficult to say to what the variations in the results are due. They may be due to the system of penmanship taught, to the efficiency of the instructor, or to the ability of the pupils to learn. The investigations of Freeman and Thorndike throw no light on these factors.

Brooks, however, conducted an experiment in which these factors were controlled or kept constant. This made it pos-

sible for him to study the effect of the variations in the length of the class period. Pupils of approximately equal ability were selected from Grades VI and VII in two schools. The teachers, so far as his judgment could determine, were equal in efficiency, and all used the same system of instruction.

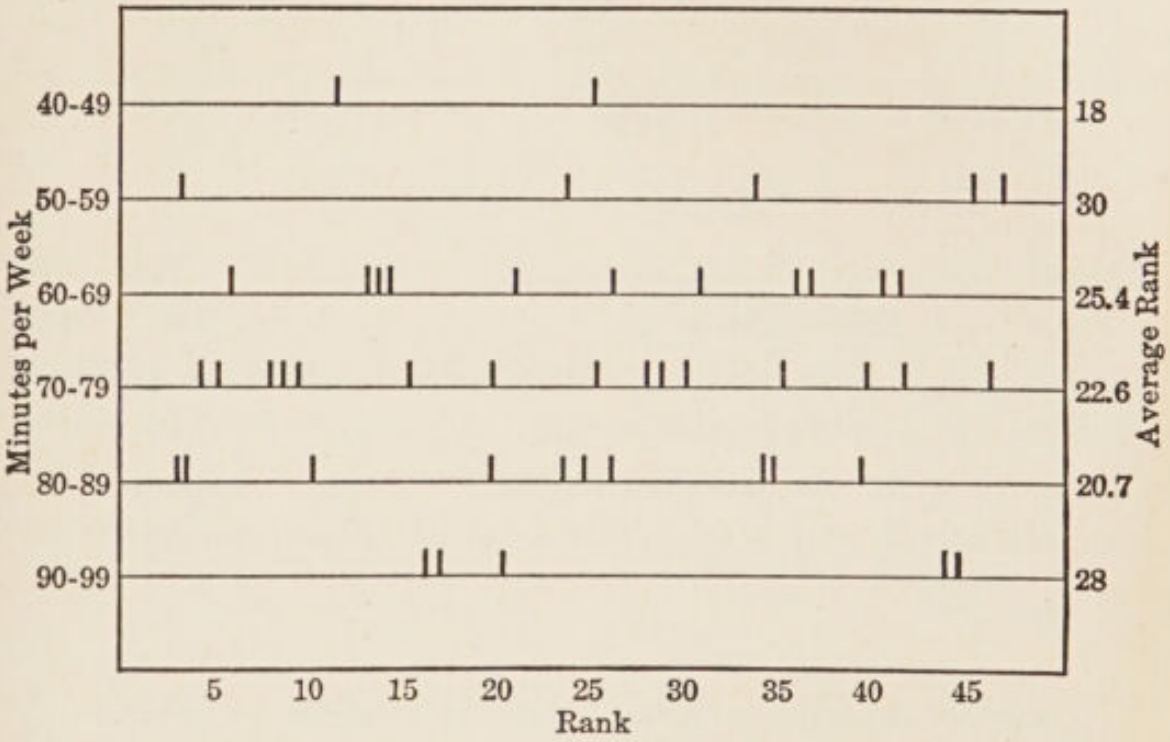


FIG. 14. Rank of forty-six cities in quality of handwriting in relation to the number of minutes per week devoted to the subject. (After Freeman)

Three lengths of class periods were studied — fifty, seventy-five, and one hundred minutes a week for a period of four and one-half months.

The handwriting of the pupils was measured before and after this time, by both the Ayres Handwriting Scale and the Freeman Handwriting Scale. The amount of improvement made by the three groups is shown in Table XLIX, on page 206.

The three time intervals yield practically the same amount of improvement, although the shortest one (fifty minutes per week) is the best by a small margin. Increasing this interval by 50 or 100 per cent adds nothing to the quality of the handwriting obtained.

TABLE XLIX. RELATION OF IMPROVEMENT IN HANDWRITING TO AMOUNT OF DRILL PER WEEK. (After Brooks)

SCHOOL	MINUTES PER WEEK	IMPROVEMENT (FREEMAN SCALE)
A	50	2.37
B	75	2.18
C	100	2.03

QUALITY AND SPEED

Quality and speed are negatively correlated. This may be seen from the results obtained by Gates when pupils from Grades V and VI were instructed to write on different occasions (1) as well as they could, (2) as fast as they could, and (3) at their ordinary speed and quality. The average scores for speed and quality for each of these conditions are given in Table L.

TABLE L. RELATION OF QUALITY OF HANDWRITING TO SPEED (After Gates)

GRADE	WRITING AS WELL AS THEY COULD		WRITING NORMALLY		WRITING AS FAST AS THEY COULD	
	Quality	Speed	Quality	Speed	Quality	Speed
V	9.85	36.8	9.175	49.6	8.65	58.9
VI	10.37	45.7	9.41	64.7	8.75	73.3

For both grades the quality decreases as the speed increases. This is true not only for variations in the same individual but also for variations in different individuals; that is, persons who write well write more slowly than do those who write poorly. This was shown more clearly in the Cleveland Survey when the average speeds for handwriting were calculated for each quality on the Ayres Scale from 20 to 90. The results are given in Fig. 15.

A practical question for teachers is, Which is the more important to emphasize, speed or quality? Before we can answer this question we must find a suitable method for combining the two measures of speed and quality into one

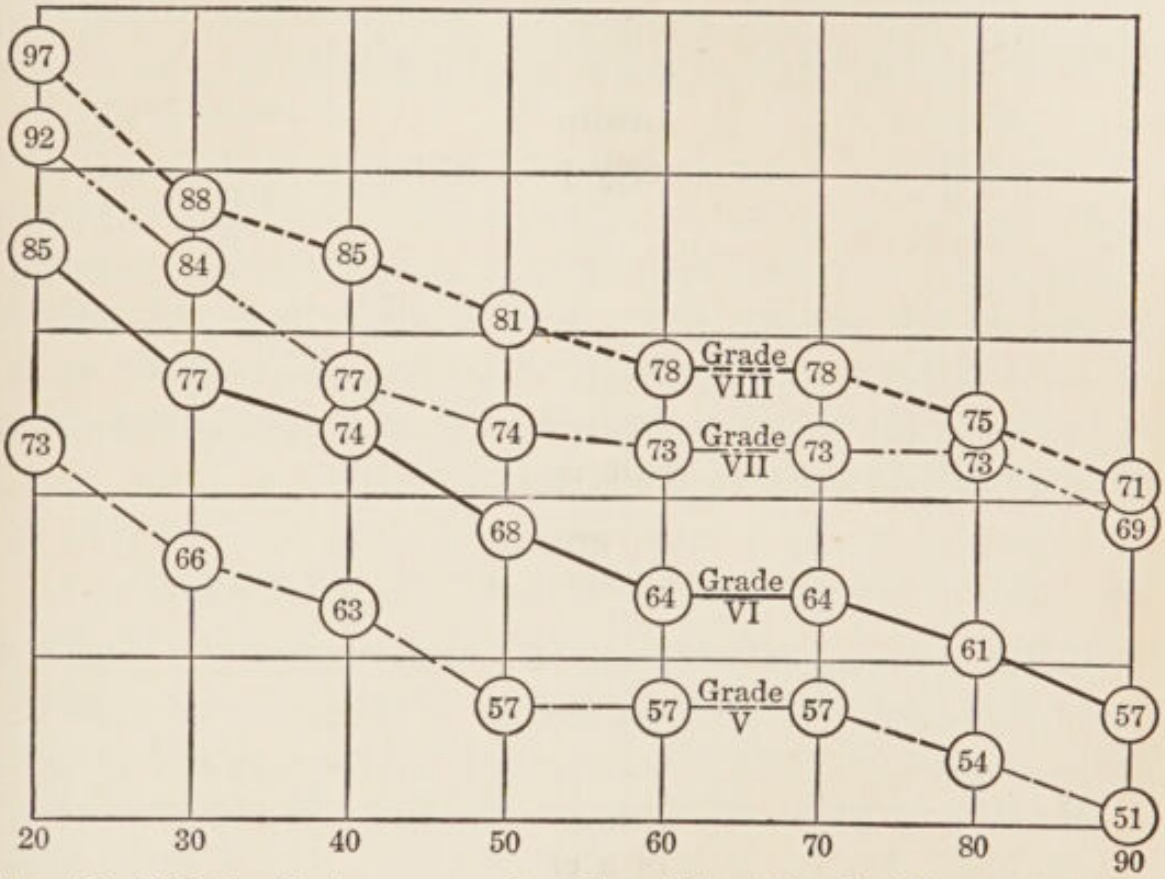


FIG. 15. Relation between speed and quality of handwriting as found in Grades V–VIII in the Cleveland Survey

Speed (letters per minute) is indicated along the vertical and quality (Ayres Scale) along the horizontal

measure of general writing ability which attaches the proper weight to each factor. For this purpose Gates has suggested the following measure:

$$\text{COMBINED SCORE} = \text{QUALITY} \times \sqrt[3]{\text{SPEED}}$$

The principal ground for the validity of this measure is that it gives approximately the same scores for the average writing ability of a class when the speed of writing is voluntarily increased from slow to fast. Assuming that the formula is correct, we can see that the combined score depends much

more upon quality than it does upon speed. If a child writes a quality 8 on the Thorndike Scale at a rate of 53 letters a minute, would it be better for him to increase his quality to 9 and maintain the same speed, or to maintain the same quality and increase his speed to 70 letters a minute? Solving by Gates's formula we get the following results:

Quality	Speed	Combined Score
8	53	30.0
9	53	33.7
8	70	32.9

Raising the quality from 8 to 9 adds more to general writing ability than does increasing the speed from 53 to 70. However, if a child has obtained a good legible hand, then the emphasis is more properly put on speed.

How well should a Pupil Write?

This is a practical question, for it is useless to take the time to develop a handwriting that is much superior to the ordinary demands of life. According to Thorndike a quality equal to 11 or 12 on his scale is sufficient. He says:

> That children in the last two grammar grades can write so much better than adult women teachers do customarily is an important fact. Considering it in connection with the past that above quality 11 there is very little difference in legibility, one is tempted to advocate the heresy that children are taught to write too well. I personally do advocate it. If school boards would furnish, for the use of school children electing "writing" as a study in the last two grammar grades, typewriting machines, I should certainly advise the transfer to typewriting of a child in these two grades whose writing at 60 letters a minute consistently reaches quality 13. For, the amount of practice required to advance such a pupil to quality 16 at a rate of 75 letters a minute would much more than suffice to advance him to substantially errorless machine writing at that rate. The value now attached to the high qualities of handwriting is, of course, largely fictitious. Employers who can afford such high qualities of writing buy machines to produce them. For

writing cash checks, simple book-entries, labels, and the like, a good plain hand of our quality 12 is entirely adequate. For attaining higher qualities (15–18) the machine is a more economical tool than the pen, and in my opinion should be provided in those schools which require such qualities. Further, such qualities should, in my opinion, be required of children in the elementary schools only when they have elected writing as a vocational subject.

By means of a questionnaire Freeman investigated the quality of writing demanded by commercial firms. These included correspondence schools, mail-order houses, packing companies, and the like, having a total of about one thousand seven hundred employees. The replies indicated that the writing should be at least as good as quality 60 in the Ayres Scale. Four of the firms demanded qualities from 70 to 90. All of them indicated that these qualities were desirable.

In a study made by Koos 1053 specimens of social correspondence and 1127 specimens from as many employees in twenty-four occupations were scored on the Ayres Scale. It was found that the average quality in the social correspondence was 49.5, and that only 13.5 per cent were better than quality 60. The average quality of the occupational groups ranged from 48 for college professors to 81 for employees in the account-sales department. Of the twenty-four occupational groups only ten were better than 60 and only one better than 70. Koos concludes from these results that it would be difficult to justify a quality better than 60 for social correspondence, and that this standard is also adequate for the needs of most vocations, such as skilled and unskilled labor, and of the professions exclusive of teaching in the elementary schools. For the latter and for those expecting to enter commercial work a higher standard is necessary but not any above 70 in the Ayres Scale.

If we compare these standards with those ordinarily obtained in the eighth grade we see that they are entirely adequate to the practical demands of life. The eighth-grade

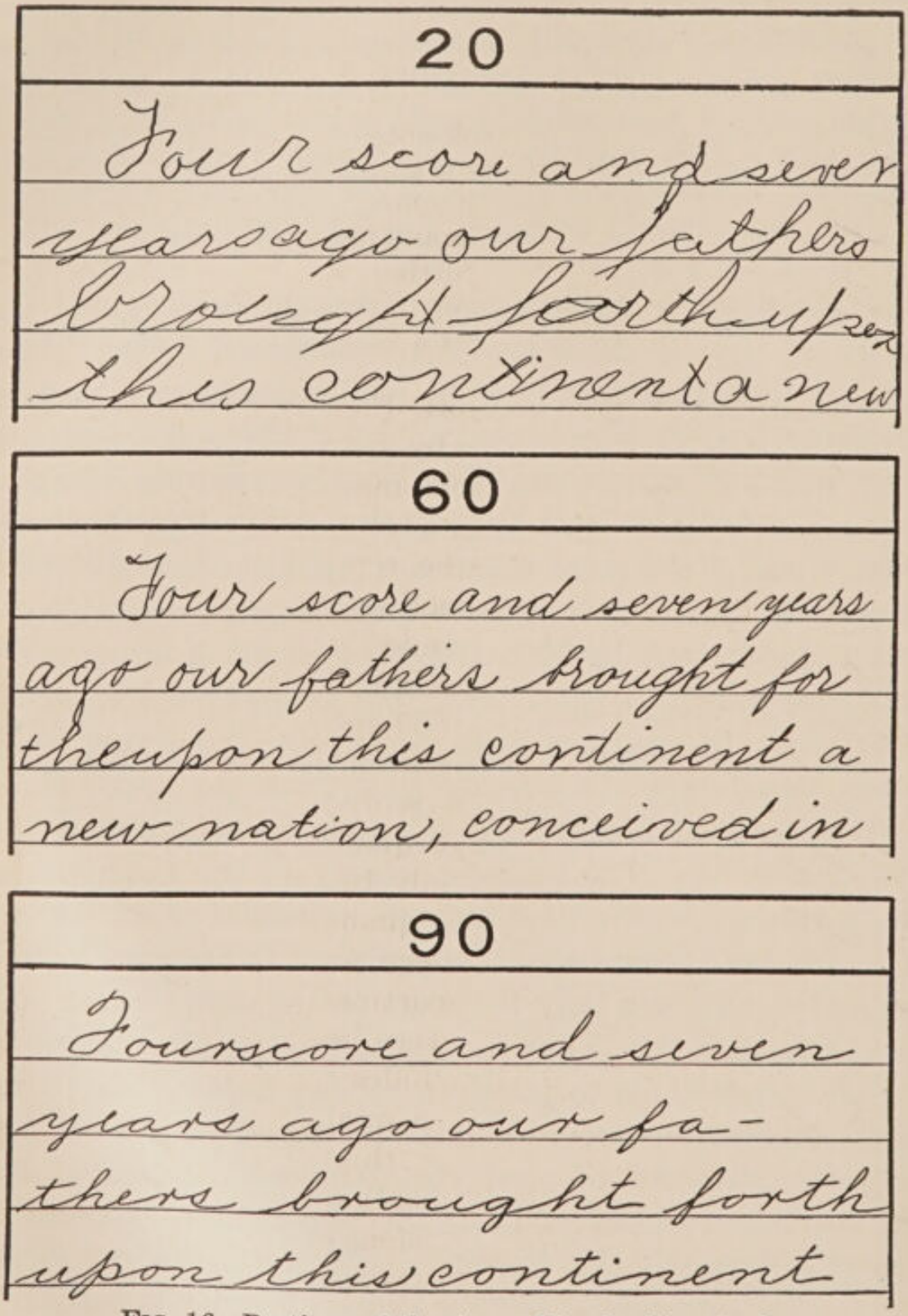


FIG. 16. Portions of the Ayres Handwriting Scale

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standard is 66 for the Ayres Scale and 13.5 for the Thorndike Scale; in fact, many children reach these standards in the sixth grade. A good idea of the legibility of quality 66 may be obtained from an examination of the sample having quality 60 in Fig. 16. Quality 66 is just perceptibly better than quality 60. In fact, many persons would be unable to notice the difference. Quality 13.5 in the Thorndike Scale is just the same as quality 60 in the Ayres Scale.

Interests appealed to in Teaching Handwriting

Handwriting appeals to the interest we have in action and in mastery and also to the love of beauty. It is, moreover, a relief from mental exercise such as is required for reading, arithmetic, and geography. In common with all school subjects it may be motivated by rivalry and the desire for approval. Possibly the most successful appeals pedagogically are to rivalry and mastery. These are made effective by the use of scales and by keeping a record of progress. Courtis and Shaw have designed a course of study in which the appeals to these two impulses are worked out in great detail. The students are required to measure their work daily both in quality and in rate and to compare it with the standard for their grade. A record book is supplied for keeping the daily scores, also a chart for graphing the number of days spent on each lesson. Thus the pupil has constantly before him a picture of his record of progress and of his rate of improvement. The record of his progress not only gives him confidence but also creates an interest in accelerating his rate of improvement. He is, in addition, constantly stimulated by similar records of his classmates. An effort is also made to get the pupil to analyze the faults in his handwriting — faults in alignment, slant, size, form, position, and movement. The rules on the following page are kept before him to help him toward making this analysis.

THINGS TO REMEMBER IN LEARNING TO WRITE

1. Write the word once.
2. Compare your writing with that in the book.
3. Are all the letters on the line?
4. Have all the letters the same slant?
5. Are all the short letters the same size?
6. Are all the tall letters the same size?
7. Look carefully to see if all the letters are carefully made.
8. If you cannot make a letter to please yourself, ask your teacher to help you. Perhaps you do not sit in a comfortable position or hold your pen in an easy manner. Do not hold the pen tightly, and do not turn the hand over on the side.
9. Practice the letters that you cannot make well, then write the word to see if you have improved.
10. Write the word a number of times so that you can write it quickly and well and make the standard rate and quality for your grade.

The principal difficulty with such a procedure is the scoring — scoring for rate and scoring for quality. This consumes two thirds of a fifteen-minute writing period — five minutes for practicing the lesson, five minutes for writing the test, and five minutes for correcting and scoring. Writing the test affords practice and consequently is probably not time lost if it is done accurately. Scoring for quality is difficult for young children, but it is facilitated by the use of scales which have the same words as the copy used in special drill. The scoring will, of course, improve with practice.

In the course given above the Ayres Scale is used for measuring quality. Another scale that could be profitably used here is Freeman's, which has the advantage of having separate scales for slant, alignment, letter formation, spacing, and quality of line. Faults in any of these features can be analyzed very accurately by this scale. Since knowledge of error is one of the essentials of improvement as well as of locating the teaching emphasis, the results yielded by such an analytical scale are profitable to both teacher and pupil.

Order of Habit Formation

With what letters or movements should handwriting begin? In what order should the letters be learned? The principles upon which these questions should be answered are easily stated. One is that the order should be such as to give the maximum amount of facilitation and the minimum amount of inhibition between the letters already learned and those yet to be learned; the other is that children should learn to write those words which they will need to write most frequently in their school work and in their correspondence. These two principles will sometimes conflict. For example, the word *children* is used frequently in the first and second grades, but it is doubtful if pupils from these grades should learn to write it. In case of conflict the first principle should be given precedence; but if careful judgment is used, serious conflicts can be avoided. A study of present-day writing systems shows scarcely any agreement in the course of study with reference to either of these principles. In one method, for example, the first two drills are in writing ovals and straight slanting lines, or pushpulls, three fourths of an inch high. In the third drill these exercises are repeated, and the pupil is also required to drill on the words *mine*, *uses*, and *sell*. The small letters in these words are only one twelfth as high as the ovals and the pushpulls. Here the pupil is suddenly required to shift from a large figure requiring only one kind of movement to very small figures requiring close coördination of a number of very different movements. It would be difficult to devise a more abrupt change than this or one that would produce so much interference and so little facilitation. The *m* requires a series of three similar but separate movements with narrow turns at the top and absolute stops at the bottom in order to produce the sharp turns below. The *i* is the exact opposite of this; then comes the *n*, which is like the *m* but is the opposite

of the *i*, followed by the *e*, which is totally different from *m*, *n*, and *i*. Then comes the *u*, which is a double *i* and would naturally follow the *i*. The next letter to be learned is an *s*, which is one of the most difficult in the alphabet and requires a totally different movement from the letters that came before. The letters *m*, *i*, *e*, and *s* have almost nothing in common in the type and coördination of movement required to make them. There would be a maximum interference in these movements. From the standpoint of the psychology of learning, each of these letters should be learned one at a time and by separate drills on different days. Combining them, or coördinating them into a series of movements as in writing a word, would be psychologically the next step — a step difficult enough to require a number of drills. But to require the child to practice in one lesson four types of letters requiring very opposite types of movement and also to combine them into a series is presenting a task of supreme difficulty.

Starting a course in handwriting with exercises that are never used in any actual writing raises some questions. Their justification is that they enable the child to learn position, movement, and swing. But these might be learned in exercises using the simplest letters. The objections to them are that they consume time and that they interfere by fixing habits which conflict with the required habits. But if a system must start with drills in making ovals, it would be psychologically more sound to start with an oval that has the same height as an actual capital *O*. This might be followed by drills in the capital *O*. The small *o* could come next, although it requires an abrupt change, then the small *a*, then the small *d* and the small *g*. Such an order would be defensible on the ground of its easy transitions.

In another course in present use there are no beginning movement exercises. The pupil starts at once writing words. In the first ten lessons the following words are used in the

order given: *it, the, next, found, breezes, quickly, jumping, whatever, Our President, Detroit, Michigan.* If we examine these words from the standpoint of the psychological principle of facilitation, we find there are common elements between successive words. The letters in *it* require the same form and differ only in extent. The word *the* has one letter, *t*, in common with *it*. The word *next* has three elements in common with *the*: *t*, *e*, and the second part of the *h*. The word *found* has one letter, *n*, in common with *next*, but all the other letters are new, although *u* will be learned more easily because of the previous practice with *i* in *it*. Here the transitions are too abrupt and too many new elements are introduced at one time. The same criticism applies to the next two words, *breezes* and *quickly*. *Breezes* contains the new elements *r*, *z*, and *s*, and *quickly* the new elements *q*, *c*, *k*, *y*. All of these require very different and opposite coördinations and cannot be learned at the same time without a maximum of interference. The same criticism applies to the next two words, *jumping* and *whatever*. *Jumping* contains the new letters *j*, *p*, and *g*, and *whatever* the new letters *w*, *a*, and *v*. After this the transitions are easier because most of the elements have now been mastered.

The practical lessons in this course of study pay some attention to the principle of facilitation, but far too many new elements are introduced at one time. In these comes the interference which overbalances the facilitation. It is also doubtful if children in the second grade should be required to write the words in standard size. It would be much easier for them if the larger letters were permitted here. This course also pays some attention to the selection of useful words, such as *it* and *these*, which are important in the second and third grades, but the other words are rare and unimportant in the young school child's writing vocabulary.

The course outlined in Freeman and Dougherty's "How to Teach Handwriting" pays serious attention to both the

principles stated above. The size of the letters is carefully adjusted to the age and capacity of the learner. The largest letters occur in Grade II and gradually reach standard size in Grade V. The order of the letters is determined by their similarity in form, and the words used are selected from the child's spelling and writing vocabulary. The course begins with an exercise that requires the making of long curved lines back and forth over the page. This movement is introduced to overcome the difficulties in movement across the page, which Freeman's photographic studies found to be characteristic of poor writers. In the third exercise the letter *i* is written with large strokes in between. In the fourth exercise occurs the *u* with long strokes in between. In the fifth exercise there is drill in writing the uncrossed *t*. The sixth exercise is a combination of the third and the fifth, being a drill in writing *its* with long strokes in between. The seventh exercise is a drill with *e*. The eighth is a combination of the third, sixth, and seventh, being a drill in writing the word *tie*. The ninth is a drill in *l*. The tenth is a combination of the fifth, seventh, and ninth, being a drill in writing *let*. This procedure is characteristic of the entire course. The elements are introduced separately in the order of their simplicity and similarity. After every one or two elements coördinating drills are given in which the elements are combined into useful words.

Individual Differences

Children of the same grade differ widely both in quality of handwriting and in speed. From Table LI it will be seen that among 311 children from the fifth grades in Boise the variation in speed is from 20 letters per minute to over 100; in quality it is from 20 in the Ayres Scale to 80. The lowest scores are below the standard for Grade II, and the highest are far beyond the standard for Grade VIII. In Table LII appears the distribution of a seventh-grade class of 42 pupils.

TABLE LI. DISTRIBUTION OF 311 FIFTH-GRADE PUPILS IN HANDWRITING IN BOISE SCHOOLS. (After Sears)

QUALITY: AYRES SCALE

SCORE	CENTRAL	GARFIELD	HAWTHORNE	LINCOLN	LONGFELLOW	LOWELL	PARK	WASHINGTON	WHITTIER	ALL SCHOOLS
100										
90										
80								4		4
70					1	1	1	9	1	13
60	2	2	1		3		5	13	2	28
50	8	4	2	6	16	6	14	11	11	78
40	17	14	5	9	21	15	18	2	9	110
30	7	11	4	9	9	7	6	1	2	56
20	3	5	3		3	3	3		2	22
10										
Totals	37	36	15	24	53	32	47	40	27	311
Medians	47	42	41	44	47	45	48	65	50	48
Norm	50	50	50	50	50	50	50	50	50	50

SPEED: LETTERS PER MINUTE

NUMBER OF LETTERS PER MINUTE	CENTRAL	GARFIELD	HAWTHORNE	LINCOLN	LONGFELLOW	LOWELL	PARK	WASHINGTON	WHITTIER	ALL SCHOOLS
110 and over		3			2					5
100–199	2	1	1		3	1				8
90–99		2	1	1	5	2	1			12
80–89	7	7		1	7	10	6	2		40
70–79	10	16	4	1	11	8	10	5		65
60–69	13	4	7	9	15	5	10	4	5	72
50–59	5	1	1	7	5	1	7	11	7	45
40–49		1	1	3	5	4	11	12	15	52
30–39		1		2		1	2	4		10
20–29								2		2
Totals	37	36	15	24	53	32	47	40	27	311
Medians	70	73	65	60	70	73	63	52	48	68
Norm	64	64	64	64	64	64	64	64	64	64

Here the range is still wider, there being a difference of 70 points in the Ayres Scale between the poorest writers in the class and the best writers. Some of the things which can be done to meet these differences are the following:

1. Excuse those from special drill who have reached a good legible hand, such as quality 60. In the Boise schools there were forty-five pupils in Grade V who had attained quality 60 or better, and there were seventeen who had attained quality 70 or better. All of these could be safely excused from further instruction in handwriting, provided their written work did not fall below quality 60. There is no great value in developing a very fine handwriting. The time required to do this could be more profitably spent on some other subject. Excusing a child from special drill as soon as he has reached quality 60 would not only prove a valuable incentive for improvement in handwriting but would help the child's education in other subjects. Special drill in Grades VII and VIII would then be only for those pupils who have not yet attained this standard. Under such a system possibly less than half the pupils would have a writing period in these grades.

TABLE LII. DISTRIBUTION OF 42 SEVENTH-GRADE PUPILS IN QUALITY OF HANDWRITING. (Ayres Scale)

	Score									Total	Median	Normal
	90	80	70	60	50	40	30	20	10			
Number of Pupils .	4	10	17	7	2	0	1	1		42	68.8	58

2. Allow for differences in position and movement. Freeman's study showed that good writers have different relative amounts of finger and arm movement. The child's attention should be directed to quality and speed and to the production of good results. The form of movement and the kind of position are significant only in so far as they contribute

to good writing. An arm movement is favorable to speed, and some finger movement is favorable to quality. Arm movement will have to be encouraged, but finger movement will follow without encouragement as a consequence of attention to quality. Less variation should be allowed in position than in type of movement, on account of the fact that good writers vary less in position than in any other factor. But here, again, absolute uniformity cannot be obtained, because children vary in the shape of their hands and in the length of their fingers. Adjustments in position should be made, particularly for children who are strongly left-handed. There is some evidence that changing from left-handedness to right-handedness in writing causes defects in speech. There is no need of taking this risk, since good writing can be done with the left hand. It is important, however, to turn the paper so that the line of the writing shall be at right angles with the forearm. If the position of the paper is kept at the same angle as for the right hand, then writing with the left hand becomes extremely awkward if not impossible.

3. There should be adjustments made for the age of the child. The prevailing system of handwriting has the same instruction for all the grades: there is the same material, the same movement, the same size of letters, and the same drill. This is not true for any other school subject, and it should not be true for handwriting. Small children do not begin to have the muscular control of the older children and they therefore should not be expected to write small letters. The course by Freeman and Dougherty described above gives much attention to this factor. These authors recommend first instruction at the blackboard, where a large free-arm movement is developed. This is followed by the use of a pencil and unglazed paper in the second and third grades. The pen is introduced in the fourth grade, and on account of this no improvement in quality is expected over that attained

in Grade III. The writing of small letters at their normal size is not required before Grade V. It is not certain whether such a long period as this should be used for reaching the normal size of small letters. The tapering down of the size of the letters has the disadvantage of requiring the formation of a new habit for each size. On the other hand, in requiring second-grade children to write letters of the same size as adults no account is taken of their immature muscular development. In the end the result is reached more quickly when an adjustment is made for this condition.

4. Individuality in the style and form of writing should be allowed. This will follow as a natural consequence of the native character of the writer. The prevailing systems of handwriting, however, aim to get a quality which is as uniform as the letters produced by a printing press. This is contrary to human nature. The attractive feature of handmade goods is their individuality, and this should be true of handwriting.

Summary

The aim in handwriting is to develop in the child sufficient skill to record facts and ideas for permanent keeping or for communication. Efficiency in handwriting depends upon two factors: quality and speed. The curve for quality shows a constant improvement from Grades II to VIII, being a little more rapid in the upper four grades. The curve for speed, however, shows more improvement in the lower grades than in the upper grades. Girls, on the average, are superior to boys in both speed and quality. Brightness is favorable to learning handwriting, but is not necessary. Adults having superior intelligence usually write less well than do those of average or inferior intelligence. No proof has yet been found for relationships between traits of character and handwriting. The quality and speed of handwriting are influenced by such factors as position, type of movement, and rhythm.

A position favorable to good writing is to support the hand on the fingers, and the arm on the muscle pad of the forearm; to have the forearm at right angles to the line of writing; to grasp the pen loosely; and to sit facing the desk squarely with the body erect and with both feet on the floor.

There is no justification for insistence on an exclusive arm movement, nor is it possible to develop such a movement.

An arm movement is favorable to the development of speed; but it can be developed as a result of emphasis on proper position and speed, without a specific drill for this purpose.

Rhythm is a symptom of maturity in handwriting and has little to do with its quality. It may be used, together with counting, for developing speed and for organizing movements which conform to the natural divisions and forms of the letters.

Statistical studies have found no correlation between the length of the class period and quality of handwriting. Experiments made by Brooks showed that fifty minutes per week produced approximately the same improvement as did seventy-five or one hundred minutes per week.

The quality of handwriting is negatively correlated with speed. Quality 12 in the Thorndike Scale or quality 60 in the Ayres Scale is sufficient for practical purposes.

The source of interest in handwriting lies in its appeal to action, mastery, and love of beauty.

The leading systems of handwriting do not agree upon the order of habit formation. The one outlined by Freeman and Dougherty is notable in its stress on the principles of facilitation and ease of coördination.

Most systems of handwriting fail to make adjustments for age and other individual differences between children. In these respects handwriting should not be an exception to other school subjects. Some adjustments which may be made are (1) to excuse from drill those who write a good hand, (2) to allow for differences in position and movement, (3) to

make adjustments for differences in age by having small children write large letters with a free-arm movement and decrease the size of the letters gradually, and (4) to allow for individuality in style and form of writing.

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BROOKS, F. D. "Time Assignment and Rate of Improvement in Handwriting," *Journal of Educational Psychology*, Vol. X (1919), pp. 350–354.

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A photographic study of the motor factors that influence quality of handwriting in both good and poor writers.

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FREEMAN, F. N. The Teaching of Handwriting. 1914.

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FREEMAN, F. N., and DOUGHERTY, MARY L. How to Teach Handwriting. 1923.

A teacher's manual outlining a course of study based on scientific studies and the laws of learning.

GATES, ARTHUR I. "The Relation of Quality and Speed to Performance: A Formula for Combining the Two in Case of Handwriting," *Journal of Educational Psychology*, Vol. XV (1924), pp. 129–144.

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Finds zero correlations between writing ability, and intelligence when age and other factors are eliminated.

GESELL, ARNOLD L. "Accuracy in Handwriting as Related to School, Intelligence, and Sex," *American Journal of Psychology*, Vol. XVII (1906), pp. 394–405.

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GRAVES, S. MONROE. "A Study in Handwriting," *Journal of Educational Psychology*, Vol. VII (1926), pp. 483–494.

HULL, CLARK L., and MONTGOMERY, ROBERT B. "An Investigation of Certain Alleged Relations between Character and Handwriting," *Psychological Review*, Vol. XVI (1919), pp. 63–75.

Finds zero correlation between qualities of handwriting and character traits.

JUDD, CHARLES HUBBARD. Measuring the Work of the Public Schools. Cleveland Survey, 1916, chap. iv.

Shows individual differences in handwriting and the relation between speed and quality.

KOOS, LEONARD V. "Determination of Ultimate Standards of Quality in Handwriting for the Public Schools," *Elementary School Journal*, Vol. XVIII (1918), pp. 423–446.

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NUTT, H. W. "Rhythm in Handwriting," *Elementary School Journal*, Vol. XVII (1917), pp. 431–445.

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THORNDIKE, EDWARD LEE. "Handwriting," *Teachers College Record*, Vol. X (1910), No. 2.

Explains the derivations of scales and discusses other questions relating to handwriting.

WEST, P. V. "Relation of Rhythm to Handwriting," *Journal of Educational Psychology*, Vol. XIII (1922), pp. 438–444.

An experiment showing that rhythm helps young people to acquire facile movement and to organize movements into unit strokes.

CHAPTER XIV

SPELLING

Aims

Spelling is learned because of its value in written communication. Its specific purpose is the production of the correct form of the word in so far as this has to do with the selection and arrangement of the letters. Correct spelling is necessary for conveying the idea intended. For example, *dying* and *dyeing, wood* and *would, great* and *grate, bear* and *bare,* although pronounced alike, have very different meanings according to the spelling. Spelling is valuable in school for taking notes and keeping good records. Outside of school its principal use is in correspondence, but it is valuable wherever records are kept or writing is done. Formerly it was thought useful for mental development. In the early half of the nineteenth century many of the public schools devoted as much as 50 per cent of the school day to the subject. Words were studied not because they were useful but because they were hard, long, and uninteresting. This idea is now obsolete. The value of spelling is conventional and instrumental, not intrinsic nor disciplinary.

Influence of Grade, Age, Sex, Intelligence, and Foreign Language Spoken in Home

Ability to spell, like ability in any other school subject, is influenced by such factors as age, intelligence, and language spoken in the home, none of which are controllable by the teacher. The influence of these may be seen in the measure-

ments made by Nifenecker in certain districts of New York. He gave to 5260 pupils from Grades V to VIII a test of twenty-five words taken from column T of the Ayres Scale. The influence of grade, age, and sex are shown in Tables LIII–LV.

TABLE LIII. INFLUENCE OF GRADE. (After Nifenecker)

	GRADE							
	V A	V B	VI A	VI B	VII A	VII B	VIII A	VIII B
Average per cent spelled correctly	43.1	54.3	65.2	74.6	79.0	83.2	88.1	91.3

TABLE LIV. INFLUENCE OF AGE. (After Nifenecker)

	AGE							
	9	10	11	12	13	14	15	16 and over
Average per cent correct	63.3	59.4	64.4	69.7	74.5	75.7	76.6	77.4

TABLE LV. INFLUENCE OF SEX ACCORDING TO GRADE. (After Nifenecker)

	GRADE							
	V A	V B	VI A	VI B	VII A	VII B	VIII A	VIII B
Boys	41.1	51.5	62.7	72.7	76.2	80.9	85.7	89.9
Girls	45.1	57.4	67.9	76.6	82.1	85.2	90.3	92.6
Superiority of girls	3.7	5.9	5.2	3.9	5.9	4.3	4.6	2.7

It will be seen that much more improvement is made in Grades V and VI than in Grades VII and VIII, that by ages there is steady progress from nine to thirteen, but very little beyond; and that girls are uniformly superior to boys by an average of 4.5 per cent.

Intelligence has a considerable influence on learning to spell, but not nearly so much as it has on the comprehension

of reading matter or on the solving of reasoning problems in arithmetic. Its value is indicated by a correlation of 0.42 with ability to spell, as found by Gates in an experiment to be described later. This is 0.30 below that for comprehension in reading and 0.37 below that for ability in solving reasoning problems in arithmetic. The reason for this is that spelling is learned principally by repetition and is influenced little by a process of reasoning. Its value in spelling is no doubt due to the fact that a bright child requires fewer repetitions than does the child who is dull.

The influence of the language spoken in the home may be described thus: if a foreign language is spoken in the home, it reduces the pupil's ability to spell, on the average, about 3 per cent, but this influence decreases with advancement through the grades. This is shown in Table LVI, the results of which are taken from Nifenecker's investigation.

TABLE LVI. AVERAGE PERCENTAGE OF WORDS CORRECT FOR ENGLISH-SPEAKING AND FOREIGN-SPEAKING PUPILS IN RELATION TO GRADE
(After Nifenecker)

	GRADE								AVERAGE
	V A	V B	VI A	VI B	VII A	VII B	VIII A	VIII B	
English-speaking . .	44.5	54.1	66	75.7	79.4	82.9	88.3	91.4	71.0
Foreign-speaking . .	40.5	54.7	63.6	72.2	78.0	84.2	87.5	90.8	67.8

Differences of this sort are probably due principally to the inaccurate pronunciations of foreign children.

ERRORS IN SPELLING AND THEIR CAUSES

A study of the errors in spelling is particularly valuable, for it throws into relief not only the points of difficulty but also the types of training that are most likely to increase efficiency in spelling. Analytic studies of errors in spelling

have been made by Foster, Hollingworth, Kallom, Cook and O'Shea, and others. These indicate that the principal causes are lapses, imperfect vision, imperfect hearing, and false associations. A lapse is a temporary forgetting caused by inattention and is usually corrected by attention to spelling. Imperfect vision is often due to the size and similarity of the letters, their position in the word, and the length of the word. The principal cause of imperfect hearing is mispronunciation, and false associations are due largely to reasoning from similarity. These and other causes become more clear from an analysis of the results in the studies named above.

Foster analyzed 2005 errors in spelling made by 300 college students in 10,000 themes. He ascribed 467, or about one fifth, to carelessness; 259, or about one eighth, to mispronunciation; 853, or about two fifths, to the insertion or omission of silent letters; 327, or about one sixth, to confusion of *ie* and *ei*, *al* and *le*, *ent* and *ant*, *se*, *ce*, and *ze*, *able* and *ible*, *ance* and *ence*; and 167 to spelling *er* as pronounced. All of these seem to be reducible to three general causes: lapses, imperfect vision, and imperfect hearing.

The same factors are illustrated in the study by Kallom, who selected from the Boston Minimum list fifty words that were misspelled by 75 per cent of the pupils in the grades. He gave this list as a test to 992 ninth-grade pupils in the suburbs of Boston and then tabulated the misspellings of each word and also the frequency of each. Among the errors caused by imperfect vision are the misspelling of such words as *knead*, *Saturday*, and *bicycle*. *Knead* was misspelled 269 times and in 17 ways; the chief were "kneed" (129), "nead" (71), and "need" (4). *Bicycle* was misspelled 475 times and in 60 ways; as, "bycicle" (220), "bycycle" (50), and "bicyle" (32). *Saturday* was misspelled 109 times and in 17 ways; as, "Saterday" (50) and "saturday" (25). Examples of errors due to mispronunciation are *boundary*, which had

155 misspellings in 18 ways, as, "boundry" (100) and "boundery" (35); and *pitcher*, which had 181 misspellings in 24 ways, as, "picture" (98) and "piture" (23). Many errors were caused by a confusion of vowels; for instance, *bureau* was misspelled 372 times and in 97 ways, as, "beareau" (42), "beauro" (36), "beaureau" (34); *privilege* had 490 misspellings in 43 ways, as, "privelege" (106), "priviledge" (95), and "privlege" (50). Some of the errors were with consonants; for instance, *misspell* had 447 errors, as, *mispell* (335), *misspelled* (50), and *mis-spell* (23). Another group was with silent letters; such as those with *column*, — *colum* (41), *collum* (13), and *colume* (10). The influence of word length may be seen in the errors with *superintendent*, which had 579 misspellings in 101 ways. Table LVII shows the percentage of error with each letter.

TABLE LVII. PERCENTAGE OF ERROR IN EACH LETTER OF THE WORD *SUPERINTENDENT*. (After Kallom)

	LETTERS													
	s	*u*	*p*	*e*	*r*	*i*	*n*	*t*	*e*	*n*	*d*	*e*	*n*	*t*
Percentage of error .	0	0	0	11	14	38	38	33	18	11	8	5	13	18

With the exception of the last two letters the frequency of error increases toward the middle of the word.

The influence of position was also shown in the investigations by Hollingworth and by Osburn. Hollingworth's analysis of the errors of three pupils with thirty-six seven-letter words showed percentages of error in regard to position as in Table LVIII.

Osburn's study pertained to the number of errors in relation to the position of the syllable. He calculated the errors per syllable in sixteen four-syllable words which occurred in a test of 50 words given to 1315 eighth-grade pupils. The average number for the first syllable was 13.7; for the second,

TABLE LVIII. PERCENTAGE OF ERROR IN RELATION TO POSITION OF LETTERS. (After Hollingworth)

	Position						
	1	2	3	4	5	6	7
Percentage of error	3	3	8	37	42	44	28

38.2; for the third, 14.6. Here, as in the errors in the word *superintendent*, we see that in long words the middle is less well perceived than the ends, but Hollingworth's study shows that with seven-letter words by far the greater number occur in the second half.

All these errors point to inaccurate perception, either visual or auditory, as their most important cause. Confirmatory evidence for this statement was found in a study made by Gates, who sought to discover the factors influencing ability in spelling by correlating performances in spelling with performances in a number of tests in perceptual achievement and perceptual ability given to a group of one hundred and five grade pupils. His results are given in Table LIX.

TABLE LIX. (After Gates)

Correlation of ability to spell	
With ability to discriminate small differences between pairs of words	0.50
With pronunciation	0.48
With oral reading	0.60
With silent reading	0.44
With writing	0.18
With intelligence (verbal group test)	0.42

The importance of visual perception is indicated by the high correlation between spelling and the ability to discriminate small differences between words; and the importance of auditory perception, by the correlation between ability to pronounce and ability to spell. In fact, these correlations are higher than the correlation between spelling and intelligence.

It is doubtful if ability in any other school subject would be found to depend more on perception than on intelligence. The correlation of spelling with oral and silent reading would be expected to be rather high, not only because the abilities are acquired together but also because ability in reading depends in part on word analysis and spelling. The close dependence of spelling upon perception suggests that the most important condition for learning to spell is an accurate and strong impression of the letters of the word. This may be acquired by adequate repetition and vivid presentation. Therefore, any method or device of teaching spelling that would increase either the frequency or the vividness of the presentation should help in improving ability to spell.

Another source of error in spelling is the use of association. In reading and arithmetic we found that this was one of the most important factors in developing skill and comprehension, but in spelling it appears to be a source of error rather than a help.

Kallom gives us the following misspellings due to analogy, or the law of similarity.

WORD	MISSPELLING
all right	"allwright," "allwrite," "alrite"
bureau	"burrough," "burrow"
boundary	"bowndary"
column	"columb"
daughter	"dolter"
doesn't	"dozent"
patient	"patcient"
quotient	"quochion"
used to	"youster"

In these cases the pupil no doubt made an effort to spell the word correctly by reasoning that it must be spelled like another word or syllable similar in sound, but the result of this reasoning was error. If this is the usual result of reasoning in spelling, then we must put our chief reliance in learning spelling on the law of repetition.

The Law of Repetition

The Number of Repetitions

According to the law of repetition we should expect that the greater the number of times the spelling of a word is repeated, the greater becomes its accuracy or retention. This law may be demonstrated by a simple experiment in which the number of repetitions is varied, the percentage of accuracy being calculated for each number. The experiment was made under the writer's direction by two teachers — Miss Gladys B. Parker and Mr. J. Wilber Nelson — in the schools of Monongahela, Pennsylvania. In this experiment a word was written on the board, was pronounced and spelled by the teacher, and was then pronounced and spelled orally in concert by the class. Such a procedure was called one repetition. Miss Parker varied the number of repetitions from one to eight and taught words from those assigned for her grade. She taught one word a day for three days for each number of repetitions, giving it before the regular class period and testing it after the period.

Mr. Nelson followed the same procedure, but varied the number of repetitions from one to five, taught five words for each number, gave two words each day, and presented them in cycles; that is, he gave one repetition the first day, two the second day, three the third day, and so on to the fifth day. In the next five days the same procedure was repeated. He used a class of fourteen pupils from Grade VI.

When all the words were taught, the average percentage of accuracy for the words having the same number of repetitions was calculated. The results are given in Table LX, on page 232.

It will be noticed that the increase in accuracy for Miss Parker's class stops at the fourth repetition, but that in Mr. Nelson's class the limit has apparently not been reached in the fifth repetition. It will also be noticed that Nelson's

TABLE LX. ACCURACY IN SPELLING IN RELATION TO NUMBER OF REPETITIONS

NUMBER OF REPETITIONS	PERCENTAGE OF NELSON'S CLASS	PERCENTAGE OF PARKER'S CLASS
1	63.5	92.0
2	74.5	97.0
3	64.0	96.0
4	83.0	98.6
5	93.0	98.6
6		98.6
7		98.6
8		98.6

class starts with an accuracy of 63.5 and ends with 93, whereas Parker's class starts with 92 and ends with 98.6. The reason for this is that Nelson selected much more difficult words, so that there was an opportunity for a greater amount of gain. The experiment shows not only the effect of the number of repetitions but also that there is a limit beyond which more repetitions are unprofitable. This appears to be four for Grade VI, but would decrease for younger pupils.

The Length of the Class Period

Another effect we should expect from the law of repetition in spelling is a consistent relationship between efficiency in spelling and the amount of time devoted to it in class, but here we shall be disappointed. The investigations fail to show any general improvement in spelling with the increase in the amount of class time devoted to the subject. The first investigation was made by Rice, who tested 33,000 children in twenty-one cities and tabulated the average grade made by each class and the length of the class period; the second was made by Nifenecker on 5260 children in the city of New York. The results obtained by each for Grade V are given in Tables LXI, *A*, and LXI, *B*.

TABLE LXI, *A*. SPELLING GRADES IN RELATION TO LENGTH OF CLASS PERIOD FOR GRADE V. (After Rice)

CITY	SCHOOL	SENTENCE TEST SCORE	MINUTES DAILY
1	B	72.6	50
9	B	76.8	45
1	A	79.6	45
7	B	81.1	40
19	A	76.6	40
1	C	81.8	35
7	B	75.0	30
11	B	81.8	25
15	H	79.1	25
7	A	73.6	20
10	B	77.2	20
15	D	83.6	20
15	B	79.4	20
16	A	74.4	20
12	B	74.4	18
7	A	79.4	15
16	B	76.4	15
12	B	79.0	10

TABLE LXI, *B*. SPELLING GRADES IN RELATION TO LENGTH OF CLASS PERIOD FOR GRADE V. (After Nifenecker)

SCORE	MINUTES PER WEEK	SCORE	MINUTES PER WEEK
87.6	70	57.7	100
74.3	100	56.9	100
73.0	90	56.2	100
66.9	100	51.0	70
65.9	120	50.1	70
65.5	100	48.4	100
65.3	100	48.0	70
61.6	70	45.3	50
61.2	100	44.7	120
60.8	100	43.5	120
59.0	70	39.5	50
58.7	70	35.0	70
58.4	100	31.7	100
58.3	80	21.7	70

Both investigations agree that no consistent relationship can be found between efficiency in spelling and the amount of time devoted to its study in class. Seventy minutes per week in one class yields a result of 87.6; in another, 51.0; in a third, 21.7. Again, one hundred and twenty minutes per week yields a grade of 65.9 in one class and a grade of 43.5 in another. Upon reflection the explanation of such variations does not appear difficult. As already pointed out, the efficacy of repetitions depends upon their number, their intensity, their mode, their point of application, the purpose of the learner, and so on. Although it is possible to perform more repetitions in one hundred and twenty minutes than in seventy, there is no guaranty that a class will do so. One class may be idle most of the time, or the pupils may be working without intensity or purpose or method, or they may be studying words that are known. In another class the pupils may be busy. They may be studying only words that they missed in a test, and they may be working with intensity and for the purpose of achieving an accuracy of 100 per cent in the next test. Under such conditions the same amount of class time will produce wide variations in the achievement.

Should Spelling be studied Regularly or only Incidentally ?

Another result which we should expect from the law of repetition in spelling is that the pupils in schools which devote a regular amount of class time daily to spelling would spell much better than those in schools which study spelling only incidentally or devote no time at all to it. Here, again, we have results which show that incidental study or no study at all is just as effective as regular study. This was shown in a study made by Cornman in the schools of Philadelphia. He found that fifty schools which gave specific instruction in spelling showed in a spelling test an average performance of 71.7 as against 69.2 in two schools which gave only incidental

instruction for a period of three years. This incidental instruction consisted in directing pupils to the dictionary when they were in doubt, in correcting mistakes in written work, and in conspicuously displaying words that were likely to be misspelled. The results obtained from four grades in the Northwest School in June, 1897, after specific instruction, and in June, 1900, after three years of no specific instruction, appear in Table LXII.

TABLE LXII. GRADES IN SPELLING AFTER SPECIFIC INSTRUCTION AND AFTER THREE YEARS OF INCIDENTAL TEACHING. (After Cornman)

COMPOSITION TEST

GRADES	AFTER SPECIFIC INSTRUCTION	AFTER INCIDENTAL INSTRUCTION
	Average: June, 1897	Average: June, 1900
VIII	99.3	99.8
VII	99.2	98.6
VI	97.80	99.0
V	97.45	97.6

WRITING WORDS IN SENTENCES

	Average: June, 1897	June, 1898
VIII	89.8	90.6
VII	86.1	78.7
VI	83.5	77.5
V	80.0	76.9

In the composition test the instructed grades were not superior to the uninstructed grades in writing isolated words, but in writing the words in sentences they were from 4 to 7 per cent superior in three of the grades. This shows so little value for the specific instruction used in this school that if we had no other results to the contrary we should be justified in omitting specific instruction in spelling, but we suspect that in this case the incidental instruction was pretty well directed.

There are, however, a number of experiments which show that skill in spelling is a product of training and that some forms of training are much better than others.

Influence of Mode of Presentation

The mode of presentation makes a difference. This was shown by Lay, who made a number of experiments with children from the first school year to the sixth, the object of the experiments being to find out through which sense verbal materials are most effectively presented. Nonsense syllables were used, and about thirty children were used in each experiment. Table LXIII shows the results.

TABLE LXIII. AMOUNT OF ERROR IN SPELLING IN RELATION TO MODE OF PRESENTATION. (After Lay)

MODE OF PRESENTATION	PERCENTAGE OF ERROR PER PUPIL
Hearing, without speech movement	3.04
Hearing, and speaking letters softly	2.69
Hearing, and speaking letters loudly	2.25
Seeing, and silent reading of letters	1.22
Seeing, and speaking letters softly	1.02
Seeing, and speaking letters loudly	0.95
Spelling aloud	1.02
Copying, and speaking letters softly	0.54

A similar experiment conducted by Baird,[1] but with words instead of nonsense syllables, yielded confirming results which are given in Table LXIV.

TABLE LXIV. AMOUNT OF ERROR IN SPELLING IN RELATION TO MODE OF PRESENTATION. (After Baird)

FORM OF PRESENTATION	PERCENTAGE MISSPELLED
Pronounced only	6.48
Heard and spelled aloud by pupil	4.66
Only shown to pupil	2.60
Seen and spelled aloud by pupil	2.27
Seen, used, spelled, and written by pupil	1.00

[1] Reported by Pryor, 1922.

Henmon, who investigated the influence of the mode of presentation, using nouns, nonsense syllables, and digits as his material, found results contrary to those given above, and so did some other investigators. None of these, however, studied the effect of the form of presentation on spelling. If we restrict our interpretation to the experiments on spelling cited above, we can say that seeing the letters is better than hearing them, but that the best is a combination of both with copying. The effect can be explained with reference to vividness. Hearing is not so good as seeing, because the same sound belongs to different letters. When the syllables are seen, there is no doubt to which letter the sounds belong. Before a syllable can be correctly copied, each letter must be clearly analyzed and a correct perception of it obtained.

Directed Study versus Independent Study

Directed study produces better results than independent study. Suzzallo and Pearson made a comparison of these two methods of study. Two classes from each of Grades IV–VII were used. One class from each grade had directed study, and the other had independent study; that is, each pupil followed his own devices. The classes having directed study used the following procedure:

1. The word was first written on the board and then studied as follows:
   a. Its meaning was given and used in a sentence.
   b. It was spelled aloud in concert, and individually by poor spellers.
   c. Its peculiarities were pointed out.
   d. The word was written once, twice, or three times by pupils, who spelled it as they wrote.
2. Each word was studied in this way.
3. Next, the whole column was reviewed orally, the children first spelling each word from the board, and then, turning from the board, spelling again and verifying results by consulting the board.
4. The words were then erased, and the pupils were tested.

The procedure for the classes having independent study:

1. The words were written on the board in a column, pronounced, used in a sentence, or their meaning given.
2. Then the pupils were allowed to study them independently without any suggestion from the teacher as to the method.
3. At the close of the period the words were dictated in sentences.

TABLE LXV. DIRECTED STUDY VERSUS INDEPENDENT STUDY
(After Pearson)

	GRADE				TOTAL AVERAGE DECREASE IN ERRORS
	IV	V	VI	VII	
Number of pupils	20	20	23	20	
Independent study: average decrease in errors per pupil . .	2.63	4.15	5.56	6.65	4.74
Directed study: average decrease in errors per pupil .	5.95	9.15	9.56	9.10	8.44

The value of directed study was also shown in a similar experiment by Miss Martha Fulton. She taught one hundred words at the rate of ten words a day for ten days by two methods. The directions for the first method were essentially the same as those used by Pearson; for the second method the direction was simply, "Study the lesson." The effect of the two methods was measured by two tests. The first test was given immediately after the experiment; the second, three weeks later. Table LXVI gives the results.

TABLE LXVI. SCORE IN SPELLING AFTER DIRECTED AND UNDIRECTED STUDY. (After Fulton)

	DIRECTED STUDY		UNDIRECTED STUDY	
	Test 1	Test 2	Test 1	Test 2
Average	98	96	73	68
Average decrease	1.9	3.4	11.2	11.8

Studying Words Singly or in Context

Studying words singly produces better results than studying them in sentences. This was shown by Winch in England, who compared the two methods of teaching in eight experiments. He used two equally difficult tests from 20 to 30 words each. In the single-word method each word was shown in written form for about twenty seconds. The teacher spelled and pronounced each word, and then the pupils spelled and pronounced each word silently. After the words were shown, they were written by the pupils. In the sentence method the word was written on the blackboard, and then the pupils were requested to use it in sentences. Each successive sentence used all the words previously presented. After all the words were taught, they were given to the pupils in a dictation test. There were slight but not important variations from this procedure in the other experiments. The efficiency of each method was measured by the average number of words spelled correctly in the final test. The results are shown in Table LXVII.

TABLE LXVII. GRADES IN SPELLING AFTER STUDYING WORDS SINGLY AND IN CONTEXT. (After Winch)

	50 BOYS, STANDARD 1, 40 WORDS	50 BOYS, STANDARD 3, 60 WORDS	BEGINNERS, 40 WORDS	BOYS, 60 WORDS,	50 GIRLS, STANDARD 3, 48 WORDS	56 GIRLS, STANDARDS 5 AND 6, 45 WORDS	54 GIRLS, STANDARD 4, 50 WORDS
Group A: words in sentences .	26.2	49.1	9.4	44.8	33.7	37.9	37.4
Group B: single words	29.9	57.3	11.7	50.7	35.6	39.0	44.5

In every experiment except one the results favored the single-word method. This is owing to the fact that presentation of a single word gives a clearer and more distinct im-

pression of it than does the presentation of a word along with a group of other words which confuse the impression and scatter the attention. The truth of this conclusion is in part confirmed by another experiment showing that the context form of teaching and testing has no advantage over the list, or column, form. In recent years it has become fashionable to teach and test spelling by presenting the words in sentences and by having pupils write them in sentences. The ground for this procedure is the theory that pupils should learn to spell in situations that are similar to letter-writing but the method requires a good deal of extra labor. Does it improve spelling? Hawley and Gallup carried out a very extensive experiment in which these two methods of teaching and testing were compared. Exactly eleven hundred pupils taught by thirty-two teachers were used in the experiment. The classes in each grade were paired, one using the context method, and the other the list method. The words were taken from the regular speller and were studied during the regular class period of fifteen minutes. The teachers gave not over six new words a day. Forty lessons were given. Tests were given at the beginning of the experiment and at the end of every ten lessons. Both tests used the same words. Table LXVIII gives the results for Tests 1 and 4.

TABLE LXVIII. LIST AND CONTEXT METHODS OF TEACHING AND TESTING SPELLING. (After Hawley and Gallup)

	Test 1		Test 4	
	List Form	Context Form	List Form	Context Form
Taught by list: number of pupils	412	412	418	420
Percentage correct	68.4	65	90.5	89.2
Taught by context: number of pupils	458	457	456	456
Percentage correct	70.8	65.8	89.7	88.4

The amount of improvement made between Tests 1 and 4 is practically equal for the two methods, but the performances in the list tests are superior to those in the context tests; hence there seems to be no justification for the extra labor involved in using words in sentences. Again, it appears that the only way to learn spelling is to study spelling and not the uses of a word.

Oral versus Silent Study

Spelling and pronouncing the words aloud after seeing them and hearing them spelled gives better results than studying them silently after hearing them read. This was shown by Winch in England in an experiment performed with boys from Standards 2 and 4. He selected two equally difficult tests called Set A and Set B, of thirty words each. The words of Set A were written on the blackboard and were spelled and pronounced by the teacher. Then the pupils spelled and pronounced each word twice. The words of Set B were read to the pupils, after which they studied them silently. An equal amount of time was spent on both sets. After all the words were studied, they were dictated, the pupils writing them. Different words were used for Standard 4 from those for Standard 2. Table LXIX gives the results in number of words correctly spelled.

TABLE LXIX. EFFECT OF ORAL STUDY, SET A, AND OF SILENT STUDY, SET B, IN SPELLING. (After Winch)

STANDARD	SET A	SET B
2	17.6	15.8
4	17.9	15.1

Here, again, the results in favor of Set A must be explained as due to the stronger impression produced by that method.

Presenting Words in Syllables

Presenting words in syllables is superior to presenting them in nonsyllabic form. This was shown by H. A. Greene, who conducted a very careful experiment with forty-one children from Grades IV, V, and VI. By a preliminary test the children were divided into two groups of equal ability in spelling. The influence of unequal ability was further eliminated by teaching each group one list of twenty-five words by each method. The effect of syllabication was measured by the average percentage of accuracy in a recall test given two weeks after the completion of the experiment, by the percentage of gain between the preliminary test and the recall test, by the average percentage of pupils making perfect scores in daily tests, and by the average percentage of words retained in recall tests. Table LXX gives the results of these measures.

TABLE LXX. EFFECT OF PRESENTING WORDS IN SYLLABLES
(After Greene)

	SYLLABIC	NONSYLLABIC
Average accuracy in recall test	79.4	78.8
Average gains in words right in recall test over preliminary test	55.6	54.3
Average percentage of pupils making perfect scores in daily tests	32.7	27.8
Average percentage of words retained in recall test	88.7	85.0

Similar results were obtained by Wolfe and Breed. They selected fifty-two of the poorer spellers from Grades IV A, V B, V A, VI A, VII B, and VII A. These were divided into groups A and B: group A included Grades VI A, VII B, and VII A; group B, the remaining grades. Each group was divided into two sections, a control section and a practice section, on the basis of a sixty-word test from the Ayres

Scale. Group B, however, received a different list of words from group A. All the pupils were then taught the words according to the following plan:

1. Pronunciation and development of meaning.
2. Oral and written spelling by pupils.
3. Study.
4. Review of yesterday's lesson.
5. Test.

Each word was presented visually on a card. For the practice group the words were presented in syllabic form; for the control group they were presented in undivided form. After all the words had been taught, a final test was given. This was repeated after twenty-three days for the purpose of measuring the effect of the syllabic form on retention. Table LXXI gives the results.

TABLE LXXI. EFFECT OF PRESENTING WORDS IN SYLLABLES
(After Wolfe and Breed)

GROUP	TEST	CLASS HAVING WORDS IN SYLLABLES	CLASS HAVING WORDS UNDIVIDED
A	Preliminary	32.5	32.5
	Final	50.8	50.7
	Retention	48.3	48.9
B	Preliminary	23.3	23.3
	Final	46.9	45.9
	Retention	43.3	41.7

It will be seen that the syllabic form is slightly superior to the nonsyllabic, an advantage no doubt attributable to the clearer presentation it offers. The results indicate that the advantage is chiefly with the younger pupils. That the difference is small is due to the fact that all the letters of a word can be clearly seen in the nonsyllabic form if an effort is made to do so.

Should Homonyms be presented Separately or Together?

Teaching homonyms separately is apparently superior to teaching them together. This was shown by Finkenbinder, but the contrary was shown by Pearson. The opposite conclusions are due to the different ways in which the two experimenters measured the effects of their two methods of teaching. Pearson taught ten pairs of homonyms to two classes of pupils in each of Grades IV, V, VI, and VII. In one class the homonyms were presented together; in the other they were presented several days apart. The pupils were first tested with them, the words being presented in sentences. Then the words were taught systematically, the elements of meaning, sound, and form being emphasized. At the end of the instruction the pupils were again tested with all the words, and the improvement was calculated by the average amount of reduction in the error per pupil between the first and last tests. Table LXXII gives the results.

TABLE LXXII. DECREASE IN ERROR FROM PRESENTING HOMONYMS TOGETHER AND SEPARATELY. (After Pearson)

SCHOOL	PRESENTATION TOGETHER	PRESENTATION SEPARATELY
Horace Mann	2.29	1.61
Montclair, New Jersey	2.63	2.24

By eliminating the results of pupils who made perfect scores in the preliminary tests Finkenbinder finds that Pearson's pupils made more gains in percentage of words correct by the separate method than by the together method; consequently he interprets the results as favoring the superiority of the separate method. This conclusion is further confirmed by his own experiment. He mixed forty-eight homonyms with ninety-six other words and then formed them into groups of eighteen words each. Three classes of fourth-grade pupils

were tested with these by writing them in sentences. One group a day was given until all were used. Then the homonyms were divided into two lists, A and B. In one of the lists the pairs of homonyms were presented on the same day; in the other they were presented several days apart. The arrangements were such that while one list was being studied by the separate method in one school, it was at the same time being studied by the together method in another school, and that all pupils studied by both methods. By this procedure any advantage for one method could not be interpreted as due either to the unequal difficulty of the words or to the unequal abilities of the pupils. The effect of each method of instruction was measured by the percentage of words spelled correctly in tests given both at the close of the experiment and at the end of one month. Table LXXIII gives Finkenbinder's results.

TABLE LXXIII. RETENTION FROM PRESENTING HOMONYMS TOGETHER AND SEPARATELY. (After Finkenbinder)

	PRESENTATION SEPARATELY	PRESENTATION TOGETHER
Immediate retention	72.7	73.4
Retained after one month, only one word of a pair requiring study	41.4	40.9
Both words of a pair requiring study	55.7	38.0

For immediate retention both methods are practically equal, but for permanent retention the separate method is much the better when both words of a pair require study. The explanation for such results is probably that when the two words of a pair are presented together their differences are enhanced by contrast, and this leads to superior immediate retention by the together method; but with the lapse of time these differences fade and become confused, producing many errors in the memory test. The separate method lacks the advantage

of increased vividness by contrast, but there is no source of confusion, and retention of the spelling is favored by the association with the sense in which the word is used.

Should Words Similar in Spelling be presented Together?

Grouping words similar in spelling is an advantage in learning them. Wagner made an experiment on this matter. He divided a sixth-grade class into two sections. One section was taught words grouped according to similarity in spelling, such as *lineal, linear, lineage,* and *lineament.* The other section was taught in the usual way. The first section raised its average percentage from 68.36 to 97.14, or an increase of 28.78; the second section during the same time raised its average from 73.25 to 93.6, or an increase of 20.35. The first section thus gained 8.43 more than the second, showing an advantage in favor of grouping words similar in spelling.

Value of Attention to Order of Letters

Calling specific attention to the order of the letters is an advantage in learning spelling. This was shown by Pryor in an experiment with two fifth-grade classes, A and B. Class A was taught in the usual manner; class B was taught to notice very carefully the order of the letters in the different words. The words were pronounced clearly, were written on the board in syllables, and were spelled while they were being written. The following points were also emphasized:

1. Silent letters, double letters, and vowels having the same sound, as in *or* and *er.*
2. Common parts in different words.
3. Difficult combinations of letters.
4. Differences in the pronunciation of such prefixes as *il, el, al, ol, em, am, en,* and *in.*
5. Trying to recall how words were spelled after they were erased.

The teacher was cautioned against mispronouncing, against using rules, against mentioning possible mistakes, against running overtime, and against making home assignments. Table LXXIV gives Pryor's results.

TABLE LXXIV. EMPHASIZING ORDER OF LETTERS. (After Pryor)

CLASS	METHOD	FIRST TEST	FINAL TEST	GAIN
A.	Traditional	50.55	83.39	32.84
B.	Emphasis on order	48.58	89.14	40.56

The gain is thus clearly in favor of the class which was taught by emphasizing the order of the letters.

Summary and Interpretation of Law of Repetition

Summarizing these experiments we can say that the following devices for learning spelling have received experimental justification:

1. Get the presentation of the words through as many sensory modes as possible. See them, hear them, pronounce them, and write them.
2. Give special attention to the difficult letters in a word.
3. Study the words singly or in columns rather than in sentences.
4. Present long words in syllables.
5. Study homonyms separately.
6. Study words similar in spelling in groups.
7. Give special attention to the order of the letters.
8. Use oral study rather than silent study.
9. Use any of these with repetition until the habit is perfected.

The favorable effect of all these is apparently due to two elements in habit formation: the intensity of the impression and its frequency. Any device which increases these is helpful.

The Law of Association

The Value of Rules

In the learning of reading and of arithmetic we found that the law of association — the development of meaning — was of fundamental importance; but our study of errors in spelling led us to believe that in spelling the use of reasoning and association has an unfavorable effect: it leads to error. It may have favorable effects, however, when it is used in learning spelling by the application of rules or by the development of the meaning of the words. But the experiments which have been made so far indicate that this is not the case. The value of rules was investigated by Turner and by Cook and O'Shea, and the value of the development of meaning was investigated by Hollingworth. Turner studied the value of rules as against drill with two groups of sixteen pupils each. The groups were given three twenty-five-minute exercises. Group 1 received drill only; Group 2 was taught rules and given a minimum amount of drill. Four tests were given to both groups after the practice periods: Test 1, immediately after; Test 2, the same as Test 1, five days later; Test 3, new words similar to those in Test 1; Test 4, the same as Test 3, five days later. Table LXXV gives the results.

Table LXXV. Percentages of Accuracy from Studying Spelling by Drill and by Rules. (After Turner)

	Test 1, Old Words	Test 2, Same as 1, Five Days Later	Test 3, New Words	Test 4, Same as 3, Five Days Later	Average of Four Tests
Group 1 (drill)	99.37	99	61.56	76	83.98
Group 2 (rules)	96	93.75	67.50	74	82.81

Here it appears that the words studied by the drill method were better learned and remembered than those studied by

rules. With new words the rule group does better in the first test, but worse in the second. No advantage appears from the study of rules.

Cook and O'Shea tested the value of learning rules in spelling by giving a test of fifty words in November to a group of university students who the previous February had completed a course in subfreshman English. In this course special emphasis was placed on rules. Practically the same test was given to thirty-nine seniors and thirty freshmen in high school who six weeks before had finished a series of exercises in which spelling was taught by rules. After the test they were requested to write all the rules they consciously used in spelling and to indicate the words to which they applied them, and also to write all the rules they saw exemplified in the test but did not consciously use.

TABLE LXXVI. EFFECT OF AWARENESS OF RULES ON ABILITY TO SPELL
(After Cook)

RULE	COMBINATION OF ALL CITING A RULE				UNABLE TO CITE ANY RULE			
	High School		University		High School		University	
	Number of Students	*Average Per Cent*	*Number of Students*	*Average Per Cent*	*Number of Students*	*Average Per Cent*	*Number of Students*	*Average Per Cent*
ie-ei . . .	31	75	30	87	38	73	40	86
Final *e* .	52	80	29	89	17	82	41	88
Final *y* .	29	70	31	94	40	73	39	91
Final *con* .	42	74	34	98	27	75	36	84
Final *ie* .	5	80	18	95	64	61	52	69

Less than half the pupils were unable to cite any rule. In the university group those who gave some use of the rule averaged 6 per cent higher than those unable to give any rule. On the high-shoool group the corresponding percentage was 3. This looks as if there were some benefit to be derived from the study of rules. But if the data are carefully analyzed it will be seen that not a single rule proved to be of value except the one relating to final *ie*.

The objections to rules are that they are difficult to remember, that they have so many exceptions that errors are made by not taking account of them or by applying them wrongly, and that their study is time-consuming. Since the results have doubtful value, the same amount of time is more profitably devoted to drill.

The Value of Teaching Meanings

Hollingworth gives us some results on the value of knowing the meaning of a word. She tried to discover this by making comparisons of (1) the percentage of words misspelled and misused, (2) the percentage correctly spelled and misused, (3) the percentage misused and misspelled, and (4) the percentage correctly used and misspelled. A favorable influence for meaning might be indicated by a larger percentage for (1) than for (2) or by a larger percentage for (3) than for (4). Table LXXVII gives the results.

TABLE LXXVII. RELATION BETWEEN ABILITY TO SPELL AND ABILITY TO USE WORDS. (After Hollingworth)

	Number of Pupils	Percentage Misspelled and Misused	Percentage Correctly Spelled and Misused	Percentage Misused and Misspelled	Percentage Correctly Used and Misspelled
Test 1 (30 words) .	14	55	34	62	41
Test 2 (30 words) .	14	52	29	59	35

It appears that if a word is misused, it is more likely to be misspelled than if it is correctly used; if it is misspelled, it is more likely to be misused than if it is correctly spelled. Correct usage and correct spelling thus have a tendency to go together. It might be concluded from this that it is an advantage in spelling to know the meaning of a word. On the other hand, if a child uses a word correctly the probability is

that he has seen that word a number of times before and has had some training in the spelling of it. Therefore this experiment is inconclusive as to the value of meaning. If the author had taught two new sets of words of equal difficulty — one set with their meanings and the other set without their meanings — and had obtained similar results, a favorable conclusion for the value of meaning could be drawn. On the other hand, we cannot say that teaching the meaning of words is not valuable.

In order to test the value of teaching the meaning of a word more accurately the writer devised an experiment in which the words taught could neither be used nor spelled correctly in advance of study. They were selected by pronouncing new words to pupils, who first wrote them and then used each in a sentence. The papers were then collected and fifty words were selected which were both misused and misspelled by all the pupils. The words were then taught at the rate of five words a day for ten days. On each day except the first the five words taught the day before were relearned. The experiment was made in the schools of Monongahela, Pennsylvania, on forty pupils in Grade VI by Miss Nellie Hanlon and on thirty-six pupils in Grade III by Miss Palmira Zanotti. Each teacher divided her class into two equal groups, experimental and control, by tests selected from the Ayres Spelling Scale, Miss Hanlon using all the words in column U, and Miss Zanotti fifty words from column L. Two methods of teaching were used. For the first repetition in both groups the word was written on the board, pronounced and spelled by the teacher, after which it was pronounced and spelled by the pupils. At this point the pupils in the control group were directed to continue to study the words silently in the same manner. In the experimental group two more repetitions were given which were just like the first except that after each word the teacher added a definition or sentence to give it meaning. Both groups spent the same amount of time in

study. After this the words were erased and given in a dictation test. When all the words were taught they were again given to both groups in a dictation test, which was repeated after six weeks in the sixth-grade class and after four weeks in the fourth-grade class. Table LXXVIII gives the average results for the two final tests.

TABLE LXXVIII. SCORES IN SPELLING WHEN WORDS WERE TAUGHT WITH AND WITHOUT MEANING

GRADES	NUMBER OF PUPILS	CLASS TAUGHT WORDS			
		With Meanings		Without Meanings	
		First Test	*Second Test*	*First Test*	*Second Test*
III A . . .	36	92	88	75	74
VI B . . .	40	88	87	75	72

The differences are so large in favor of teaching the meanings that there can be no doubt of the superiority of this device in teaching spelling. The most probable explanation is that teaching the meanings gives the child associations with which to remember the word and that remembering the word enables the child to remember its spelling. The teacher should therefore feel confident that time spent in explaining and in defining the meanings of words while teaching spelling is not wasted. But such associations and meanings are not the kind that permit reasoning about the letters to be used in spelling.

It thus appears that so far as the law of association pertains to reasoning from similarity or to applying rules, it has little if any value in the learning of spelling. There is so little logic in spelling that the application of it is likely to result in error. It seems practical and economical, therefore, to discourage the use of reasoning and rules in the learning of spelling. On the other hand, it will be economical and profitable to rely on the mechanics of vividness and frequency.

Instincts appealed to in Learning Spelling

The principal instincts appealed to in learning spelling are mastery and rivalry, or the satisfaction of succeeding in the task one sets out to do and of doing it better than the other fellow. The desire for approval and praise may be satisfied by the teacher as a reward for success. The appeals made by learning spelling are probably fewer than in any other school subject. The mental play, the reasoning, and the novelty of arithmetic are missing. The wide appeal to the instincts through the imagination, as in reading, is also not possible. Neither is there an opportunity for the display of skill, dexterity, and beauty as in drawing or handwriting, nor the appeal to heroism and ambition as in history. But in spite of these limitations spelling is not necessarily a dry subject. It has these advantages: the bonds to be formed are definite so that the pupil may always know when he is right or wrong and what should be done to correct his mistakes, improvement is easily measured, and the use of scales makes it possible to find out quickly if the pupil is doing as well as pupils of his age and grade in other schools and cities. If the words are selected from those ordinarily used in correspondence, the pupil has the further satisfaction of knowing that he is learning words which make it possible for him to write satisfactory letters to his friends and to make a good impression in applying for a position. If the test-study method is used, he has the further satisfaction of knowing that he is spending his time only on those words that he does not know. With these satisfiers to work on, it is possible to make spelling an interesting activity. The following are important conditions to keep in mind:

1. The pupil should keep a record of the number of his mistakes per day or lesson.

2. The pupil should compare these mistakes with the number of mistakes ordinarily made by other pupils of his grade.

3. The pupil should be tested frequently with a standardized scale for the purpose of keeping up his ambition to be as good as, or better than, others in his grade.

4. The test-study method should be used.

5. Only words ordinarily used in correspondence should be used.

Individual Differences

Differences in Pupils of the Same Grade

We have seen that the ability to spell increases with age and grade, and that it varies somewhat according to sex and to the language spoken in the home. These differences, however, are small and unimportant in comparison with individual differences among those of the same grade or age. Table LXXIX shows in relation to grade the variation in score in twenty-five words from the Ayres Scale, made by the school children of Pittsburgh, Pennsylvania. The scores vary all the way from 0 to 16 in II A, and from 9 to 25 in VIII A. Each grade has a number of pupils whose scores fall below or above the average scale of each other grade. This variation is shown more clearly in Fig. 17 (p. 256), which shows the number of pupils from the second half of each of the grades, except the first, making each score from 0 to 25.

Differences between Schools

Not only are the differences between individuals of the same grade very wide, but the differences between the average scores of the same grade in different schools are almost equally as wide. This is shown in Fig. 18 (p. 257), which has the average scores of the upper fourth grades in one hundred and twenty-four schools of Pittsburgh, Pennsylvania. The extremes are 3.0 for School 98 and 14.0 for School 30.

TABLE LXXIX. DISTRIBUTION OF PUPILS IN PITTSBURGH PUBLIC SCHOOLS IN ABILITY IN SPELLING. (After Guy)

SCORE	GRADES						
	II A	III A	IV A	V A	VI A	VII A	VIII A
0	22	1	3	1			
1	55	5	4				
2	75	8	6	3			
3	119	23	7	5	1		
4	132	45	26	9	1		
5	117	82	34	17	4	1	
6	122	125	68	36	5		
7	91	146	76	49	8	1	
8	82	145	100	84	20	2	
9	29	126	109	110	26	6	1
10	37	86	124	115	28	11	4
11	19	79	140	152	68	25	13
12	10	38	104	147	76	38	19
13	3	32	105	154	130	59	30
14	2	18	77	112	133	92	53
15		8	32	59	137	102	87
16	1	5	20	35	137	146	102
17		3	12	20	119	133	126
18		2	2	7	90	123	158
19		1	1	6	47	114	142
20		1	1	1	26	70	122
21				1	20	49	80
22					10	11	75
23					4	11	39
24					2	8	12
25					1		4
Total	916	979	1051	1123	1093	1002	1067
Medians	6.11	8.38	10.75	11.87	15.54	17.32	18.62
Range of middle 50 per cent	4.15	3.68	4.49	4.05	4.12	3.85	3.94

Differences between Pupils of the Same Age

The differences between those of the same age are shown in Table LXXX, on page 258, where the number of individuals making each score from 0 to 25 is shown for the eight-year-olds, ten-year-olds, twelve-year-olds, and

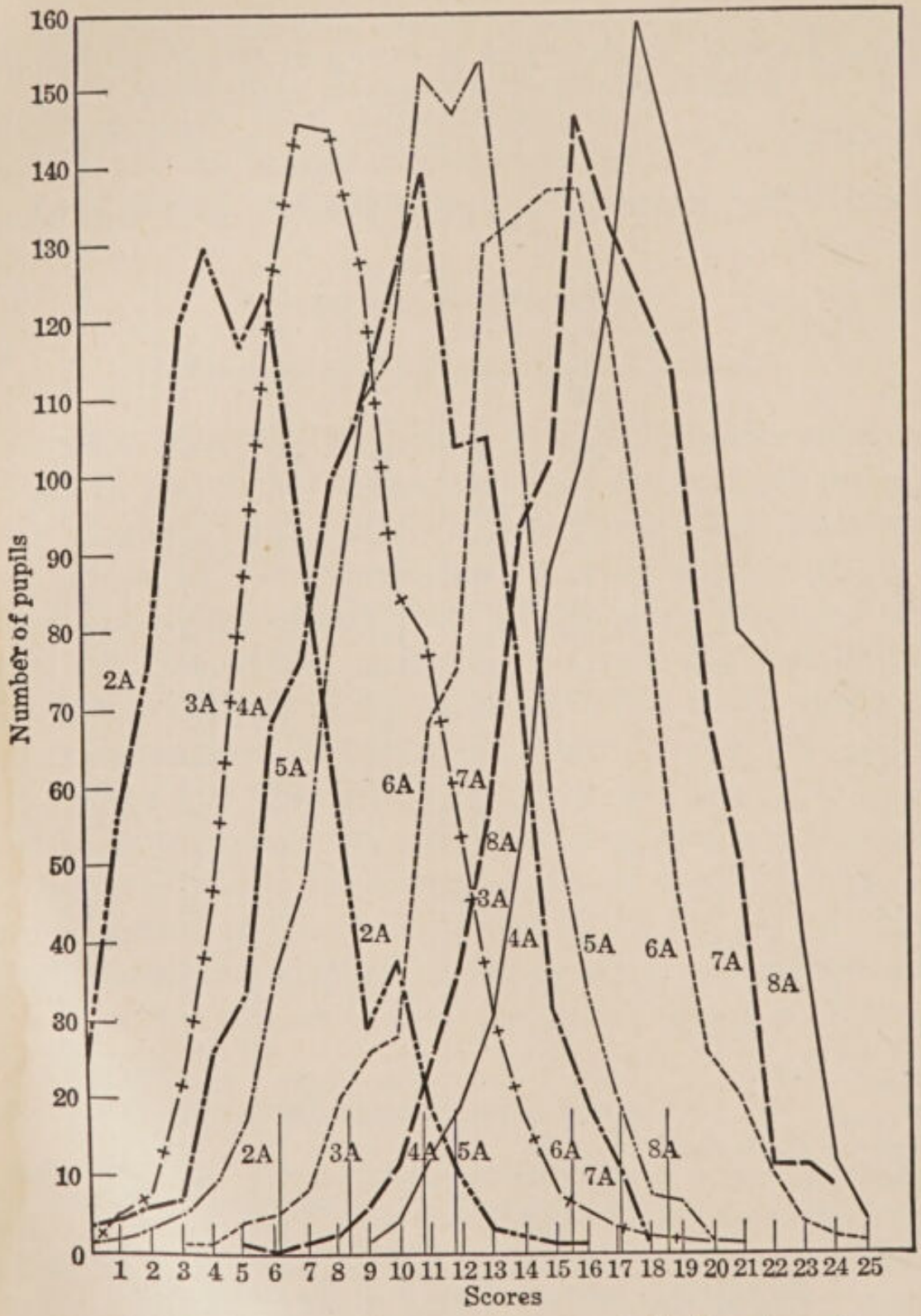


FIG. 17. Distribution of pupils from the upper half of each grade except the first, Pittsburgh public schools, in ability to spell, tested by twenty-five words from the Ayres Scale. Verticals marked 2A, 3A, etc. show medians for corresponding grades. From the data in Table LXXIX. (After Guy)

fourteen-year-olds. The medians for the eight-year-olds and fourteen-year-olds differ by 7.24 words, but the differences between those of the same age vary from 20 to 25 words. Fig. 19 (p. 259) shows the number of pupils making each score for the ages of eight, ten, twelve, and fourteen.

The average scores for the children of each age increase with age; but when we compute the average scores for the

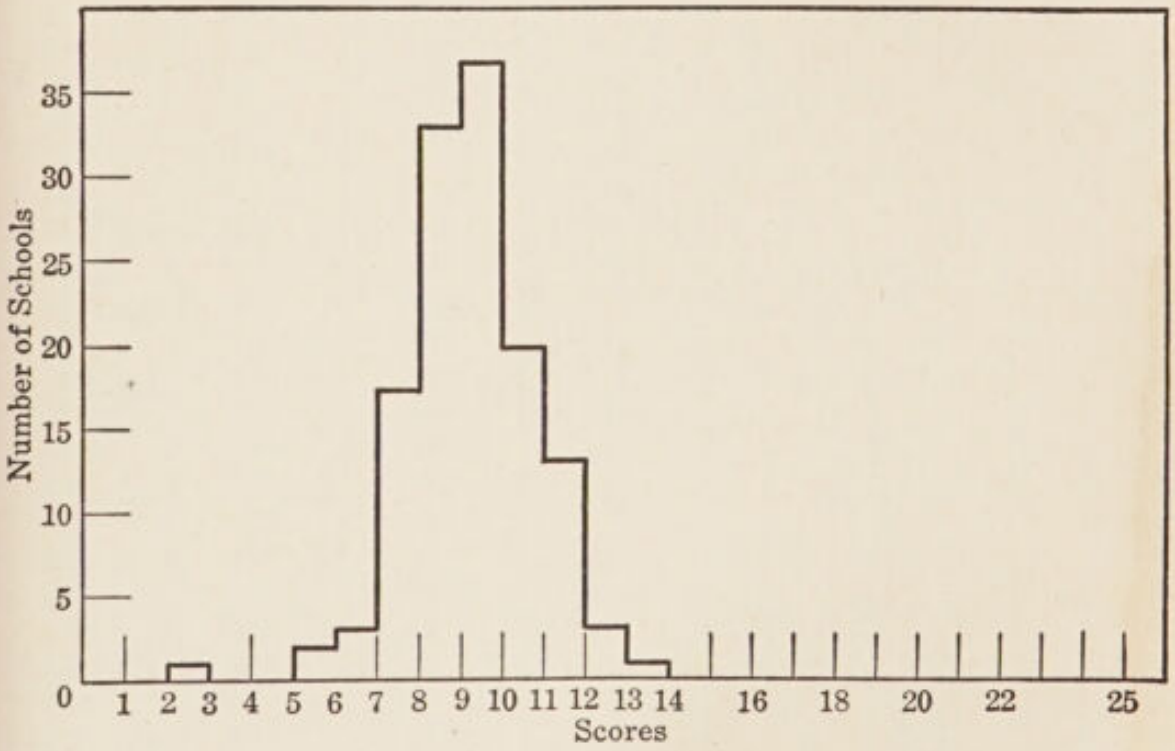


FIG. 18. Showing distribution of the average scores made by the upper fourth-grade pupils in one hundred and twenty-four schools

From Guy's Spelling Survey, Pittsburgh public schools

children of each age within the same grade, they decrease with age. This may be seen from Table LXXXI, on page 258, which shows the age score for six hundred and twenty-five pupils belonging to Grade VII A.

This is no doubt to be attributed to the fact that the young children have higher I. Q.'s and probably also higher mental ages than the older ones.

The result of such wide differences between those of the same age or grade is that the abilities of the pupils of the

TABLE LXXX. DISTRIBUTION OF GRADE PUPILS IN PITTSBURGH SCHOOLS IN ABILITY IN SPELLING FOR THE AGES OF EIGHT, TEN, TWELVE, AND FOURTEEN. (After Guy)

SCORE	AGE			
	Eight	Ten	Twelve	Fourteen
0	43	19	12	5
1	118	55	15	7
2	173	84	36	7
3	242	111	31	5
4	313	189	71	19
5	464	264	75	37
6	582	416	128	50
7	608	464	190	73
8	625	516	245	91
9	552	543	303	120
10	437	624	304	133
11	304	640	406	179
12	246	605	446	230
13	174	566	508	304
14	103	512	575	405
15	54	366	541	391
16	28	268	582	436
17	9	149	525	444
18	6	131	370	492
19	2	63	338	415
20	1	42	213	337
21		22	134	214
22		5	77	159
23		1	18	56
24			12	16
25			5	3
Totals	5084	6655	6160	4628
Medians	7.99	11.07	15.43	16.59
Range of middle 50 per cent	4.39	5.70	5.97	5.44

This table should be read as follows: A score of 0 was received by 43 pupils aged eight, 19 pupils aged ten, etc.

TABLE LXXXI. SPELLING SCORES ACCORDING TO AGE WITHIN THE SAME GRADE. (After Nifenecker)

	AGES						
	10	11	12	13	14	15	16
Number of pupils	5	60	199	176	134	43	8
Score	89.6	87.3	81.3	79.7	74.3	71.3	54.5

different grades overlap. This may be seen by the amount of surface in common for the grades and ages represented in Figs. 17 and 19. It may also be seen from Table LXXXII,

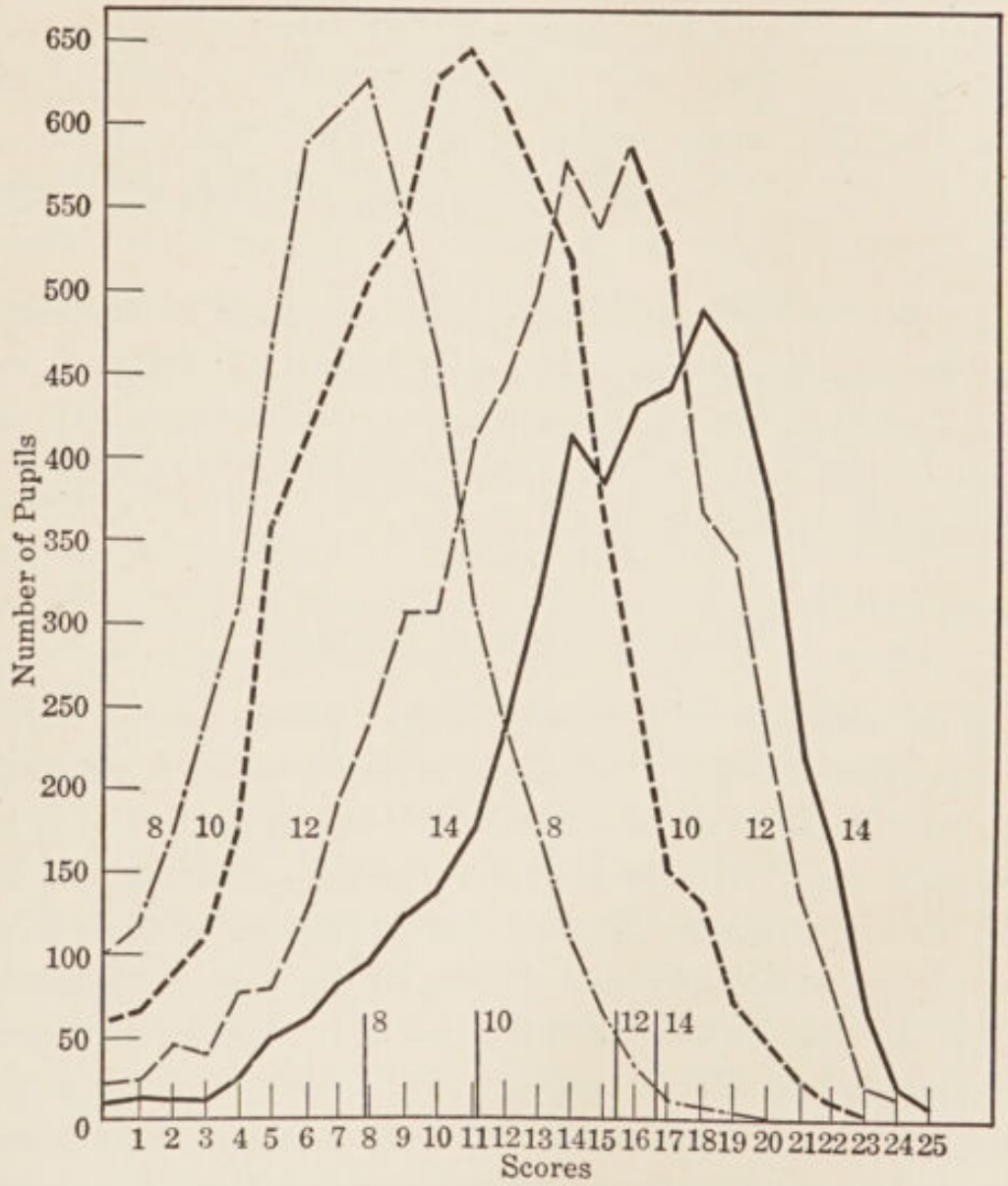


FIG. 19. Showing distribution of the pupils of the Pittsburgh public schools in spelling ability for the ages 8, 10, 12, and 14.

From the data of Table LXXX. (After Guy)

on page 260, which shows the number and percentage of pupils in Grade VI B who exceeded the average for each grade or fell below it.

What is true of pupils in Grade VI B is equally true of those in every other grade. As a general proposition it may be

TABLE LXXXII. NUMBER AND PERCENTAGE OF 751 PUPILS IN GRADE VI B WHOSE SCORES FELL BELOW OR EXCEEDED EACH GRADE. (After Nifenecker)

	GRADES							
	V A	V B	VI A	VI B	VII A	VII B	VIII A	VIII B
Average	43.1	54.3	65.2	74.6	79.0	83.2	88.1	91.3
Number	− 70	− 130	− 218	+ 442	+ 391	+ 33.9	+ 216	+ 216
Per Cent	− 9.3	− 17.3	− 29.0	+ 58.9	+ 52.1	+ 45.1	+ 28.8	+ 28.8

stated that the abilities of all grades are usually represented in one grade. This shows us again how inadvisable it is for the teacher to follow the prescribed course of study and teach the words which the spelling book contains for Grade VI to all the pupils in that grade.

THE TEST-STUDY METHOD

The adjustment of the instruction in spelling to the individual differences of the pupils is much easier than in most other school subjects. By means of a spelling test it is comparatively easy to classify the pupils according to their ability in this subject. Having done this, the teacher can use the so-called test-study method to advantage. The essential features of this method are as follows: the teacher selects from a graded spelling book the words suitable for a group of pupils; she pronounces these slowly and distinctly, the pupils following in concert with their books open; the books are now closed, and the teacher pronounces the same words again, the pupils writing them on paper; the papers are now exchanged, and the misspelled words are marked either by reference to the book or to the teacher's spelling; the papers are returned to their owners, who write the correct form of each misspelled word; the learning of these misspelled words constitutes the pupil's work for the next lesson. For the third lesson he is again tested, and the misspelled words are determined as in

the first lesson. The fourth lesson is again a study of the misspelled words as was the second. This procedure is kept up until all the words are mastered. Every test lesson should contain both review words and new words so that the correct spelling becomes permanently fixed. The advantage of this method is that a pupil spends his time only on those words that he does not know. If he knows them all, he may be excused from study until the next test.

What Spelling Habits should be Formed?

Studies of Words used in Correspondence

Fortunately we can answer this question more accurately for spelling than for any other school subject. The only occasion where spelling is needed is in written composition. Then all that is necessary for finding the words whose spelling should be learned is to make an inventory or count of the words that are used in written composition. Since the written composition of all but a small percentage is in correspondence, this problem becomes one of making a count of the words used in correspondence. Such counts have been made by Anderson, Ayres, Chancellor, and by Cook and O'Shea. Anderson tabulated 361,184 running words from 3723 letters written by Iowa people and found a total of 9223 different words. These letters were collected by school children from adults living in twenty-two different cities and representing thirty-five different occupations and callings throughout the state. These callings were classified into six groups: professional, business, domestic, miscellaneous, personal, and farmers. From the 9923 different words a final list of 3087 was selected. Only those words were included in the final list which had a total frequency of five or more in three of the occupational groups given above.

Ayres tabulated the first word of each line of several hundred letters, obtaining in all 23,629 words, including

repetitions. He found that 542 with their repetitions made up seven eighths of the total number of running words used, and that 23,087 with their repetitions made up the other eighth.

Cook and O'Shea counted the words used in the family correspondence of thirteen persons. They tabulated 200,000 running words and found 5200 different words.

Chancellor tabulated the words of his personal correspondence and found a total of 1020 words. W. Franklin Jones counted 15,000,000 running words from a total of 75,000 themes written by school children from all the grades above the first. He found a total of 4532 words. The total and average number of words per grade is shown in Table LXXXIII.

TABLE LXXXIII. TOTAL AND AVERAGE VOCABULARIES IN RELATION TO GRADE. (After Jones)

	GRADE II	GRADE III	GRADE IV	GRADE V	GRADE VI	GRADE VII	GRADE VIII
Total vocabulary	1927	2396	2838	3270	3695	4114	4532
Average vocabulary	521	908	1235	1489	1710	1926	2135

Studies of Words used in Reading

Counts of the words found in reading materials were made by Eldridge, Starch, and Thorndike. Eldridge tabulated 43,989 words from four different newspapers and found 6002 different words. Starch tabulated some 40,000 running words (about a thousand from each of forty authors) and found a total of 15,903 different words. To show how few are the words that are used very often, Table LXXXIV gives the distribution of the words in the Starch list according to their frequency.

Thorndike made by far the most complete count of words found in reading materials. He published his results in "The Teacher's Word Book," which, he says, "is an alphabetical

TABLE LXXXIV. NUMBER OF WORDS IN RELATION TO FREQUENCY OF USE. (After Starch)

3111	words occurred each once
1009	words occurred each twice
512	words occurred each three times
280	words occurred each four times
189	words occurred each five times
121	words occurred each six times
97	words occurred each seven times
82	words occurred each eight times
53	words occurred each nine times
225	words occurred each from ten to nineteen times
224	words occurred each twenty or more times

list of the 10,000 words which are found to occur most widely in a count of about 625,000 words from literature for children; about 3,000,000 words from the Bible and English classics; about 3,000,000 words from elementary-school textbooks; about 50,000 words from books about cooking, sewing, farming, the trades, and the like; about 90,000 words from the daily newspapers; and about 500,000 words from correspondence. Forty-one different sources were used."

In addition to these results a number of cities — Boston, Chicago, Santa Cruz, and others — have made up spelling lists which contain words of both general and local importance.

The Use of these Lists in Spelling Books

These lists show us the words that are used in both reading and writing. All will agree that it is not necessary to learn to spell words which are never used either in reading or in writing, and probably most persons would agree that only those which are ordinarily used in writing should be learned. A spelling book should probably not be based exclusively on one list, such as was made up out of themes written by children, personal correspondence, newspaper articles, magazine articles, or books. The minimum list should contain words from all these fields, the number taken from each field depending on

its importance. Pryor made up such a list from twelve special lists. His basis of selection was that each word should occur in at least six of the lists. He found 1309 such words. He does not mean that this list should replace the spelling book, but that every spelling book should contain all these words.

Starch selected a minimum spelling list according to the following plan:

> Every word occurring three or more times in the Starch List, every word occurring three or more times in the Eldridge List, every word occurring seven or more times in the Cook List, and every word in the Ayres 1000-word list was selected if it also occurred in one other list including the Jones List. A word occurring three or more times in the Starch List or in the Eldridge List, or seven or more times in the Cook List, or any word occurring in the Ayres List was not included if it occurred only in one list. This safeguarded against the inclusion of words confined to one type of vocabulary only.

This mode of selection yielded a total of 2626 words, which is above the average eighth-grader's vocabulary.

Horn and Ashbaugh selected a list for their spelling book from a compilation of nine scientific studies which had been made of the words used in correspondence. These lists contained a total of over 700,000 running words. From them 3998 different words were selected which were most frequently used. There are many advantages in using such a derived list. One advantage is that it saves much time. Most spellers contain from five to ten thousand words, the majority of which never need to be spelled after graduation from school. By learning only those that are ordinarily used in correspondence the time devoted to spelling can be reduced over one half. Another important advantage is that the useful words can be thoroughly learned, so that something approaching an accuracy of 100 per cent can be expected from eighth-grade graduates.

Grading the Words

Having selected the important words to be spelled, the next problem is to grade them. This might be done according to four principles:

1. The frequency of the word, putting the most frequent in the lower grades and the least frequent in the upper grades.

2. The grade in which a word is first used either in reading or in writing.

3. The grade where it ought to be taught according to the judgments of competent teachers.

4. The difficulty of the word determined statistically by the percentage of pupils missing it.

Starch first arranged his words according to their order of frequency and then placed those which appeared in the Jones list in the grade in which that list showed them to be first used in writing themes. Those which did not appear in the Jones list were placed in the grade which calculations showed to be the average grade assigned by experienced teachers. Horn and Ashbaugh first arranged their words in the order of increasing difficulty. This was determined as follows: The word lists were sent out to nearly all the towns in Iowa with populations of over one thousand. The teachers in these towns tested their pupils with the lists according to specified directions and marked the words missed. The papers were then assembled in one central office, and the percentage of children missing each word was calculated. The word having the fewest misses was then rated the easiest, the word having the next fewest misses was rated the second in difficulty, and so on for all the words. In the first three grades the words were placed according to two considerations: their easiness and the grade in which they most frequently made their first appearance in readers. In the upper five grades they were placed principally according to their difficulty. These two

examples show how a speller is scientifically made. The majority of new spellers now being published claim to be based on such principles. But the teacher selecting a text should justify the claim. She should ask at least two questions of every book: first, Are the words selected from those lists which scientific studies have shown to be used in writing? Secondly, Have they been graded according to scientific methods? Woody, who made an analytical study of five widely used spellers, found that the percentage of words which they have in common with the Anderson List varies from 22.7 to 41.8. He points out that this means that from 58 to 77 per cent of the time devoted to spelling in the public schools is spent on words not commonly used, and that this is one cause of children's inability to spell the words which the world expects them to spell.

Summary

Spelling is learned for its value in written communication and in keeping records. Ability in it increases with the age, grade, and intelligence of the child. It is somewhat greater in girls than in boys and greater in English-speaking pupils than in foreign-speaking pupils. The principal cause of errors in spelling is inaccurate perception, either auditory or visual. Confirmatory evidence of this is found in the high correlations of the ability to spell with the ability to discriminate small differences, to pronounce, to read orally, and to read silently. According to statistical investigations ability in spelling is little influenced by the length of the class period, but in spite of this we have abundant evidence that repetition is the fundamental law by which spelling is learned. There is experimental evidence for using the following devices:

1. Get the presentation of the words through as many sensory modes as possible. See, hear, pronounce, and write them.

2. Give special attention to the difficult letters in a word.

3. Study the words singly or in columns rather than in sentences.

4. Present long words in syllables.

5. Study homonyms separately.

6. Study words of similar spelling in groups.

7. Give special attention to the order of the letters.

8. Use oral study rather than silent.

9. Use any of these methods with repetition until the habit is formed.

The law of association has comparatively small value in learning to spell, a fact that is shown by the ineffectiveness of the time spent on the study of rules in comparison with the time spent on drill; but it is helpful in explaining the meanings of words given in spelling lessons. Such explanations increase their retention.

Interest in learning to spell is due chiefly to the ease of identifying the correct bonds and of perceiving improvement. The motive of rivalry also contributes to interest.

Extremely wide individual differences and correspondingly great overlappings exist in spelling. Fortunately it is easy to make adjustments for these differences. The test-study method selects only words which the pupil does not know. Its economy consists in its usefulness as a method of selection rather than as a method of study.

The question What habits shall be formed? can be answered more accurately for spelling than for any other school subject. Spelling is used principally in written correspondence. Many investigations have been made to find the words used most frequently for this purpose. They showed the happy result that less than three thousand words occur with sufficient frequency to warrant pupils' learning to spell them. This number is small enough to make possible an accuracy of approximately 100 per cent.

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CHAPTER XV

LANGUAGE: AIMS AND ABILITIES

Aims

Command of the art of communication in speech and in writing is the aim of language instruction. This is relating the aim of the study of language directly to the function of language; namely, communication. If we keep this in view we can save ourselves much waste of time in trying to accomplish objects that relate only indirectly to the primary purpose of language, such as the formation of character, training for citizenship, development of the capacity for enjoyment, and the development of skill useful in acquiring health and civic efficiency. Each of these ideals has been set forth by serious teachers of English as the primary aim of instruction in English. Yet many believe that character-building is a part of the work of all teachers regardless of the subject taught, and that it is not a responsibility peculiar to teachers of English. To put this responsibility on them alone would put too heavy a burden on them, would give too wide a range to their activities, would make it too difficult to define their materials of instruction, and would make it next to impossible to measure the outcome of their instruction.

What Language Abilities are and their Relation to Age and Grade

The study of language covers many activities: reading, spelling, handwriting, grammar, speech, written composition, and literature. For the purposes of this chapter we shall re-

strict the term "language" to grammar, speech, and written composition. Even this restriction does not make our task a simple one, for the mastery of these subjects requires the learning of scores of habits, such as applying dozens of rules and definitions and picking out parts of speech; parsing; diagramming; acquiring habits of punctuation; acquiring habits of capitalization; acquiring habits of correct form in verbs, nouns, and pronouns; acquiring habits of using particular words correctly; acquiring a vocabulary; and many other particular skills which we shall have occasion to mention later.

The scales which have so far been developed for measuring these activities show a steady increase in relation to age and grade. Of these scales the following are well known:

Charters's Diagnostic Language and Grammar Test: Pronouns
Charters's Diagnostic Language and Grammar Test: Verbs
Charters's Diagnostic Language and Grammar Test: Miscellaneous
Charters's Diagnostic Language Test: Pronouns
Charters's Diagnostic Language Test: Verbs
Charters's Diagnostic Language Test: Miscellaneous
Holley's Sentence Vocabulary
Hillegas's Composition Scale
Hudelson's Composition Scale
Kirby's Grammatical Test Scale
Nassau County Supplement to Hillegas's Scale
Pressey's Test in Diagnostic Composition
Starch's Grammatical Scale A
Starch's Punctuation Scale
Terman's Vocabulary Test
Thorndike's Visual Vocabulary Scale
Thorndike's Extension of the Hillegas Scale
Trabue's Completion Language Scale
Wilson's Language Error Test

A study of the contents of some of these scales, together with the median scores for age or grade, will give us a good picture of the growth of language abilities. The Charters Scale tests the pupil's ability to use pronouns and verbs correctly and also to state the rules of grammar which the errors in the sentences used in the scale violate. Each scale consists of forty sentences to be corrected. In the pronoun scale such sentences as the following are used: "May Inez and me go?" "Who do you want?" "Brother John and myself went home." In the verb scale such sentences as the following are used: "They set there yesterday." "Lay down, Tige." "Neither of them are right." Two scores are given: one for language and one for grammar. The language score is the number of sentences corrected. The grammar score is the number of sentences for which the rule of grammar is correctly named. Table LXXXV gives the results. The results for Grades III–VI inclusive are the midyear standards; those for Grades VII–XII inclusive are the end-of-the-year standards.

TABLE LXXXV. STANDARD SCORES FOR CHARTERS'S LANGUAGE AND GRAMMAR SCALES

TEST	GRADES									
	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Pronouns										
Language	13.6	15.1	18.5	21.4	32.6	39.8	31.2	33.1	34.7	37.4
Grammar					15.5	22.3	14.5	13.0	19.8	23.0
Verbs										
Language	12.6	17.7	22.4	24.3	33.1	35.0	35.2	33.9	37.6	37.2
Grammar					25.1	26.1	23.8	25.1	31.7	30.0

The growth of the ability to write compositions is indicated by the scores of Table LXXXVI, on page 276. What these scores mean may be gathered from the samples which appear on pages 276 and 277, taken from Hudelson's Typical Composition Ability Scale.

TABLE LXXXVI. STANDARD SCORES FOR THE HILLEGAS, THORNDIKE, NASSAU, AND HUDELSON COMPOSITION SCALES

	Grades								
	IV	V	VI	VII	VIII	IX	X	XI	XII
Score	3.0	3.6	4.2	4.7	5.3	5.5	5.9	6.3	6.7

SAMPLE NO. 5: A SNOWBALL FIGHT ON SLATTER'S HILL
(Quality 3.0)

Slatter's hill is sometimes called no mansland is the northern part of the city. It covers about an acre land. One day their was a snowballing their. All the boys in the city made them a fort and three hundred snowballs ready for the enemy. The enemy was not long in approaching. The one at the head of the enemies army threw the first snow and hit the other sides captain. The boys in the city won and as the enemie went back they were whistling Yankee Dootle.

SAMPLE NO. 9: A SNOWBALL FIGHT ON SLATTER'S HILL
(Quality 5.0)

It was on Slatter's Hill that the Battle took place.

Slatter's Hill is the boundary line between the North End and the South End.

We took possession of the hill one afternoon and made us a fort of snow. Under the command of Colone J. Harris we made plenty of ammunition. Some three hundred snowballs.

The South End was enraged when the saw what had happened and the silk handkerchief that floated on the flagstaff waved defiance to the enemy. The resolved to attack the fort that afternoon and under the brave and daring command of Mat Ames they climbed the height. They were slowly advancing toward our strong hold while we lay in wait.

Each man was well supplied and the orders were not to be sparing with the ammunition. As Ames led his men nearer and within range of the fort. Our noble commander jumped upon the breast works and took daedly aim at the advancing officer of the enemy.

The aim was fatal for the spinning snowball hit its aim and the enemys leader went rolling down the hill.

This confused the enemy and our captain took advantage of the situation and ordered rapid firing on them. This being done the enemy was soon put to flight except a few who were climbing the breast works. And they were captured.

SAMPLE NO. 15: A SNOWBALL FIGHT ON SLATTER'S HILL[1]
(Quality 7)

Slatter's Hill, or No-Man's-Land as it was sometimes called, stands in the center of town. One morning after a heavy snow the Northenders, led by Jack Harris, took possession of the hill and erected a snow-fort upon it. The news spread, and the Southenders, under the command of Mat Ames, accepted the challenge and prepared to storm the fort.

At two that afternoon the Southenders began to ascend the hill in battle formation. General Harris opened fire by hitting General Ames in the stomach with one of the three hundred snowballs prepared for the engagement. Then the struggle waged fiercely. Twice we were nearly dislodged from our stronghold, only the gallantry of our General and his staff saving us. Twelve of the enemy assaulted our very walls, but five of them were seized and made prisoners, while the rest fled. At sunset the fort was still unconquered and the thinned ranks of the enemy finally retreated.

Above the confusion I heard our General say, "My coldiers, I'm proud of you," and my heart swelled with pride.

Starch's Grammatical Scales consist of groups of sentences which contain correct and incorrect forms. The pupil is asked to cross out the incorrect forms. The groups increase in difficulty from the easiest, which is called Step I, to the most difficult, which is called Step 16. The score is the highest step which a pupil can do. The character of these steps may be judged from the following samples:

[1] This Sample and Samples No. 5 and No. 9 on pages 276–277 are used by permission of the Public School Publishing Company, publishers.

STEP 7

1. A fireman seldom rises above (an engineer; the position of an engineer).
2. The difference between summer and winter (is that; is) summer is warm and winter is cold.
3. He is happier than (me; I).
4. They are (allowed; not allowed) to go away on Saturdays.

STEP 9

1. It tastes (good; well).
2. Send (whoever; whomever) will do the work.
3. (Who; Whom) do you mean?
4. You (will; shall) not stir; I forbid it.

The following are the grade scores given by the author:

TABLE LXXXVII. GRADE NORMS FOR STARCH'S GRAMMATICAL SCALE A

	GRADES						COLLEGE
	VII	VIII	IX	X	XI	XII	
Score	8.0	8.3	8.6	8.9	9.2	9.5	10.3

Starch's Punctuation Scale A is made on the same plan as his grammatical scales. Steps 7 and 9 are reproduced below:

STEP 7

1. I told him but he would not listen.
2. Concerning the election there is but one fact of much importance.
3. The guests having departed we closed the door.
4. The train moved swiftly but Turner arrived too late.

STEP 9

1. He was satisfied, I suppose, with his situation.
2. A faithful sincere friend is prized highly.
3. The present situation however is very different.
4. Our national capitol situated at Washington is a magnificent building.

The grade scores for this are the same as for the grammatical scale.

The Wilson Language Error Test consists of three stories, each containing twenty-eight common errors. The child scores one point for each error corrected. Tables LXXXVIII and LXXXIX show the scores in relation to age and grade.

TABLE LXXXVIII. GRADE NORMS FOR THE WILSON-LANGUAGE ERROR TEST

	Grades									
	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Score	7	11	14	17	20	22	23	24	25	26

TABLE LXXXIX. AGE NORMS FOR THE WILSON-LANGUAGE ERROR TEST

	Age													
	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Score	10	12	14	16	18	20	22	23	24	25	25	25	25	25

The meaning of these scores may be taken from Story A of the scale, of which the first paragraph is reproduced here.

STORY A—SATURDAY MORNING

Saturday morning is a busy time to are house. A feller has a good chance to work. Me and Dorothy divide the tasks between us. Then we race to see who will finish first. Last Saturday I taken the breakfast dishes as one of my tasks. I am especial fond of washing dishes. You should have saw me work. I wanted to get through so as I could play.

The Trabue Completion Test Language Scales consist of sentences with certain words omitted. They increase in difficulty from very easy to very difficult. It is not known just

what ability or abilities these scales measure, but the scores made in this test are highly correlated both with intelligence and with ability to make scores in English and composition. Two points are allowed for each word correctly filled in, one point for a partly correct word, and none for a wrong word. Table XC gives the standard scores in relation to grade for Scales B, C, D, and E, each of which consists of ten mutilated sentences.

TABLE XC. GRADE NORMS FOR TRABUE'S LANGUAGE SCALES B, C, D, AND E

	Grades										
	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Score . . .	4.8	8.0	10.0	11.4	12.4	13.4	14.4	15.2	16.0	16.7	17.4

Scale B is reproduced here in part:

1. We like good boys ____ girls.
2. The ____ is barking at the cat.
3. The poor baby ____ as if it were ____ sick.

8. ____ weather usually ____ a good effect ____ one's spirits.

10. To ____ friends is always ____ the ____ it takes.

Terman's Vocabulary Test consists of one hundred words arranged according to difficulty. The increase according to age in the number of these words which the average child can define is shown in Table XCI.

TABLE XCI. AGE NORMS FOR TERMAN'S VOCABULARY TEST

	Age					
	8	10	12	14	16	18
Score	20	30	40	50	65	75

Language Ability in Relation to Intelligence and Training

All these scales agree in showing that whatever the language ability measured, it increases with age and grade. From the teacher's point of view it is important to know how much this increase is due to training and how much to the natural growth of ability. Unfortunately too little work has been done with this problem to enable us to give a definite answer. It seems that the scores made in the language-completion and vocabulary scales depend principally upon intelligence. Trabue found a correlation of 0.83 between his language scale and the Binet mental-age scale, but Valentine found this correlation to be 0.64. Trabue also found that his scale correlates 0.72 with ability in composition as measured by the Hillegas Scale. Van Wagenen and Kelley, however, found that this correlation is only 0.44 when the composition is measured by teachers' marks. Feingold found that the correlation between grades in English and intelligence is measured by Army Alpha to be 0.70, but Rector found it to be only 0.25. The variability in teachers' marks prevents us from attaching as much importance to the correlations between intelligence and ability in English measured by such marks as to those between intelligence and ability in English as measured by a scale. If so, we should judge intelligence to be the most important single factor of ability in English composition. This is especially true in so far as the quality of a composition depends on clearness and coherence. When it comes to such matters as punctuation, capitalization, and correct form of noun, pronoun, or verb, it would seem that native ability is a less important element, and that correct usage in these matters depends principally on training and custom. In any case we shall see later that usage in correct form can be immensely improved by training.

Influence of Sex

The ability to use language is somewhat influenced by sex. The grades in English for girls in high school are higher than those for boys. Usually from 33 to 40 per cent of the boys reach the average for girls. Even on paper, girls are more voluble than boys, use longer sentences, and in the average write a better quality of composition. Burt found that the average length of a composition for twelve-year-old girls is 213.3 words; for boys of the same age it is 192.6. The average length of a sentence for twelve-year-old girls is found to be 18.4 words as against 14.9 for boys. The quality of the composition for twelve-year-old girls is found to be 13.1 as against 12.0 for boys. In this case quality is measured in terms of mental age; that is, 13.1 means the quality of such a composition as is written by the average girl having a mental age of 13.1 years. Twelve-year-old girls are thus a little over a year ahead of boys of the same age in quality of composition. Trabue, in his Completion Language Scale A, found the following scores for boys and girls in relation to grade:

Table XCII. Norms for Trabue's Language Scales in Relation to Grade and Sex

	Grade						
	III	IV	V	VI	VII	VIII	All
Boys	10.5	12.9	16.3	21.6	24.7	21.8	21.9
Girls	9.5	12.6	18.3	23.4	28.3	30.0	22.8

Except in Grades III and IV the girls are slightly superior to the boys in the ability measured by this scale. So far as language ability is measured by composition and completion scales, there is not enough difference between boys and girls to justify separating them for the purpose of teaching language or to justify measuring their work in language by different standards.

SUMMARY

Command of the art of communication in speech and in writing is the aim of language instruction.

In the chapters on language the term "language" is restricted to grammar, speech, and written composition.

Language ability increases with age and grade. This is true of all language abilities that so far have been measured by scales.

Not many correlations have yet been calculated between the various language abilities and intelligence; but those that we have calculated indicate that they are very high, — somewhere between 0.64 and 0.83, — a fact that suggests the necessity of accurately adapting language work to the mental level of the pupils.

Girls write better and longer compositions than do boys and also show a somewhat superior ability in completion scales.

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CHAPTER XVI

LANGUAGE: THE LAW OF REPETITION

The effects of drill on language ability can be better seen if we describe the typical errors in spoken and written English. This is because more studies have been made of errors in language than of errors in any other school subject, and also because such experiments as have been made of the effects of drill relate closely to the correction of these errors. As a matter of fact, the most economical method of training in any school subject is first to find the point of error and then to devise a type of drill that will correct these errors.

Studies of errors in language have been made by Watson, Betz and Marshall, Thompson, Meek, Charters and Miller, Sears and Diebel, Randolph, Courtis, Fillers, Jones, Charters, Treisler, Johnson, and others. In spite of the fact that the studies were made in states as widely separated as Michigan, Louisiana, Missouri, and Pennsylvania, they are much alike, not only in the type of error but also in the misuse of many particular words and phrases. The study made under the direction of Charters at Pittsburgh is typical of all. The essential facts are reproduced in Tables XCIII and XCIV for the purpose of showing the most frequent errors. This study is a classification of 25,676 errors in oral language collected by the teachers of Pittsburgh in November, 1919. The errors were then classified according to the categories used by Charters in similar studies made in Kansas City and Detroit. An interesting fact in this study, as in those made earlier, is that the bulk of the errors fall into a few classes and on a compara-

tively small number of words. Five classes constitute 71 per cent of the errors. These are shown in the following table:

TABLE XCIII. THE PRINCIPAL CLASSES OF ERROR IN SPOKEN ENGLISH

	PER CENT
Wrong verb (*lie* for *lay*, etc.)	18
Syntactical redundance (*this here*, etc.)	16
Confusion of past tense and perfect participle (*seen* for *saw*, etc.)	14
Failure of verb to agree with subject in person and number (*He don't*, etc.)	13
Double negative (*not — no*, etc.)	10
Total of five classes	71

Twenty-three individual errors with a frequency of over two hundred constitute 56 per cent of the total errors. Table XCIV gives these.

TABLE XCIV. NUMBER OF OCCURRENCES OF THE MOST FREQUENT ERRORS AT PITTSBURGH. (After Charters)

was for *were*	1555
seen for *saw*	1513
ain't	1561
can for *may*	1150
done for *did*	895
is for *are*	777
don't for *doesn't*	721
this here	684
John, he went	671
didn't no	531
them things	479
that there	472
ain't got	443
have got	439
ain't got no	435
come for *came*	350
It (was, is, ain't) me	340
why, there was	330
didn't nothing	302
lay for *lie*	280
off for *from*	276
went for *gone*	245
give for *gave*	202

The teacher's task in English is to get rid of such errors as are found above. The frequency of each error tells him how serious it is and how much corrective drill it needs. He can make his efforts count by concentrating on the correction of these particular mistakes. He could do still better if he knew the grade location of these errors and the particular mistakes made by each pupil. He then could devise the special drill needed. If this is not possible, he will not go far wrong if he gives corrective drill for the most frequent errors given in Table XCIV.

Grade Location of Language Errors

An experiment designed to determine in which grades the common language errors are most frequently made was performed by C. A. Brown, principal of the Corkery School, Chicago. He gave to twelve hundred pupils in his school Wilson's Language Error Test, which contains the twenty-nine errors having the highest frequency in five studies of language errors. He then calculated the percentage of pupils in each grade who missed each error. An error was located in that grade in which over 20 per cent of the pupils missed it. On this basis he obtained the grade location of each error as shown in Table XCV. The advantage of such a table is that it tells the teacher what errors are most in need of corrective drill in a particular grade. A table of this sort should be made for each school.

Table XCV. Grade Location of the most Frequent Errors in Spoken English. (After Brown)

PRACTICE FOR THE FIRST, SECOND, AND THIRD GRADES

1. *I seen.*
2. *he done.*
3. *she run.*
4. *he come.*
5. *She give it.*
6. *If I get it.*
7. *ain't.*
8. *me and John.*
9. *My mother she.*

FOURTH GRADE

1. *shouldn't never.*
2. *ain't got none.*
3. *are* for *our.*
4. *hisself.*
5. *theirselves.*
6. *learned* for *taught.*
7. *you was.*
8. *Is there enough pencils?*
9. *can* for *may.*
10. *have got* for *have.*

FIFTH GRADE

1. *there, their.*
2. *can* for *may.*
3. *have got* for *have.*
4. *was there many boys in the yard?*
5. *to, two, too.*
6. *guess* for *think.*
7. *them books.*
8. *my brother he.*
9. *learned* for *taught.*
10. *ask* for *asked.*

SIXTH GRADE

1. *can* for *may.*
2. *if I was you.*
3. *had come.*
4. *had went.*
5. *awful good.*
6. *had saw.*
7. *guess* for *think.*
8. *to, too, two.*
9. *have got.*
10. *lots of fun.*

SEVENTH GRADE

1. *can* for *may.*
2. *their, there.*
3. *if I was you.*
4. *lots of fun.*
5. *to, too, two.*
6. *awful good.*
7. *sack-full, sackful.*
8. *sure, surely.*
9. *pay up, pay.*
10. *have got, have.*

EIGHTH GRADE

1. *guess, think.*
2. *to, too, two.*
3. *lots of fun.*
4. *sure, surely.*
5. *pay up, pay.*
6. *sack full, sackful.*
7. *cup full.*
8. *can, may.*
9. *if I was you.*

Errors in Written Composition

Errors in written composition are very similar to those in oral composition in so far as sentence structure is concerned. Some are more frequent in the written than in the oral, others are less frequent. Those which are more frequent in written composition are wrong form of noun or pronoun, failure of

verb to agree with subject in number and person, confusion of past and present tenses, and misplaced modifier; the less frequent are wrong verb and confusion of past tense and past participle.

In the remainder of Charters's classes of errors pertaining to syntax there are no significant differences between oral and written composition. However, there are many new types of error, and, as we should expect from the law of habit, these make up the majority. They are punctuation, spelling, form of arrangement, capitalization, and the use of the apostrophe. The principal studies of errors in written composition have been made by Professor R. I. Johnson, who made studies of the errors both in compositions and in letter-writing. His study of errors in composition consisted of an analysis of 2160 errors made by 132 high-school freshmen and of 787 errors made by 66 college freshmen. Table XCVI, on pages 290–292, gives his classification as well as the number of errors in each class and in each subclass. An important finding in this study was that from 79 to 26 per cent of errors in the freshman college year persisted from the freshman year of high school.

Johnson's study of the errors made in letter-writing consisted of an analysis of 2745 errors made in 250 social letters and of 3934 errors made in 750 business letters. The social letters were written by women having the standing of college freshmen; the business letters, by high-school seniors who were considering entering college. Table XCVII, on page 293, gives the classification.

The reliability of this classification was tested by putting the errors in five equal divisions and then calculating the rank of the fourteen categories of errors in each division. The rank correlations between each sample and the entire group ranged from .90 to .95, thus justifying the conclusion that the types of error distribute themselves in the same manner in small bodies of written material as in large bodies.

TABLE XCVI. CATEGORIES OF ERROR. (After Johnson)

MADE FROM AN ANALYSIS OF THE ERRORS IN THE COMPOSITION OF 132 HIGH SCHOOL AND 66 COLLEGE FRESHMEN

	NUMBER OF ERRORS IN EACH SUBCLASS	TOTAL ERRORS IN CLASS	RANK
I. Mistakes in the case of pronouns.			
1. Subject or object of verb in wrong case: She saw my brother and I.	4		
2. Predicate nominative in wrong case: I do not know whom he is.	0		
3. Object of preposition in wrong case: They called to my friend and I.	3		
4. Use of objective for possessive with gerund: It was all the result of that cat crossing my path.	4	11	14
II. Other misuses of pronouns.			
5. Disagreement of pronoun and antecedent: A person can find what they look for. . .	15		
6. *You* used indefinitely: When you start to high school you feel important.	80		
7. Miscellaneous misuses of the pronoun: A lady which, etc.	7	102	7
III. Mistakes in the use of verbs.			
8. Disagreement of verb and subject: On the bank was some water lilies. . . .	39		
9. Change of tense in main clause	8		
10. Wrong past tense or past participle: We had drank.	32		
11. Wrong verbs used: I will lay down.	12		
12. Mistakes in mode: He acted as though he was the king's son. .	2	93	8
IV. Mistakes in the use of adjectives and adverbs.			
13. Use of adjectives for adverbs: He spoke respectful.	26		
14. Use of *most* for *almost*: I go most every time.	9		
15. *Only* misplaced in the sentence: I only had one lesson to study.	2		
16. The use of the double negative: There wasn't hardly room for me.	0		
17. Miscellaneous misuses of adjectives and adverbs: It was a very healthy food.	15	52	10

TABLE XCVI. CATEGORIES OF ERROR (CONTINUED)

	NUMBER OF ERRORS IN EACH SUBCLASS	TOTAL ERRORS IN CLASS	RANK
V. Mistakes in the use of prepositions and conjunctions.			
18. Use of wrong or superfluous preposition: He got off of the car.	32		
19. Use of wrong conjunction: The reason was because, etc.	7		
20. Misuse of *like*: It looks like he wasn't coming.	11	50	11
VI. Ungrammatical sentence structure.			
21. Incomplete sentence.	27		
22. Failure to make a new sentence for a new thought.	121		
23. Miscellaneous mistakes in sentence structure.	72	220	4
VII. Failure to express clear meaning.			
24. Ambiguity due to indefinite pronominal reference: He had to eat olives with the Smith girls although he didn't like them.	8		
25. Awkward, "wordy," or complicated phrasing.	5		
26. Other cases of failure to express clear meaning: Her mother cooked a dozen eggs and twice as much bacon.	33	46	12
VIII. Mistakes in punctuation.			
27. No period.	17		
28. Members of series not separated.	24		
29. Independent clauses of compound sentences not separated.	23		
30. No punctuation after introductory expression: Well how are you?	13		
31. Name of city and state written without punctuation.	19		
32. Miscellaneous mistakes in punctuation . .	136	232	2
IX. Mistakes in the use of the apostrophe.			
33. Failure to distinguish between *it's* (it is) and *its* (possessive): The bird will not do it's best singing if its a cloudy day.	9		
34. Wrong form of possessive nouns: There was a sale of ladie's dresses. . .	64		
35. *O'clock* written without an apostrophe. . .	38		
36. Miscellaneous misuses of apostrophe: I dont know.	39	150	6

TABLE XCVI. CATEGORIES OF ERROR (CONTINUED)

	NUMBER OF ERRORS IN EACH SUBCLASS	TOTAL ERRORS IN CLASS	RANK
X. Mistakes in capitalization.			
37. Failure to use capital letter.	88		
38. Improper use of capital letter.	108	196	5
XI. Careless omission or repetition.			
39. Omission of word or phrase.	97		
40. Omission of letter or syllable.	111		
41. Repetition of syllables, words, or phrases.	15	223	3
XII. Mistakes in spelling.			
42. Compound word incorrectly written.	136		
43. Misspelling of *to*, *too*, and *two*.	25		
44. Misspelling of *their* and *there*.	24		
45. Other misspelled words.	490	675	1
XIII. Misuse of quotation marks.	25	25	13
XIV. Miscellaneous errors.			
Doctors, lawyers, teachers, etc.	85	85	9

The last three columns in the table give the rank of the errors as to frequency in each of the classes: the social letters, the business letters, and the compositions respectively. These columns show some interesting peculiarities. Adjectives and adverbs are misused much oftener in social letters than in business letters and in compositions, probably because so many more of them are used in social letters. In business letters mistakes in form are much more frequent than in social letters. Mistakes in pronouns are much more frequent in compositions than in business and social letters, and mistakes in diction are much less frequent. Mistakes in punctuation and in spelling make up over half the errors in both letters and compositions. The value of such a study is the same as in oral composition: it shows the teacher the points on which he must concentrate his energies to get the child to write an errorless letter or composition.

TABLE XCVII. AN ANALYSIS OF ERRORS IN 250 SOCIAL AND 750 BUSINESS LETTERS. (After Johnson)

TYPES OF ERROR	NUMBER OF ERRORS IN LETTERS		RANK OF ERROR		
	Social	Business	Social Letters	Business Letters	Compositions
1. Punctuation	889	2242	1	1	2
2. Sentence structure	517	263	2	4	4
3. Spelling	308	242	3	5	1
4. Adjectives and adverbs	269	28	4	11	10
5. Letter form	223	402	5	2	
6. Capitalization	131	273	6	3	5
7. Diction	97	56	7	8	12
8. Apostrophe	88	80	8	7	6
9. Careless writing	61	53	9	9	3
10. Verbs	59	222	10	6	8
11. Prepositions and conjunctions	47	47	11	10	11
12. Case	25	7	12	14	14
13. Pronouns	22	9	13	13	7
14. Quotation marks	9	10	14	12	13
	2745	3934			

EFFECT OF DRILL IN ELIMINATING LANGUAGE ERRORS

How shall we eliminate the errors in language? Again, the two principal methods of language training are available — grammar and drill. The effect of training in grammar will be considered later. We know that drill has been found effective in establishing quick and accurate habits in arithmetic, in reading, in spelling, and in handwriting. There is no reason why language should be an exception, but unfortunately we have few experiments to which we can refer for proof. This is not because the drill method has not been used, but rather because the hundreds of teachers of English who have used it did not keep or publish a record of their procedure and results. In a few cases, however, this has been done. McGraw, for example, tried out the effectiveness of drill in two classes in high school. He started by giving Kirby's grammar test to

two sections of twenty-one pupils each from Grade XI. This test consists of forty-three sentences for testing correctness of form and forty-three sentences for testing knowledge of grammatical principles. McGraw calculated the frequency of each error made by the classes and then gave drill designed for their corrections. He selected his exercises in part from Woolley's "Handbook of Composition" and in part from his own materials. Ten minutes of each recitation were devoted to drill for a period of two years. Improvement was measured by the gains made in the Kirby grammar test, which was repeated at the end of each year. Table XCVIII gives the results.

TABLE XCVIII. EFFECT OF DRILL ON GAINS IN ABILITIES IN GRAMMAR AND IN CORRECTING LANGUAGE ERRORS. (After McGraw)

	OCTOBER, 1922		JUNE, 1923		APRIL, 1924	
	Principles	Sentences	Principles	Sentences	Principles	Sentences
Medians	34.5	37	39.4	39.3	40	39.6
Percentage of decrease in number of errors			47		13	

These scores mean that in one year these classes gained as much in knowledge of principles as the average high-school class usually gains in four, and as much in ability to select the correct sentence as such a class usually gains in three years. If these results are typical of the effectiveness of the drill method, we know definitely what method of instruction to use if we wish to improve language habits.

USE OF SUPERVISED STUDY

An experiment to test the effectiveness of this method of instruction was made by Heckert, who, by means of a group intelligence test, divided a class of thirty-three pupils (pre-

sumably high-school pupils) into two groups of equal ability. Both had the same teacher, but one had supervised study and the other did not. Both groups worked for twenty-five periods of one hour each. The pupils in the supervised group received help on such points as how to choose a subject, how to plan and arrange the materials, and how to make, word, and use the outline. Particular emphasis was placed on having something to say. How these points were adjusted to the individual needs of the pupil is shown in the following quotation from Heckert:

> One of the boys chose as his subject "Mischievous Billy." Although he had been taught how to make an outline, there was nothing in his outline to indicate what he planned to say. When asked, he said, "I am going to tell how Billy went up town and a lady asked him, 'How do you do Billy,' and Billy said, 'I do as I please.'" When the writer objected that this would not do, the boy said that he did not know what else to write. When asked he replied that he had had no one in mind when he chose his subject.
>
> Further questioning brought out the fact that there was a little boy in his neighborhood, who might well be called "Mischievous Billy." This little fellow had visited the yard of the pupil, where he had found a coaster wagon and a can of paint; he had proceeded to paint the wagon and had gotten considerable paint on himself. The boy was asked whether he knew another escapade of this little fellow. It happened that this small boy had had some difficulty with children in an adjoining block. The older children took up the fight and punished him by throwing a basin of water on him. The pupil agreed that this would make another good incident for a story about Mischievous Billy. He was then led to recall an incident in which he and his brother were the actors, an incident that might well be added to this story. These two boys had a bantam rooster, a rather troublesome animal to members of the family and the neighborhood. One morning they tied a tin can to the rooster's tail. The immediate results convulsed with laughter both the boys and other members of the family. The boy thought this incident would do very well for his story. He was then asked to make out an outline. This is his outline: (1) Billy has some fun with his rooster. (2) Billy paints a wagon but also

himself. (3) Billy receives a bath. (4) Billy has a settlement with his mother. Next came the writing of the story. The boy showed that further development of the incidents was necessary, because he was too much inclined to state mere facts and did not appreciate the value of interesting details. He was then requested to imagine the various things that might have happened in the incident with the rooster (he had rather completely forgotten them); these he was asked to state orally first. Occasionally the writer offered suggestions, some were received gladly, others were rejected; in no case were they forced upon the boy. When the incidents had been thought through in this detailed fashion, the boy seemed ready to write. Another difficulty now manifested itself. Since he had never taken any interest in composition work he had a rather meager vocabulary. Suitable modes of expressions had to be sought; but after consideration of a number of expressions he had used, he began to attend to this matter upon his own responsibility. Here is the first paragraph from this boy's final test composition. "It was one dismally sultry, rainy day last summer in Wisconsin. It had been raining hard all the night before and of course everything was covered with water. The roads were bad all around the hill but none as bad as the newly made dirt road coming down the hill." This paragraph still is faulty in some respects but it does show a very definite attempt to choose words which are adequate to the ideas to be conveyed, and is immeasurably better than this boy's work six weeks previous.

The gains made in quality of composition were determined by scoring the compositions at the beginning and end of the experiment of the Thorndike-Hillegas Scale. By calculating the percentage of gain made by each group the experimenter was able to determine the effectiveness of supervised study. By calculating the percentage of gains made by the upper and lower 50 per cent of each group in brightness he could determine whether the brighter pupils profit as much from supervised study as the duller ones. By calculating the percentage of gains made by those above the median initial composition score and those below it he could determine whether supervised study is more helpful or less helpful to those who write

the better compositions than to those who write the poorer ones. The results from these calculations are given in the following table.

TABLE XCIX. EFFECT OF SUPERVISED STUDY ON GAINS IN COMPOSITION
(After Heckert)

	MEDIAN PERCENTAGE OF GAIN	
	By Supervised Groups	By Unsupervised Groups
Whole class	8.00	3.00
Upper 50 per cent in brightness . . .	4.80	1.60
Lower 50 per cent in brightness . . .	4.27	2.72
Above median initial composition score	3.65	0.16
Below median initial composition score	10.37	4.60

The supervised group made twice as much proportionate gain as the unsupervised. Of the supervised group the upper half in brightness gained more than the lower half; in the unsupervised group the upper half gained less than the lower half. In the supervised group the half which wrote the better grade of compositions at the beginning gained only about one third as much as the half which wrote the poorer compositions, but in the unsupervised group the half which wrote the better compositions gained only one thirtieth as much as the half which wrote the poorer compositions. Hence supervised study, as used in this experiment, produces more than twice as much proportionate gain as the unsupervised. It is as helpful to the upper half in brightness as to the lower half, but it is less helpful to those who write good compositions than to those who write poor ones. The last may be due to the greater difficulty in improving a good composition. We know from practice experiments that when the curve for a learner's efficiency approaches his physiological limit, it is extremely difficult to make more gains. But such gains, although small, are qualitatively more important than larger gains by a less efficient learner in the earlier stages of learning.

Use of the Socialized Recitation

An experiment to determine the effectiveness of the socialized recitation in teaching English composition was made by Thompson. According to his report this method differs from the usual, or academic, method in the following respects:

1. In the socialized recitation the pupil talks or writes to an audience, whereas in the academic method he talks or writes only to his teacher.
2. The form of composition used is less rigorous. Usually it is a letter suitable to the occasion.
3. Less attention is given to mechanics: it is incidental to communication.
4. The publicity given to a theme when read to an audience compels a better quality of work.
5. The pupil has more stimuli: in addition to the motive of pleasing the teacher, he has the motive of telling a story to an audience, the motive of being a community worker, and the motive of doing something in a living social situation.
6. Attention is directed not to the elements or qualities of writing, but to communication.

Two classes from a large technical high school were taught for a period of nineteen weeks, one by the academic method, the other by the socialized method. The progress of each class was tested monthly in two ways: first, by the number of errors per hundred words of composition; secondly, by the quality of the composition as rated on the Harvard-Newton Scale. Table C gives the results of both methods of measurement for each class.

If we compare the amount of improvement made from Test 1 to Test 5, we see that the socialized class reduced its error by a percentage more than three times as great as that of the academic class and improved the quality of its compositions by a percentage more than five times as great. Another way of stating the difference is that the socialized

TABLE C. EFFECT OF SOCIALIZED TEACHING ON ERRORS AND QUALITY OF COMPOSITION. (After Thompson)

	ERRORS PER 100 WORDS					PERCENTAGE OF DECREASE
	Test 1	Test 2	Test 3	Test 4	Test 5	
Academic class	8.9	8.7	8.5	8.0	7.6	14.6
Socialized class	6.8	5.8	5.1	4.8	4.6	47.8

GRADES ON HARVARD-NEWTON SCALE

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	PERCENTAGE OF INCREASE
Academic class	72.3	73.9	76.0	74.0	74.0	2.3
Socialized class	74.3	79.1	82.9	82.0	83.0	11.7

class made as great a gain in nineteen weeks as is ordinarily made in two years by an average high-school class, while the academic class made as great a gain as is usually made by such a class in half a year. On this basis the ratio of the gains of the socialized and academic classes is as 4 to 1. If we study the differences between the two classes with respect to the kinds of errors as classified by Johnson, we notice that in no class did the socialized group make more errors than the academic.

THE FUNCTION OF IMITATION IN TEACHING COMPOSITION

Some famous writers claim to have learned their art by imitating other great writers. Stevenson, for example, says:

> Whenever I read a book or passage that particularly pleased me, I must sit down at once and set myself to imitate that quality of propriety or conspicuous force or happy distinction in style. I was unsuccessful and I knew it, but I got some practice in these vain bouts in rhythm, in harmony, in construction, and in co-ordination of parts. I have thus played the sedulous ape to Hazlitt, to Lamb, to Wordsworth, to Defoe, to Hawthorne, to Montaigne, to Baudelaire, and to Obermann.[1]

[1] R. L. Stevenson, Memories and Portraits, p. 55.

Benjamin Franklin tells how he tried to improve his own style by imitating the essays in the *Spectator*. He says:

I read it over and over and was much delighted with it. I thought the writing was excellent, and wished, if possible, to imitate it. With that view I took some of the papers and making short hints of the sentiments in each sentence, laid them by a few days, and then, without looking at the work, tried to complete the papers again, expressing each hinted sentiment at length, and as fully as it had been expressed before, in any suitable words that should occur to me. Then I compared my 'Spectator' with the original, discovered some of my faults, and corrected them. To acquire a stock of words and a readiness in recollection and use of them, I took some of the tales in the 'Spectator' and turned them into verse; and after a time when I had pretty well forgotten the prose, turned them back again.[1]

The advantage of using a model is that it gives not only a concrete expression of some quality of style but also the choice of words through which that quality is achieved. When a quality of a composition is raised to a clearly conscious level in this way, and when an earnest effort is made to reproduce it, there is no doubt that a writer will succeed in mastering that quality more quickly than if he simply writes blindly, hoping that by some fortunate accident the product will be good. In making imitations of models effective, a helpful device would be to make a clear analysis of the qualities which a good piece of composition should have. R. I. Johnson has made such an analysis of the qualities of social letters. His material consisted of one hundred and fifty letters contributed by women of recognized leadership throughout the country, of modern collections of literary letters, and of a thousand letters written by young women of approximately college-freshman standing. Approximately half the letters had one or more of the important characteristics he selected; namely, courtesy, informality, humor,

[1] Quoted by F. E. Bolton in "Principles of Education," p. 421.

opinion, optimism, and few centers of organization. An additional value in Johnson's study is that he describes the devices by which these qualities are expressed. These are given below:

Courtesy

1. They give due attention to the points in the letter which is being answered.
2. They never fail to express expected congratulations.
3. They never fail to acknowledge obligations. They show a sense of gratitude.
4. They express good wishes.
5. They inquire about matters which are of the first importance and interest to the recipient of the letter.
6. They apologize, if there is any occasion for it.
7. They express or imply respect, esteem, or affection.
8. They adapt the subject matter to the age and interests of the reader (for example, letters to children).

Informality

1. They use colloquialisms or conversational expressions.
2. They use invented expressions.
3. They use pen sketches and illustrations.
4. They eliminate overformal headings and conclusions.
5. They use figures of speech humorously exaggerated.

Humor

1. They smile at the expense of human weakness (sympathetically, of course).
2. They depict absurd situations.
3. They exaggerate — intentionally.
4. They juxtapose apparently unrelated thoughts.
5. They make reference to amusing experiences.
6. They indulge in plays on words.

Opinion

The letters from the distinguished and literary persons were found to be distinctly opinional. They did not contain much description or narration, but were rich in the author's intellectual reactions toward life. They were not philosophical essays, however.

Optimism

The letters from the distinguished and literary persons had a prevailing atmosphere of optimism. Indulgence in despondency was rare. Practically all the letters from the women of recognized leadership contained a cheerful outlook on life.

Few centers of organization

This quality refers to the fact that the letters from the distinguished and literary persons contained few instances of loose organization. They were confined to a few, clearly unified subjects of thought. They were not scrappy or gossipy, nor did they contain an incoherent mass of detail.

Although Johnson did not follow his analysis by an experiment showing its value for training in language, it seems evident that such an analysis of the qualities of social letters, together with the models in which they are illustrated, should make imitation an effective method of teaching. Similar analyses of other pieces of composition, such as business letters, narration, exposition, description, argumentation, short stories, and the like are much needed. It would also be helpful if we knew the order of merit of these qualities. That would give us an idea of which qualities we should imitate.

Order of Merit in the Qualities of Composition as shown in Teachers' Ratings

A step in this direction was made by Hudelson, who investigated the amount of penalty or of merit which teachers assign to qualities of composition in rating them. The method was to prepare thirteen versions of each of seven original themes. Each of these discarded some particular quality or feature of the original composition while it left others unchanged. In this way ninety-one compositions were obtained, each of which was scored by a group of trained

judges. The order of merit from highest to lowest of the thirteen versions was found to be as follows:

1. The original clearly written.
2. The original with ornate diction.
3. The original with difficult words misspelled.
4. The original with easy words misspelled.
5. The original with "staccato" sentences.
6. The original with unity violated.
7. The original with run-on sentences.
8. The original with wrong forms.
9. The original with no change.
10. The original with incomplete sentences.
11. The original with faulty grammar.
12. The original with errors in punctuation and capitalization.
13. The original with meaning obscured.

Here we see that clearness is considered by teachers to be the most important merit in a composition, and the lack of clearness its most serious defect. They attach a high value to the use of ornate diction and apparently do not penalize or detect misspelled words. Next to obscurity, mistakes in punctuation and capitalization, the use of faulty grammar, and the use of incomplete sentences are the most serious defects. The use of run-on and "staccato" sentences and the violation of unity receive a medium amount of penalty. Since communication is the primary function of language, it is right that clearness in expression should be made the first requisite of composition, and the lack of clearness its most serious defect; but it is doubtful if ornate diction and misspelled words should rank second and third among the excellent qualities of composition. Ornate diction may be tolerated, but not misspelled words. The quality of clearness can be imitated, and its imitation, no doubt, be made more effective, if the pupil is given a number of models in which it is illustrated and an analysis of the devices by which it is accomplished.

Influence of Oral and Written Practice

Should practice be oral or written? The prevailing custom used to be to have nearly all the practice in English composition written. If the amount of practice in the schools is to be decided on the basis of the amount that we use of each, we should have very little practice in the written. Since school children receive almost no practice in written composition outside the school, the proportion of time given to it must be much larger than that in which it is used. On the other hand, there are almost no school children who can give a clear, coherent, and errorless oral discourse without special training; the schools must therefore offer a good deal of work in correct speaking in order to make this possible. It will help not only in oral speech but also in written. This was shown in an experiment conducted by Clapp in connection with the high schools of Illinois. The plan was to have classes of second-semester ninth-grade pupils taught in two ways: one class would have only written exercises, the other a combination of two thirds oral and one third written. All classes were to have the same written tests at the beginning, middle, and end of the semester. The results favored the use of oral composition.

> The sections taking the combined course were better at the end of the semester in thought, vigor, freedom, interest, than the others; they were better in point of grammatical and rhetorical structure; they were no worse in spelling or punctuation, and better in handwriting — indeed, the writing sections showed marked degeneracy in all matters of mechanics.[1]

For the purpose of finding out what number and proportion of exercises our language texts give respectively to oral and written work in composition, the writer counted the number of each in five texts. One of these was published in 1909, and

[1] J. F. Hosic, Essentials of Composition and Grammar. Fourteenth Yearbook of the National Society for the Study of Education, Part I (1915), p. 99.

the other four during the years 1920 to 1924. Text A, published in 1909, had no exercises in oral composition and only 10 in written; text B, a two-book text published in 1920, had 73 oral exercises and 129 written; text C, a three-book text published in 1922, had 342 oral and 176 written; text D, a three-book text published in 1923, had 132 oral and 180 written; text E, a two-book text published in 1924, had 63 oral and 67 written. The four texts published since 1920 averaged 152.25 exercises in oral composition and 138 in written. This indicates a very radical change since 1910, not only as to the amount of practice but also as to the kind. The language text of today contains 30 exercises in composition where a book issued fifteen years ago contains only 1; and over half the exercises are oral, whereas none were so fifteen years ago. The textbook of that time was committed to the idea that language could be taught by grammar alone; the present-day text is committed not only to the value of grammar but also to the idea that practice in using language is necessary, and much of it.

How Well should an Eighth-Grade Pupil Write?

According to Mahoney an eighth-grade pupil should be able to write "an interesting paragraph of clean-cut sentences unmarked by misspelled words and by common grammatical errors." He gives the following standard of written work as a sample of the best that may be expected.

A PICTURE IN OUR SCHOOLROOM[1]

As I sit at my desk and write, I can see, if I look at the wall on my right-hand side, a copy of "The Angelus," by Millet. When I study this picture carefully, I seem to see the whole of the scene that it represents passing before my eyes. The autumn sun is setting, and the gloaming that is descending upon the plain will soon overtake the two peasants, who have been digging potatoes.

[1] Used by permission of the World Book Company, Yonkers, New York.

Suddenly, the deep, solemn-toned bells are heard, pealing on the air. It is the Angelus bell, which tolls thrice a day to remind the people of the birth of the Savior. Both the man and his wife stop working and bow their heads in prayer. All the earth is clothed in a glorious beauty by the soft, yellow light of the sunset, and but for the bells, all is silent. Who knows but that the angels are hovering near, though unseen, ready to carry to the Almighty in heaven the prayers of these two faithful souls?

The standard for the eighth grade in the Hillegas Composition Scale is 5.3; for the twelfth grade it is 6.7. For purposes of comparison the reader should turn back and re-read Samples No. 9 and No. 15 from the Hudelson Typical Composition Ability Scale.[1] These show us not what the eighth-grade or twelfth-grade graduate should do in written work in English, but what he actually does on the average. It will be seen at a glance that Mahoney's standard is far beyond each of these in quality. Neither is free from errors in spelling or punctuation. Sample No. 9 has other errors of a more serious nature. The paragraphs are not organized under logical subdivisions; they are choppy, and some of them consist of only a single sentence. There are incomplete sentences, subordinate and appositive clauses being made into sentences. Independent sentences are strung together by *and*. The complex sentence occurs, but it is handled in a bungling manner; its chief defect is that the subordinate clauses are not separated by commas. There is redundancy: the subject is repeated needlessly in one case, and an indirect object occurs needlessly in another.

Turning to Sample No. 15 we notice a decided improvement in organization. The paragraphs are written under subdivisions, in a time order, and the sentences all relate to the subtopic. The incomplete sentences do not occur, and, strangely enough, neither does the simple sentence. This, however, is an accident peculiar to this sample and is not a

[1] See page 276–277.

general characteristic of a high-school graduate's written English. There is also a decided improvement in the handling of the complex sentence: it is no longer bungling, incoherent, or lacking in clearness, but it is imperfectly punctuated. Subordinate clauses and appositive phrases are not properly separated from the rest of the sentence. Redundancy, the superfluous use of *and*, and the use of loose compound sentences are conspicuously absent.

The standard set up by Mahoney has all these merits and some others in addition. There are no mistakes in spelling or in punctuation. The sentences are clearer and more coherent, and, in fact, have an æsthetic quality. The mastery of the complex sentence is complete. The standard attained by the average eighth-grade graduate is probably something between the quality represented by Sample No. 9 and that set up by Mahoney. The mastery of the complex sentence represented in Mahoney's standard is unattainable in the grades not only because of the skill required to produce it but also because of the intellectual level necessary for thinking in such a complicated manner. Neither can we expect much style or æsthetic quality in the average eighth-grader's production. We can, however, expect him to avoid all the errors represented in Sample No. 9, such as using the subordinate clause as a sentence, stringing independent sentences together with *and*, misspelling common words, punctuating incorrectly simple sentences or complex sentences containing one subordinate clause, using one-sentence and choppy paragraphs, and capitalizing a common noun that does not begin a sentence. In other words, we can expect him to master the simple sentence, the complex sentence with one subordinate clause, the paragraph consisting of such sentences, and the correct spelling, punctuation, and capitalization of such a paragraph. The fact that such standards are not obtained is not due to lack of ability but rather to lack of practice. Compositions of quality 5 in the Hillegas Scale show that an eighth-grade

child can think in complex sentences. Punctuating or capitalizing the composition correctly or spelling the words used in it correctly is somewhat less difficult, but the habit of doing so cannot be learned by studying the rules and principles of language.

The following composition, entitled "John's Fire," which is given by Mahoney as a standard for oral work in Grade VII, may be taken as about the best attainable average for eighth-grade English, written or oral.

JOHN'S FIRE[1]

John counted one, two, three, four, and so on up to sixty-eight. It was a fire! Now John's mother had forbidden him to go to fires. But John's mother was away, and so John thought that he'd "take a chance." The house was burned to the ground. The firemen saved a few things, but not many. Luckily, the property was insured, and the people got something from the insurance company. John got something, too, when he got home. But it was not from the insurance company.

Summary

The most effective method of improving ability in language is to discover the child's errors and then give him corrective drill. Numerous studies have been made of the errors in spoken language made by school children in widely separated states. A typical study shows that about three fourths of the errors fall into five classes — wrong verb, syntactical redundance, confusion of past tenses and perfect participles, failure of verb to agree with subject in person and number, and double negative — and that over half the total number of errors is composed of twenty-three individual errors. Some statistical studies have also been made of errors in written composition, such as themes, social letters, and business letters. Syntactical errors in written composition are

[1] Used by permission of the World Book Company, Yonkers, New York.

similar to those in spoken language, but some types occur more in written than in oral and some less frequently. Most of the errors in written composition, however, are in punctuation, spelling, form of arrangement, capitalization, and the use of the apostrophe, but the frequency of each type varies according to the kind of composition. The value of the studies in language errors is that they indicate the points where language habits need correction and strengthening. The economy of applying corrective drill at the point of error is shown by an experiment by McGraw in which the pupils made as much gain in one year as is ordinarily made in three or four years.

The use of supervised study, in which the teacher helped pupils to choose a subject, to plan and arrange the materials, and to make, word, and use an outline, enabled them to make more than twice the percentage of gain than was made during the same time by an equally competent group of unsupervised pupils. It helped bright pupils as well as dull ones, but pupils who wrote good compositions did not gain as much as those who wrote poor ones.

The use of the socialized recitation, in which the pupil talks or writes to an audience, usually writes letters, and gives little attention to mechanics but a good deal to communication, has been shown to enable pupils to gain in quality of comprehension in one semester as much as the average class gains in four semesters.

Many writers have found the conscious imitation of good models a helpful kind of training. The value of imitation should be increased by a careful analysis of the good qualities of different types of composition such as the one made by Johnson of the qualities of social letters.

According to teachers' ratings clearness is the most important merit in a composition, and the lack of clearness its most serious defect. This is justified by the theory that the function of language is the communication of thought.

Classes in which two thirds of the practice was in oral and one third in written composition were found to improve more rapidly in the use of language than classes in which all the practice was written. In view of the fact that oral English is used so much more than written, this seems a justifiable distribution.

The standard quality of composition required of eighth-grade graduates should be an attainable one. We can expect them to master the simple sentence, the complex sentence with subordinate clause, the paragraph consisting of such sentences, and the correct spelling, punctuation, and capitalization of such a paragraph.

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CHAPTER XVII

LANGUAGE: THE LAWS OF ASSOCIATION AND OF SATISFACTION

The Law of Association

The law of association would lead us to expect that any device or method which would make composition and the structure of language meaningful would be good to use in language training. Composition is made meaningful by selecting meaningful and familiar topics, those about which the pupil has a rich background of experience; we should expect him to produce a better composition on such a topic than on one about which he knows little or nothing. The structure of language is made meaningful by the study of grammar and of foreign languages: grammar gives us the principles which control the use of language, and the study of foreign languages throws these into clear relief not only in the foreign language but also in the mother tongue. Therefore the value of the law of association in language training is to be ascertained by examining the studies which show the influence of the nature of the subject on the quality of the composition, the influence of the study of grammar on correct usage, and the influence of the study of foreign language on correct usage in English.

Influence of the Kind of Subject

The quality of a pupil's composition depends not a little on the nature of the subject chosen. It may make a difference as wide as that which exists between the average fourth-grade composition and the average composition of the tenth grade.

This was shown in an experiment conducted by Hudelson, who assigned thirty-two topics for seven hundred and seventy pupils in Grades VII–XII inclusive to write about. To neutralize the effects of practice from one composition to the next, half the pupils wrote on the topics in the reverse order from the other half. A time limit of fifteen minutes was allowed for writing and correcting each theme. Each theme was scored by an average number of eight judges. In selecting the topics an effort was made, first, to appeal to the various interests, emotions, and experiences of adolescents; secondly, to choose such topics as are typical of those widely used and recommended. A special device in the arrangement of the topics was that they were paired either in the relation of contrast or of similarity; for example, "The Funniest Thing I ever Saw" was paired with "The Saddest Event of my Life," "The Most Exciting Ride I ever Had" was paired with "The most Exciting Incident of my Life." It was found that the paired topics yielded nearly the same quality of composition, but this was not true of topics not paired. In Grade VII the topic "Did it happen right in Church?" yielded the average that is ordinarily made by Grade III; but the topic "A Story based upon a Picture" yielded a composition with an average mark just above the standard for Grade X, a difference of six grades. In Grade VIII the topic "An Argumentation on 'School'" yielded an average mark about half a grade below the standard for that grade, but the topic "A Description of Camping" yielded an average mark that was near the standard for Grade XI. In Grade IX the topic "Relate an Interesting Story which you have Heard" yielded an average mark below the standard for Grade VII, while the topic "The most Exciting Ride I ever Had" yielded an average mark just above the standard for Grade XI. In Grades X and XI the topic "Relate an Interesting Story which you have Heard" yielded marks a little below the standard for Grade VIII, but the topic "How I learned a Lesson"

yielded marks equal to the standard for Grade XII. The reason for such wide variations in the quality of the composition in relation to the topic is no doubt found in the amount of experience which the pupil has on that topic. A seventh-grade child can write a good composition on a picture because it is directly before him and requires little beyond description. There is little to be recalled and no necessity of investigation. He may need to draw on his imagination for interpretation, but this is usually suggested by the picture. But the material on the topic "Did it happen right in Church?" is not so near at hand. A seventh-grade child rarely experiences an exciting incident in church and hence may not be able to recall anything definite either about himself or others. Consequently he is forced to draw practically all the material from his imagination, and this is apt to be scant. Similarly, the topics "A Description of Camping," "The most Exciting Ride I ever Had," and "How I learned a Lesson" yield good compositions in grades beyond the seventh because practically all children in these grades have had vivid experiences in such things and can recall them with ease; but such a topic as "An Argumentation on 'School'" is a poor one, because it presents no issue to the child and because, moreover, the school child almost never thinks of a school as a social institution or of its merits and demerits for the social welfare. For this reason he has no material on this topic and is compelled to rely on the pictures of his imagination. These results suggest that the topic which yields the best composition is one that requires no search for material — one about which the child has vivid experiences and memories, or one which requires only description of familiar things before him. Since the aim of composition is to perfect habits of writing and speech, it is doubtful whether in that subject much stress should be put on the extension of the pupil's information and experience. Rather we should require him only to learn to tell well what he already knows. Adherence to this principle

will go far toward solving the child's persistent problem in composition: What topic shall I choose, and what shall I say on it?

Influence of Grammar on Correct Usage

Those who believe in knowledge of grammar hold that the key to correct usage lies in a correct understanding of the structure and principles of language; in knowing the parts of speech, knowing how they are related, and knowing how they must be combined; and in the ability to put these parts together according to rule. The first step in approaching language by this method is to master a group of rules and definitions; the second step is to analyze language into its component elements and to define the relations between them. Having mastered the first and second steps, it is generally supposed that the third step — using language according to rule — will follow as a matter of course without much training in this function. This is the traditional method of teaching language and the one most widely used. But there are questions to be raised about the third step: Does it follow? Do those who know grammar practice it, and do they practice it better than those who do not know it? Or is there such a thing as knowing the better but doing the worse?

Four studies — by Briggs, Hoyt, Starch, and Asker — have been made which enable us to answer these questions. Briggs investigated the truth of the claims often made for the study of grammar, namely, that it develops the abilities to see likenesses and differences, to test definitions, to apply and make definitions, to test reasons, to draw judgments from a mass of data, to demand facts before making judgments, to reason logically, and to detect "catches." He devised fifty-four tests to measure a pupil's skill in using these abilities. He then trained two rooms of children both in formal grammar and in language for six months. During the first three months one room received training in grammar and the other

in language; during the second three months the training was the other way about. At the beginning, middle, and end of the six months both rooms took the fifty-four tests for the purpose of determining the gains which each kind of training produced in the pupils' powers of reasoning. An idea of the nature of these tests may be gathered from the following three samples. In the tests of the ability to see likenesses and differences the pupil was required to mark eight of sixteen words which were alike in some way:

bek	bukder	bugler	laknit
bikreb	ribbon	seb	rudest
butter	big	begin	bak
sabsed	sihtad	rob	baggage

(eight are nonsense)

The tests of the ability to judge a good definition were like this:

DEFINITIONS OF AN ISLAND

1. A piece of land out in the water.
2. A small body of land.
3. A body of land entirely surrounded by water.
4. Cuba is an island.
5. A portion of land rising above the surrounding level.

Place a small cross before those definitions which you think are good.

The tests of the ability to judge reasons were like this:

Among the reasons why horses are better than cattle for driving and working animals, check those reasons which are good:

1. Horses are more intelligent than cattle.
2. Cattle are not so tall as horses.
3. Horses like corn, oats, and hay.
4. Horses are much more active and walk faster than cattle.
5. Cattle are used extensively for food.

The following table shows the results of the training upon the abilities tested.

TABLE CI. EFFECT OF TRAINING IN FORMAL GRAMMAR UPON IMPROVEMENT OF REASONING POWERS. (After Briggs)

TEST	GAINS	
	Room 1 Grammar	Room 2 No Grammar
Ability to see likenesses and differences	1.14	8.44
Ability to judge a definition	14.56	14.24
Ability to apply a definition	2.69	3.05
Ability to judge reasons	2.40	1.09
Ability to use data	0.29	0.40
Ability to reason in arithmetic	0.12	0.15
Ability to reason syllogistically	0.60	0.61
Ability to detect catches	0.15	0.12
Ability to correct language errors and to point off sentences	0.001	1.58
Knowledge of grammar	29.09	44.76

All the tests on reasoning powers show approximately equal gains for both types of training. Another interesting result is that the group which had training in language and composition gained more, not only in ability to correct errors in language but also in knowledge of grammar, than the group which had training in formal grammar. The author draws the following conclusion: "As a result of this experiment it may safely be asserted that these particular children after the amount of formal grammar that they had, do not as measured by the means employed, show in any of the abilities tested improvement that may be attributed to their training in formal grammar."

Even if training in formal grammar does not improve one's general reasoning powers, it may be worth while just for the help it gives in the correct use of language. To measure this effect was the purpose of Hoyt's experiment. Using two hundred high-school pupils from Indianapolis as subjects he tested their knowledge of grammar by ten questions on the sentence structure, the parts of speech, and the verb forms in four stanzas of Gray's "Elegy," their powers of interpretation

by requiring them to transpose the thought of another set of four stanzas into their own words, and their ability in composition by a forty-minute essay on the topic "How would you spend a Thousand Dollars if that Sum should be given you to spend during the Christmas Holidays?"

The three sets of papers were graded by two persons, A and B, and then the correlations between them were calculated. These were found to be as in Table CII.

TABLE CII. CORRELATIONS BETWEEN ABILITIES IN GRAMMAR, COMPOSITION, AND INTERPRETATION. (After Hoyt)

	A's Work	B's Work
Grammar and composition	0.12	0.23
Grammar and interpretation	0.22	0.19
Interpretation and composition	0.27	0.30

The lowness of these correlations shows that grammar and composition are only slightly related, and that the one is not necessary for the other. Grammar has also a slight influence on the ability to interpret. But the ability to interpret and the ability to write a composition are more closely related.

Starch's experiment consisted of tests of knowledge of grammar and of ability to select correct forms in English. The tests in formal grammar consisted of three-minute exercises in indicating the parts of speech of as many successive words as possible in a passage of prose, in indicating the cases of nouns and pronouns, and in indicating the moods and tenses of verbs. The ability to use English was tested by a series of one hundred sentences, each of which was stated in two ways. Both might be correct or both might be incorrect, or one might be correct and the other incorrect. The pupils' task was to cross out the incorrect forms. The following table shows the average scores in both tests for pupils classified in groups according to the amount of foreign language which they studied.

TABLE CIII. EFFECT OF FOREIGN-LANGUAGE STUDY ON ENGLISH GRAMMAR AND USAGE
(After Starch)

	TIME OF FOREIGN LANGUAGE STUDY	NUMBER OF STUDENTS	AVERAGE SCORES FOR KNOWLEDGE OF GRAMMAR	AVERAGE SCORES FOR CORRECTNESS OF USAGE
University juniors and seniors	0	2	48.0	81.5
	2–5 years	12	47.8	71.1
	6–9 years	25	58.6	75.5
	10–15 years	15	63.4	75.7
High-school pupils	0	12	14.7	32.2
	8 weeks	50	20.8	43.0
	1 year	18	25.5	43.4
	2 years	39	24.8	45.9
	3 years	27	28.6	47.7
	Time of Latin Study			
University juniors and seniors	0	15	45.8	70.9
	1–3 years	11	56.1	75.7
	4 years	14	57.5	74.3
	5 years or more	9	51.8	76.1

Starch's conclusion from this experiment is that a pupil's knowledge of grammar is greatly increased by the study of foreign languages, but that it only slightly increases his ability in the correct use of the English language. His reasons for this position are worth quoting:

> Notice, for example, the upper part of Table CIII, on page 319. The students who had 10 to 15 years of foreign languages made a score in grammatical knowledge of 63, as compared with a score of 47.8 made by the students who had 2 to 5 years of foreign languages, a difference of 32.6% in favor of the former group. For correctness of usage, the corresponding difference is only 6.4%. The two students with no foreign languages made high scores because they were exceptionally good students, but they are too few in number to be considered. The high-school pupils show a gain in grammatical knowledge of 37.5% from the 8-week group to the 3-year group and a gain in usage of only 10.9%. The twelve pupils with no foreign language made low scores because they were exceptionally poor pupils. This is indicated by their low scholarship records, by the fact that many were over-age, by the fact that they avoided the foreign languages, and also by the large difference between their scores and those of the 50 pupils who were just beginning foreign languages. Eight weeks of foreign languages could hardly have produced such a big gain. Their higher scores must be due largely to a difference in original nature.

Asker tested two hundred and ninety-five freshmen from the University of Washington with Starch's Language Scales: Grammatical Scale A for the correctness of sentences, English Test 1 for parts of speech, English Test 2 for cases, and English Test 3 for modes and tenses. From the university records he compiled their grades in English composition and their average grades for all subjects during the freshman year. The first gave him a measure of the student's ability in English composition in terms of teachers' judgments; the second gave him a measure of the student's general ability. From these results he calculated the correlation between knowledge of grammar and the ability to correct sentences and to write

English compositions, and the ability to write English compositions and general intelligence. The results are given in Table CIV.

TABLE CIV. CORRELATIONS BETWEEN ABILITIES IN GRAMMAR, COMPOSITION, AND SCHOLARSHIP. (After Asker)

Combined score in Tests 1, 2, and 3, and Scale A	0.23
Combined scores in Tests 1, 2, and 3, and English composition .	0.37
Average freshman grades and English composition	0.63

Again, we see that knowledge of grammar is only slightly related to the ability to use English and also that the latter is determined principally by general intelligence. The author interprets his findings as follows:

> The facts of this investigation show, then, that knowledge of formal grammar influences ability to judge the grammatical correctness of a sentence and ability in English composition only to a negligible degree. As the number of cases involved is large enough to be a fair representation of conditions in general, we may therefore be justified in the conclusion that time spent upon formal grammar in the elementary school is wasted as far as the majority of students is concerned, and that teachers of English composition must seek some other reason for the alleged generally poor ability in this subject than the neglect of formal grammar in the grade school.

INFLUENCE OF THE STUDY OF FOREIGN LANGUAGES ON ENGLISH COMPOSITION

The claims for the benefits of the study of foreign language are much the same as those for Latin: not only does it improve the processes of observation and the powers of reasoning, but it also gives a writer quality in his English style, greatly increases his vocabulary, and gives him a wise and discriminating judgment in the use of words. We are interested here not in the disciplinary effects of the study of foreign language on the mind, but only in its effect on the ability to use English. Studies of the effect of Latin on Eng-

lish have been made by Partridge, Wilcox, Starch, Carr, Thorndike, Ruger, and others.

Partridge studied the relation of the grades of the English examination papers of seven hundred and eighty-three third-year high-school pupils to the number of years of Latin which they had studied. He discovered the facts shown in Table CV.

TABLE CV. GRADES IN ENGLISH COMPOSITION IN RELATION TO THE NUMBER OF YEARS OF LATIN STUDIED. (After Partridge)

	NUMBER YEARS OF LATIN			
	0	1	2	3
Number of papers written	181	123	220	259
Average standing (percentage)	65	65	69	76

When the papers of those who studied only Latin as their foreign language were considered, the grades varied from 63 for those without Latin to 78 for those with three years of Latin. Partridge concludes that this increase in the quality of English in relation to the number of years of Latin studied is due to the training received in Latin. But this conclusion is not warranted because of the fact that the superiority of the Latin students might be due to their greater native ability. That this is the case is shown in the study by Wilcox, who found that the grades of the Latin students' papers in English were superior to those of the non-Latin students before they studied Latin. He tabulated the grades in English of the pupils who graduated from the Iowa City High School during a period of ten years. He then grouped them according to the foreign language which they studied, Latin or German, and calculated the average grade in English for each year of high school. He found that the Latin students were superior to the German students and that this superiority was somewhat greater during the freshman year than it was during the

senior year. If this superiority had appeared only after the pupils had studied Latin we might suppose it was due to Latin; but since it existed before that, it must have been due to native ability. Wilcox also grouped the English grades of the Latin students according to the number of years which they studied Latin. He found again that the grades of the four-year Latin students were superior to those of the three-year Latin students and that those of the three-year Latin students were superior to those of the two-year Latin students, but also that these advantages were just as great during the freshman year, when the pupils began the study of Latin, as they were during the senior year, when some of them had had four years of Latin. Wilcox also made a study of the English grades of one hundred and fifty graduates of the Cedar Rapids High School having Latin, German, or no foreign language. He calculated the median grade in English of each group for each year of high school. He obtained the results shown in Table CVI.

TABLE CVI. MEDIAN GRADES IN ENGLISH OF STUDENTS OF CEDAR RAPIDS (IOWA) HIGH SCHOOL WHO STUDIED LATIN, GERMAN, OR NO FOREIGN LANGUAGE. (After Wilcox)

		Median Grades			
	Number of Pupils	First Year	Second Year	Third Year	Fourth Year
All Latin	70	91	89	89	86
All German	60	86	86	85	87
No foreign language	30	86	83	84	85

Here we see that the Latin students are superior in English to the students who studied German or no foreign language, but that the superiority is greater during the first year of high school than during the fourth year. If the superiority in English were due to the effect of Latin, it would increase with the number of years in school instead of decrease. Wilcox con-

cludes that it is probably due to the fact that students who choose Latin are superior in ability to those who refuse to take it.

The object of Starch's experiment was to find out how much of the superiority in English of students who studied foreign language was due to the foreign language and how much of it was due to native ability. He gave a number of language and mental tests to a group of one hundred and seventy-seven university students. He had them write compositions, rated them by the Hillegas Scale, and counted the number of words written in each composition. He gave tests to measure the students' speed and comprehension in reading, tests in cancellation, memory span, and association, and tests of the ability to imagine geometrical forms and words. In order to get a measure of native ability he secured the grades which students made in the first year of high school. He then grouped the students according to the number of years for which they studied foreign language and calculated the average score of each group in each test. Table CVII gives a sample of the essential facts.

TABLE CVII. COMPARISON OF STUDENTS WHO HAD FROM THREE TO FOUR YEARS AND FROM SEVEN TO EIGHT YEARS OF FOREIGN LANGUAGE IN ABILITIES IN COMPOSITION, READING, ASSOCIATION, AND SCHOLARSHIP
(After Starch)

Years of foreign language	3–4	7–8
Number of persons	53	40
Composition score (Hillegas)	69.3	71.5
Words written	158.3	168.1
Different words used	86.6	96.8
Speed of Reading	5.4	5.2
Comprehension in reading	65.0	65.7
Association of synonyms	15.0	15.4
Grade made in first year of high school	85.7	86.7

Comparing the results of those who had from seven to eight years of foreign language with those who had from three to four years, we see that the former group made a

better grade in English compositions, wrote longer compositions, used a greater number of different words, and made a better grade in the first year of high school than did the latter group, but did no better in the speed and comprehension of reading or in the ability to give synonyms. The higher grade in the first year of high school shows that the former group had greater ability than the latter, and raises the question whether this is sufficient to account for their superior scores in English compositions. To answer this, Starch reduced the percentages for the high-school grades and the Hillegas Scale marks to common terms. When he had done this, he found no difference, and therefore concluded that the superiority in English composition of the groups that studied the foreign language the longer period was due to their greater native ability. The results for comprehension in reading and for ability to name synonyms justify this view, but native ability seems insufficient to account for the difference in the length of the composition and in the number of words used.

A more conclusive experiment of the effect of the study of Latin on ability in English composition was made by Otis, who eliminated the factor of native ability by selecting Latin and non-Latin groups by means of an intelligence test. She found two groups, each containing forty-two high-school pupils who made the same average score in the Terman Group Intelligence Test. She measured their ability in English composition by having them write a composition of approximately one hundred and fifty words on one of three topics. These were rated by the Nassau Scale. She also tested their knowledge of English words of Latin origin by having them write in ten minutes as many definitions as possible of fifty Latin derivatives. Table CVIII, on page 326, gives her results.

Here there is a difference of 0.4 of a step in the Nassau Scale in favor of the Latin group. This is the same as the amount of gain in English composition ordinarily made by a year's training in high school. It is an appreciable difference

TABLE CVIII. COMPARISON OF LATIN AND NON-LATIN STUDENTS IN ABILITIES IN COMPOSITION AND VOCABULARY WHEN BALANCED FOR INTELLIGENCE. (After Otis)

	LATIN GROUP	NON-LATIN GROUP
Intelligence score	153.6	153.6
Number of years in high school	2.2	2.6
Number of years in modern foreign-language study	1.0	1.7
Composition score (Nassau)	6.5	6.1
Vocabulary-test score	16.2	12.2

and is greater than the size of the figure indicates to an average person. It cannot be attributed to native ability or to the amount of schooling or to the amount of training in modern foreign language. Some of it is no doubt due to the fact that the Latin group consisted of pupils taking a literary and classical course, whereas the non-Latin group consisted principally of those taking a commercial course. Therefore the Latin group probably had more training in English than the non-Latin group. Whether this factor is sufficient to account for the difference is not certain. It is probable that the study of Latin makes a slight addition to one's ability in English composition and a considerable addition to one's knowledge of English words of Latin origin.

The effect of training in Latin on knowledge of English vocabulary was investigated by Starch, by Carr, and by Thorndike and Ruger. Of these studies the one by Thorndike and Ruger was the most extensive and conclusive. These authors made a study of the effect of first-year Latin on gains in knowledge of English words of Latin and of non-Latin derivation by testing 2575 ninth-grade pupils who studied Latin and 2944 ninth-grade pupils who did not. The test used was the Carr English Vocabulary Test, which consists of fifty words — twenty-five of Latin derivation and twenty-five of non-Latin. The word which the pupil is to define is printed in italics in a sentence, and below it are five other words, one of which has the same meaning as the italicized

word. The pupil's task is to check this word. The test has fifty items like the following:

The man was left in *fetters*.
power, ignorance, bonds, exile, rags.

Three forms of the test were used: one at the beginning of the year, one at the middle, and one at the end.

The score in this test is the number of words correctly defined. The year's gain is the difference between the first and the third test, and the half-year's gain is the difference between the first and the second test. Table CIX states the essential facts discovered by the authors.

TABLE CIX. EFFECT OF A YEAR'S STUDY OF LATIN AND GAIN IN KNOWLEDGE OF ENGLISH WORDS OF LATIN ORIGIN AND OF NON-LATIN ORIGIN
(After Thorndike and Ruger)

	AVERAGE GAIN OF LATINS	AVERAGE GAIN OF NON-LATINS	SUPERIOR GAIN OF LATINS
Half-year Gains			
In Latin words . . .	2.8	0.7	2.1
In Non-Latin words .	0.3	0.3	0
Year Gains			
In Latin words . . .	4.7	1.8	2.9
In Non-Latin words .	1.1	1.4	−0.3

The conclusions drawn by the authors are as follows:

"On the words of Latin derivation the pupils gain in the year about $2\frac{1}{2}$ or $2\frac{2}{3}$ times as many words as the non-Latins. In the words not of Latin derivation there is no demonstrable difference between the pupils who studied Latin and those who did not."

If the claim that the study of Latin gives a student a nice discrimination in the use of words is justified, the Latin student should, other things being equal, be able to read English with a better degree of comprehension than the non-Latin student. Whether he does so was investigated in an extensive experiment made by Thorndike, who gave the Thorndike-

McCall Reading Test to several thousand Latin and non-Latin ninth-grade pupils in over a hundred schools. Form 2 was given at the beginning of the year, Form 8 at the middle of the year, and Form 4 at the end of the year. An idea of the results found may be obtained by comparing the year's gains of 254 Latin pupils and of 257 non-Latin pupils, all of whom made a score of 56 in the first test. The Latins gained 4.6 points; the non-Latins, 3.0 points. In general the gain made by the Latins was about one and one-half times as great as the gain made by the non-Latins. Thorndike, however, doubts if this superiority is due to the study of Latin, inasmuch as all of it was made during the first half of the year. Since Latin produced no superior gain during the second half of the year, it is probable that the gain made by the Latins during the first half is due to other causes.

Summary of the Influence of Knowledge of Grammar and of Foreign Language on Ability in English

The experiments in grammar show that the study of this subject does not improve a pupil's general reasoning powers any more than do other subjects, and that it has only a slight influence on ability in English composition or on the ability to use English correctly. The evidence for this statement is the low correlation between the knowledge of grammar and ability in English composition and the fact that large differences between individuals in knowledge of grammar are accompanied by only small differences in their ability to use English correctly. The improvement in English derived from the study of foreign language is scarcely any more than that derived from grammar. None of the experiments proved conclusively that it is a positive help in English composition, although Otis's experiment indicates that it probably is a slight help. Knowledge of Latin, however, does produce a considerable increase in a pupil's knowledge of English words

of Latin origin. It does not increase his knowledge of words of non-Latin origin, however, nor does it make a demonstrable increase in his ability to read English. The conclusions to be drawn from these results are, first, that the benefits for English from a study of grammar or foreign language are much less than they are commonly thought to be; secondly, that the ability to use English is largely independent of knowledge of grammar and of foreign language; thirdly, that the remedy for bad English is not to be found in the study of formal grammar and of foreign language.

Why Knowledge of Grammar and of Foreign Language has so Little Effect on Ability in English

The key to the answer to this query is found in the psychology of habit and in the idea that the use of English is an art and not a science. Knowledge of grammar does not give us habits in speaking and writing, for the same reason as knowledge of arithmetical terms does not give us habits of addition, knowledge of harmony does not give us habits of singing, and knowledge of anatomy does not give us habits of hygiene. Habits are formed by practice, not by studying about them. In learning to master the difficult art of using a language we must follow the same method as in mastering the art of addition, or of singing, or of playing a musical instrument. We must begin by practicing the simpler elements, learn to combine these into more complex units, find out what the difficulties and mistakes are in the art, and then give special drill in overcoming them. In fact, if we apply the same pedagogy to the mastery of language that we now do to the mastery of arithmetic, we shall undoubtedly make progress. We used to teach arithmetic by rules and definitions. Examples were given only as illustrative cases of the rule. Now we teach it by drilling not only on the examples but also on the elementary combinations used in the examples.

In a similar way we shall have to find out what the elementary habits in language are and give specific drill in them. The first reason, therefore, for the failure of grammar is lack of practice in the habits of using English.

The second reason is found in the young pupil's lack of ability in generalizing from a rule; that is, in the failure to see points of application between a specific habit and a general rule. If the pupil had sufficient powers of generalization, we should not need to teach him the multiples of numbers from 1 to 9 inclusive. He could work them all out by a process of counting or addition. But it is a great economy to teach these multiples. In fact, habits of multiplication are so specific that knowledge of 5×6 does not guarantee a knowledge of 6×5. We must teach both. Habits are specific responses to specific stimuli. Often if the stimulus is changed as little as from 5×6 to 6×5, it fails to provoke the correct response. The same is true of language habits. A pupil may learn that a subject of a sentence should be in the nominative case and that the object of a preposition should be in the objective case, and yet fail to see why such statements as "Sara and me went to town," and "Them dogs ran between you and I" are wrong. Even if he sees that they are wrong, he may not know what to do to correct them. To insure correctness as well as facility in the use of pronouns we must work out the elementary habits involved in them and then give specific drill in each of these.

The writer undertook to work out the elementary habits for personal pronouns and made the discovery that there are 528 of them. Yet they are all governed by three simple rules: namely, that a pronoun used as a subject is in the nominative case; that a pronoun used as a predicate noun is in the nominative case; that a pronoun used as an object of a verb or preposition is in the objective case. The list of the elementary habits in personal pronouns is given in Table CX, on page 331. From the list it will at once be clear that it would be an ex-

traordinary assumption to suppose that a child could, by a process of generalization, derive the correctness of each of these 528 habits from the three simple rules which govern them.

TABLE CX. NUMBER OF ELEMENTARY HABITS IN USES OF PERSONAL PRONOUNS

1. As simple subject:
   (Him, He) is going to town.
2. As members of compound subject:
   (Her, She) and (me, I) are going to the city.
3. As subjective complement:
   It is (I, we) (they, them).
4. As subjective complement and antecedent of relative clause:
   That was (she, her) who called yesterday.
5. As subject in apposition:
   (We, Us) boys went to the game yesterday.
6. As subject of adverbial clause:
   John is older than (he, him).
7. As simple object of a verb:
   John hit (me, I).
8. As a member of a compound object of a verb:
   You warned John and (me, I) against this.
9. As object of a verb and antecedent of a relative clause:
   We saw (him, he) who pitched the winning game in the National Series.
10. As simple indirect object of a verb:
    John gave (us, we) some candy.
11. As a member of a compound indirect object of a verb:
    Father is sending John and (me, I) some books from Germany.
12. As simple object of a preposition:
    John was kind to (me, I).
13. As members of a compound object of a preposition:
    It was a question between (him, he) and (I, me).
14. As object of an omitted preposition:
    It is (he, him) you seek.
    Woe is me, for I am undone.

TABLE CX (CONTINUED)

15. As indirect object in apposition:
    John gave us boys some apples.
16. As direct object in apposition:
    They chased us girls down the street.
17. As object in apposition of a preposition:
    Some of us girls did not go to school today.
18. As an object of an infinitive:
    My father would be glad to have Harry and (I, me) go to church.
19. As object in an adverbial clause:
    The speaker annoyed you more than (I, me).
20. As object in apposition with direct object of verb:
    They sent us, John and (I, me), to the medical examiner.

With respect to persons and cases there are sixteen forms of the personal pronoun for the first seven uses in the declarative sentence	112
The same number in the interrogative sentence	112
For uses 8, 9, 10, 11, 12, 13, 14, 16, 18, 19, there are eight forms in the declarative sentence	80
The same number in the interrogative sentence	80
For uses 15, 17, and 20 there is only one form for each in both types of sentence	6
For uses 8, 9, 10, 11, 12, 13, 14, 16, and 19 there are fifteen forms in the imperative sentence	135
For uses 15, 17, and 20 there is one form for each	3
	528

The writer also worked out the elementary uses of other pronouns: indefinite compound, possessive, relative, interrogative, and demonstrative. When the number of these uses was added to the number of those in personal pronouns, he found a total of 696. Not being a linguist, he undoubtedly overlooked some, and so in reality there are probably over 700 elementary habits in pronouns. He is now curious to know how many there are in other parts of speech, but he leaves this problem to a linguist. The number of uses found in pronouns gives us some idea of the complexity of language habits and of the hundreds of elements which must receive specific drill in order to insure correctness and facility in their use.

The Law of Satisfaction

Language work, like other school subjects, must be motivated and made interesting by attaching to it some native interests or instincts. The instincts that may be used are vocalization, display and social approval, curiosity and mental play, and self-assertion. Language has its direct source in vocalization — in the cries, babblings, ahs, and yells of the infant. These express his good humor, distress, fear, or anger before he learns to talk. Afterwards he expresses the same moods through language when it is adequate; when it is inadequate he falls back on primitive vocalization. The child has a direct motive for learning language, not only because he can do what others do and so win their approval, but also because it is a more effective and direct method of satisfying and expressing other native wants and impulses, such as hunger, thirst, and play. The call "bottle," "water," or "ball" usually brings him the wanted article. When he becomes a little older he learns, by listening to directions, how to play a game. Because of this direct connection of language with the satisfaction of native wants, learning to talk is an interesting process to the child. Learning to talk correctly is less interesting because talking incorrectly accomplishes the functions of language. Learning to write correctly is still less interesting, because none of the child's native wants are left unsatisfied through failure to write. It would seem that learning to talk and write correctly could be made just as interesting as learning to talk if we provided the same incentive; that is, if we refused food or drink or plaything until it is correctly asked for. An additional incentive would be supplied if the family would frown on the child's errors and praise his correct speech as lavishly as it does his first attempts at saying words. The teacher is at a disadvantage in these respects. He cannot withhold a native want in order to make the child speak or write correctly — at least not native organic wants. He can

approve and disapprove, but that is a weak stimulus when the parents and playmates do not approve and disapprove in the same way. However, he can greatly increase the strength of this stimulus if he can get the pupils to imitate him in these respects. He can get support for this by arranging games in which the user of bad English is made the "goat," and also by appealing to the child's instinct for self-assertion; that is, by rewarding him for succeeding in doing what he attempted to do. This source of satisfaction for the learner becomes greater after he can give a reasonably clear expression to his thought in writing and is able to convey them to his playmates and teacher. In addition, he secures the applause of his playmates and teacher for a task well done. This alone may be sufficient to keep up his interest in further productions.

Language Games

The language game undoubtedly makes the widest appeal to the instinctive impulses of the child in his learning of correct English. It may appeal either to action, as in dramatization; to exploration, as in a guessing game; to self-assertion and rivalry, as in a game in which sides are chosen and scores kept; to the love of rhythm, as in a jingle which contains a language error and its correction; to hunting, as in an "I spy" game; or to fear, as in the dramatization of "Billy Goat Gruff" in which the troll threatens to eat the little billy goat. One example of each is given below.[1]

THE WINDS

(Drill on *shall* and *will* is afforded through dramatization.)

Five children may represent the cold north wind, five the east wind, five the warm south wind, and five the west wind, while other children represent flowers of different seasons of the year, such as violet, daisy, and goldenrod.

[1] All are taken from "Games and Other Devices for Improving Pupils' English," by Werrett W. Charters and Harry G. Paul.

EAST WIND. Shall I come now, Violet?

VIOLET. Yes; and bring your warm spring rains.

(*The* East Wind *blows, and the five children softly pass the violet.*)

SOUTH WIND. Shall I come now, Daisy?

DAISY. Yes; you may come now and bring warm weather.

(*The* South Wind *passes the daisy very, very quietly.*)

WEST WIND. Shall I come now, Goldenrod?

GOLDENROD. Yes; you may come and bring Jack Frost.

(*The* West Wind *with huffing and puffing passes by.*)

NORTH WIND. Shall I come now, Flowers?

ALL FLOWERS. Yes; you may come and scatter our seeds about.

(*The* North Wind *passes noisily by, and the children scatter to their seats.*)

PRINCE OF PARIS

This game can scarcely be surpassed for rapidity, interest, and much drill in a short space of time. The children are numbered, and then the following dialogue takes place:

TEACHER. The Prince of Paris has lost his hat, and who's to blame but No. 9?

NO. 9. What, I, sir?

TEACHER. Yes, sir; you, sir.

NO. 9. It wasn't I, sir.

TEACHER. Who, then, sir?

NO. 9. No. 3, sir.

NO. 3. What, I, sir?

TEACHER. Yes, you, sir. [Etc.]

WHERE DID YOU GET THOSE PENCILS?

The class is divided into two parts. A child in part 1 may ask a question, using *them* or *those*; as, "Where did you get those pencils, John?" John, in part 2, answers, "My sister gave them to me." A child in part 2 then asks a question of someone in part 1 until every child has either asked or answered a question. If the words are used incorrectly, points are scored against the side making the error. The side having the lowest score is the winner.

SOME RIMES

In the course of study of the schools of Decatur, Illinois, the following rime is offered:

A fat little boy who said *ain't*
Fell into a big can of paint.
And when he got out,
He said, with a shout,
"I'll say *isn't* and *aren't*, not *ain't*."

When children have learned the uses of *will* and *shall* they may perhaps learn this rime:

When I or we desire to ask
Of things that are or may be,
We summon *shall* and bid it lead
Our question on its journey.

SOMEBODY HAS BEEN HERE

After it has been pointed out that the sentence "Somebody left their book here" is not only grammatically incorrect but false in statement, the children enjoy passing around the room in a slow walk and, without the one watching the other, leaving a book or less easily identified article, such as a ruler, an eraser, or a pencil, on the desk of a classmate. When all have resumed their seats, they may rise, one after another, and say, "Somebody left his or her ruler or pencil on my desk." The teacher asks that the name be not mentioned; but when the children do know the owner of the various articles, they enjoy the emphasis they place on *his* or *her* alone.

THE TROLL AND THE THREE BILLY GOATS

TROLL, *a rather large child*
LITTLE BILLY GOAT, *a small child*
BROTHER BILLY GOAT, *a medium-sized child*
BILLY GOAT GRUFF, *a large child*

(*The big* Troll *crouches in the aisle past which the billy goats have to go as though crossing a bridge in search of greener pastures.*)

TROLL. (*In a very grumbly voice*) Who is crossing my bridge?

LITTLE BILLY GOAT. It is I, Mr. Troll.

TROLL. I am going to eat you for walking on my bridge.

LITTLE BILLY GOAT. Oh, please don't eat me, Mr. Troll. My brother is coming soon, and he is much fatter than I am.

TROLL. Very well, I'll wait for him; but don't you walk on my bridge again.

LITTLE BILLY GOAT. Oh, thank you, Mr. Troll; I won't.

(BROTHER BILLY GOAT *now comes onto the bridge, and the conversation is repeated.*)

TROLL. Who is crossing my bridge?

BILLY GOAT GRUFF. It is I, Mr. Troll.

TROLL. Ah, you are the one I have waited for, and now I shall eat you all up.

BILLY GOAT GRUFF. We'll see about that. (*He chases the* Troll *away.*)

Thereafter if a child uses the wrong pronoun the teacher has only to remind him that even a billy goat uses better language than that, and the next time he is more careful.

SUMMARY

The law of association leads us to expect improvement from those types of training which make composition and language meaningful, such as the selection of topics about which the child has a rich background of experience, the study of grammar, and the study of foreign language. It has been found that grade and high-school pupils can write far better compositions on subjects about which they have experience than on those which are new and strange. The subject may make a difference as wide as that between the average fourth-grade composition and the average tenth-grade composition. This suggests that we should recommend topics that do not require research, those about which the pupil can tell what he already knows.

The experiments in grammar show that the study of this subject does not improve a pupil's general reasoning powers any more than do other subjects, and that it has only a slight influence on the ability to use English correctly. The corre-

lations between knowledge of grammar and ability in English composition are low, and individuals who differ widely in their knowledge of grammar differ very little in their ability to use English. The influence of the study of foreign language is no greater than that of grammar. There is no clear proof that it improves the ability to use English. Knowledge of Latin, however, does increase a pupil's knowledge of words of Latin derivation but not his knowledge of words of non-Latin origin. It does not demonstrably increase his ability to read English. Hence it seems that the benefits for English from the study of grammar and foreign language are much less than they are usually thought to be, that the ability to use English is largely independent of knowledge of these subjects, and that the remedy for bad English is not to be found in studying them. The reasons are that the use of English is an art and not a science, and that young pupils lack sufficient power in generalization to apply the principles of grammar and language — a skill that can be acquired only by extensive practice in usage.

According to the law of satisfaction a useful type of language training is to reward correct responses and punish incorrect ones. If the functions of language could not be accomplished by its incorrect usage, there would be little difficulty in developing correct language habits. The language game undoubtedly makes the widest appeal to the instinctive impulses of the child in his learning correct usage.

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CHAPTER XVIII

LANGUAGE: INDIVIDUAL DIFFERENCES AND ESSENTIAL HABITS

Individual Differences in Composition

Individual differences in ability in composition are just as wide as in other school subjects, and possibly wider. Standardized tests in other school subjects often fail to show the extremes of individual differences because of certain limitations in them. If a pupil, in taking a time-limit test, finishes with a correctness of 100 per cent before time is called, the difference in ability represented in that reduction of the time remains unrecorded. A test may also not be difficult enough to measure the upper levels of pupils' abilities; if so, the differences shown in the test are not so wide as they are in fact. The writing of a composition, when no time limit is set, is free from these limitations. A pupil having special ability in language can give free expression to it. If such a test has any limits, it is in the nature of the subject assigned and in the difficulty of getting an expression of zero ability. Cyril Burt, in his "Mental and Scholastic Tests," gives two compositions, each written by ten-year-old pupils from the same neighborhood. The topic assigned was George Frederick Watts's well-known picture entitled "Hope." The compositions are quoted in full below, and undoubtedly represent the extremes of ability in composition among pupils of this age.

HOPE

Sublimely, majestically sorrowful she seems. Yet her name is Hope. Cowering low, not in submission to Fate, but longing for happiness, she sits, blindfolded; and fingers, lovingly and mus-

ingly, the one vibrating string of her lyre, striving to create sweet melody. The first beam of sunshine is kissing her feet; and in her inmost soul she wonders whether the time will come when it will kiss her drooping head.

She is the good spirit of the world, and the ruler of the minds of those who dwell in it. In the darkest hour of night she visits us, and helps us to wait patiently for dawn and the light.

Hope cannot read the future. But the morning star, the eye of heaven, is the prophet; and though Hope cannot see it, she feels its light shining in her heart. It puts into her soul dreams of happiness, thoughts of the realization of her ideals, and the winning of eternal bliss.

In the most unhappy moments of the life of man, she comes to him, drives away despair, and teaches him patience. She is like a sparkling and refreshing fountain to a thirsty flower, or a light seen in the darkness by some weary footsore traveller.

HOPE

Wos a pon a tim a putr of a lrg sitndan was out a bot ro stne no. (Once upon a time a picture of a girl sitting down without any boots or stockings on.)

Hudelson, who investigated the individual differences among 770 pupils from Grades VII to XII inclusive, found within each grade a much wider difference in quality between the poorest composition and the best than the difference which exists between the standard composition of Grade IV and that for Grade XII. This means that some high-school seniors cannot write as good a composition as the average fourth-grade child. The tables below give the figures for Hudelson's investigation. Table CXI gives the highest and the lowest score found in each grade, the range between them, and the median score for the grade. Table CXII gives the percentage of overlapping between one grade and each of the other grades. The least overlapping was that found between Grades VII and XII, 24 per cent of the pupils in Grade VII equaling or surpassing the median of Grade XII; the most overlapping was found between Grades VIII and IX, 49 per cent of the

TABLE CXI. LOWEST, HIGHEST, AND MEDIAN SCORES AND RANGE IN COMPOSITION IN GRADES VII–XII. (After Hudelson)

GRADE	LOWEST SCORE	HIGHEST SCORE	RANGE	MEDIAN
VII	1.0	8.2	7.2	4.7
VIII	1.0	8.0	7.0	5.5
IX	1.9	8.4	6.5	5.6
X	1.8	9.0	7.2	6.2
XI	2.5	8.8	6.3	6.5
XII	3.3	8.9	5.6	6.7
All	1.0	9.0	8.0	6.1

TABLE CXII. PERCENTAGE OF OVERLAPPING OF EACH GRADE WITH EACH OTHER GRADE, GRADES VII–XII. (After Hudelson)

GRADES	VII	VIII	IX	X	XI	XII
VII . .		39	38	31	26	24
VIII . .	60		49	41	35	32
IX . . .	74	51		37	33	32
X . . .	65	56	55		40	34
XI . . .	74	64	61	55		44
XII . .	73	63	61	56	52	

The table should be read as follows: 39 per cent of Grade VII equals or surpasses the median score of Grade VIII, 38 per cent of Grade VII equals or surpasses the median score of Grade IX, 31 per cent of Grade VII equals or surpasses the median score of Grade X, and so on.

pupils in Grade VIII equaling or surpassing the median of Grade IX. Another way of expressing these facts is to say that 74 per cent of the pupils in Grade VII would match an equal percentage of those in Grade XII, and that 99 per cent of the pupils in Grade VIII would match and equal the percentage of those in Grade IX. If more instruction is to be given in composition, the instruction that is suitable for Grade VIII would be suitable for Grade IX, and it would not need to be changed very much to be suitable for Grade XII. But the wide range of abilities within each grade shows that what is needed is individual instruction.

Methods of Individual Instruction

A number of methods are possible in adapting instruction in English composition to the individual; namely, special promotions and classification according to ability, the Dalton plan, the Winnetka plan, and the supervised-study plan. The plan of special promotion and classification according to ability implies no necessary change in the curriculum or in the school organization. When a pupil has unusual ability it allows him to cover the ground more rapidly than the average by skipping. Placing him in a class according to his ability also increases his chances for finding the material suitable to his needs.

The Dalton plan, like the plan of special promotion, requires no change in the curriculum. It differs from the ordinary school procedure in the following respects: At the beginning of the year the pupil is given an outline of the year's work in English. At the beginning, or as soon as he is ready, he receives a detailed assignment for the month. This includes the textbook material and exercises to be covered that month and is accompanied by typewritten instructions for doing this work. The month's work is given in four blocks, one for each week, and each week's work is subdivided into five units, one for each day. The pupil is permitted to do his units, or jobs, as rapidly as he pleases and in the order he pleases. Each morning he confers with his teacher, who checks up his work of the day before and helps him to plan his work for the day now beginning. Both pupil and teacher keep a graph of the units completed, the completion of each unit counting so much toward the pupil's credit. His composition is due when presented, at which time his teacher goes over it with him, corrects it, points out the mistakes, and, if necessary, requires a rewriting. If it passes, the pupil receives credit and proceeds to his next task.

The Dalton plan meets the pupil's individual needs in these respects: It allows him to work at his own rate and in the

order he chooses, it does not allow anyone else to restrain him or push him along, and it enables the teacher to give him suggestions that apply to his own case. The plan may fail to meet the pupil's individual needs, since the assignments are presumably the same for all the pupils of a given grade; therefore they may not be suitable for remedying his defects or they may not be adjusted to his interests and abilities.

The essential features of the plan used at Winnetka and some other places are the following:

1. Determining the pupils' needs, abilities, and classification by standardized tests.
2. Setting up specific goals to be accomplished within each grade.
3. Using practice exercises devised to help the pupil to accomplish the goals.
4. Determining the attainment of a goal by scientific tests.
5. Allowing the pupil his own time for achieving the goals.
6. Stimulating the pupil by having him keep a graphic record of his progress.
7. Absence of class work and of the usual school marks.
8. Self-correction of errors by comparison with a correct model.

The goals set up for the language work of the fifth grade are a mastery of the following:

1. Simple possessives.
2. Tricky possessives.
3. Plural possessives; as, *boys'*.
4. Plural possessives; as, *children's*.
5. Comma in series.
6. Comma in address.
7. Comma: *yes, no, oh.*
8. Simple quotation.
9. Exclamations.
10. Capital for deity.
11. Paragraphs.

If a child has mastered the first four of these goals, he begins reading the developmental material on commas in series. He then begins the practice of writing sentences which contain series, of placing commas in their proper places, and of correcting his work by referring to answers in the back of his practice book. He then takes a practice test in which he is required to copy correctly a paragraph that has all capitals and punctuation marks omitted. He compares this with the correct model in his book. If he has made no mistakes, he proceeds to his next goal; if he has made mistakes, he resumes practice until he thinks he is prepared for another test.

This plan has all the merits of the Dalton plan and some additional merits as well: the content and goals are not determined by the traditional curriculum, but are selected on the basis of their widespread social value; the practice materials are devised and specifically adapted to the accomplishment of the goals. And it has the same weaknesses as the Dalton plan, but to a lesser degree. In spite of the fact that a goal is selected on the basis of its social value, it may not be adapted to the needs and interests of a particular individual. This is particularly true of the method required in reaching it. It also, like the Dalton plan, lacks social stimulation for language work. There is no reason, however, why this could not be supplied by providing a group to hear and criticize the pupil's achievement.

The supervised-study plan of teaching English composition is not a fixed procedure. One of the most efficient methods has been developed in the University High School of The University of Chicago. Mr. Hanes, a teacher in the school, describes this method as follows:

> In the beginning, each pupil is tested in order to determine his present knowledge and power, and auxiliary evidence of current practice is gathered from the papers which he writes for subjects

other than English. In this way the individual need of each pupil is determined and recorded.

The pupil, having been apprised of his characteristic errors and convinced of the necessity of correcting them, is introduced in turn to the principles involved. The presentation of each principle is followed by practice exercises until he shows under testing his understanding of the principle and his mastery of the correct practice. Further observance of the correct usage then becomes his responsibility and personal obligation in all composition work, not only in English but in all subjects involving expressional activities.

The principles involved in the correction of such errors as are common to all of the members of a class or to any considerable number of the pupils are presented by the instructor in general lessons to the entire class or to the group needing the instruction. The presentations of the principles, together with the illustrations of their use, may be strengthened by means of similar material from the textbook. During the use of such textbook material and during the subsequent period of practice the pupils engage in study under the supervision of the instructor. The teacher moves quietly about the room while the pupils are studying or practicing their exercises and gives supplementary explanations, repeats the information already given, where necessary, checks the correctness of the exercises completed, administers tests to the pupils who are ready for them — in short, offers the stimulation or guidance that each pupil requires. It can be readily surmised that in such a procedure some pupils will progress more than others. Since the work is highly individualized and there is a record of each individual need, any pupil can attack a new problem as soon as he has satisfactorily mastered the first. If it is desired to make a group presentation from time to time, the pupils who finish a problem ahead of their classmates are permitted to read from the literature content of the course. Books are at all times available in the classroom for this purpose.

The classroom thus becomes the workroom of from twenty to thirty pupils, each at work on a project in the successful completion of which he may need from time to time the instructor's assistance, either in straightening out his thinking or in stimulating his will to progress. The functions of the instructor are stimulation, sympathetic guidance and explanation, and constant

observation of individual progress. There is no recitation, no group testing of results. The unit of instruction is the individual; the unit of content, the principle he must learn to observe. Progress is determined through testing the individual and observing his subsequent unsupervised work.

What Habits should be formed in English Composition?

Before answering this question we should know the specific skills to be developed in English composition, written and oral. These, according to the National Joint Committee on the Reorganization of English in the High Schools, are as follows:

1. Ability to write a courteous letter according to the forms in general use.
2. Ability to compose a first draft, a clear and readable paragraph, or series of paragraphs, on familiar subject matter.
3. Ability to analyze or present in outline form the gist of a lecture or piece of literature.
4. Ability with due time for study and preparation to plan and work out a clear, well-ordered, and interesting report of some length upon one's special interests.
5. For those who have literary tastes or ambitions, ability to write a short story or other bit of imaginative composition.

Note. All expression in writing demands correctness as to formal details; namely, a legible and firm handwriting, correct spelling, correctness in grammar and idiom, and observance of the ordinary rules for capitals and marks of punctuation; the writer should make an effort to gain an enlarged vocabulary, a concise and vigorous style, and firmness and flexibility in constructing sentences and paragraphs.

The Joint Committee says the general purpose of oral expression is to make possible "an accurate, forceful, living speech."

The immediate classroom aims of teaching in oral expression are the ability (1) to answer questions intelligently and fully; (2) to converse agreeably; (3) to collect and organize material for oral discourses; (4) to present effectively in a natural environ-

ment material already organized; (5) to join courteously and pertinently in informal discussion; (6) to read aloud in such a way as to present the writer's thought and spirit; (7) for those who have, or hope to develop, qualities of leadership, the ability to address an audience or to conduct a public meeting.

To attain these ends the Joint Committee recommends practice in the mechanism of oral expression: breathing, vocalization, posture and gesture, phonetics, oral reading, recitation and declamation, dramatics, conversation, extemporaneous speech, debate, and the formal oration on special occasions. "All expression in speech demands distinct and natural articulation, correct pronunciation, the exercise of a sense for correct and idiomatic speech, the use of an agreeable and well-managed voice."

The skills named in this report apply also to grade work, the principal difference being that we expect a lesser degree of them. The ability to outline a lecture or a piece of literature should be limited to the ability to outline a story according to a time order. The long, well-written report on a special topic should be limited to making a booklet on some geographical project with short paragraphs on the most interesting parts. The ability to write a short story should be limited to a simple narrative from one hundred and fifty to two hundred words in length. Neither should we expect in the grade pupil a vigorous style nor great firmness and flexibility in constructing sentences and paragraphs. In oral English all the skills named by the Joint Committee are attainable in the grades excepting the ability to conduct a public meeting or the ability to prepare and deliver a formal oration.

The value of this report is not only that it tells us what we should expect pupils to be able to do in English but also that it points to the kind of exercises for which the time devoted to language should be used. It happens not infrequently that the major portion of the time devoted to language is used for exercises in diagramming and parsing, but these have little to

do with the ability to write or speak. If the skills enumerated above are to be formed, the time devoted to language should be given to exercises in breathing, modulating the voice, gesturing, oral reading, pronouncing difficult words, reciting, declaiming, conversing, using the dictionary, speaking extemporaneously, making prepared speeches, and debating. In written English the time should be devoted to exercises in capitalization, punctuation, spelling, copying dictation, using the dictionary, and writing compositions and familiar letters.

Another type of exercise which should receive a great amount of time in every grade, a type not mentioned in the report of the Joint Committee, is corrective drill to avoid common errors in speech and in writing. This is one of the major tasks of the teacher of English. It applies more to him than to teachers of other subjects, because pupils have already formed language habits when they come to him, and are continually being drilled in them outside the school while receiving instruction in school. For the majority of pupils these outside exercises give practice in error rather than in correct usage. The teacher of English must therefore make a direct attack for breaking habits as well as for making them. Two kinds of exercises are available for this purpose: exercises in correcting errors and exercises in using the correct form. Both are necessary: the first, because the child must be able to recognize an error before he can correct it; the second, because the correct habits must be developed until they have greater strength than the incorrect ones. Otherwise the child will fall back on the incorrect habit when he is out of school and is receiving no disapproval for his errors. The best instrument for developing the correct habit is undoubtedly the language game, since it not only has the advantage of interest but also the advantage of developing the correct habits in a social situation, where language normally functions. The specific errors to which these exercises should

be directed and for which correct substitute habits should be formed have been indicated in the tables giving the most frequent errors and their grade location.

Materials which are useful in developing language habits are games, formal drills, pictures to be interpreted; selections to serve as correct models of punctuation, capitalization, sentence arrangement, and other forms; selections to be rewritten in correct form; and selections of literature to be used for declamation and for interpretation. A superior collection of language games has been compiled by Charters and Paul and published by the Bureau of Education. All these games have been tried and successfully used by experienced teachers. Materials mainly used in formal drills are (1) models of the correct form, (2) mutilated sentences, (3) questions and answers, and (4) suggestive words for sentence-building.

Models of the correct form may be in verbs, pronouns, phrases, and sentences. Frequent repetition of these develops a correct habit of speaking and also trains the ear to detect the correct form by sound. Mutilated sentences may consist either of sentences in which both correct and incorrect forms are used or of sentences in which blanks appear. In the first kind the child's task is to cross out the incorrect form, and in the second, it is to fill in the correct form. These may be used for any part of speech.

Questions and answers are used by both pupils and teachers, or by the pupils alone. The type of error to be corrected by this method is determined by the form of the questions. Examples are:

"Who read the paper last night?"
"John and I read the paper."

"What can you tell me about these pictures?"
"The pictures are very pretty."

In sentence-building the teacher places suggestive words either on cards or on the blackboard and asks the pupils to

build sentences out of them. Among the suggestive words are usually the correct forms of common errors. Examples are:

We boys
We girls
My mother and I
John, Henry, and I

No study has yet been made of the best pictures for developing stories and speeches, but nearly all modern-language texts contain good ones. The most complete list, classified according to grade, is given by Mahoney in his "Standards in English." The reading selections useful for developing speeches and stories would undoubtedly be the same as those used in the teaching of reading. The standards given in the chapter on "Reading" may be applied here.

What Grammar should be Taught?

Because of the fact that the value of formal grammar in enabling pupils to speak and to write correct English has not yet been demonstrated in any of the scientific studies that have been made of it, the writer is not convinced that any grammar should be taught in the grades. It would be an economy to teach it if pupils could or would use it to correct their own errors in English after leaving school. But because of the limits to the ability in generalizing from rules to specific cases and because of the fact that usage is determined by habit rather than by reason, the hypothetical values of grammar often fail to become real. However, it is a reasonable proposition to suppose that the right sort of grammar, taught in the seventh and eighth grades, could be made useful. If any is taught, it should be such as relates directly to the diminution of common errors in speech and in writing. Charters has worked out these parts of grammar and recommends them to be taught, not on the basis of their proved usefulness but on the basis of their logical or functional relationship to the common errors. An outline of the content of this material is

given below in the form summarized by Mabel C. Hermans in her pamphlet on "Teaching Grammar by Problems."

ITEMS INCLUDED IN A COURSE OF STUDY IN GRAMMAR IN KANSAS CITY, BASED ON GRAMMATICAL ERRORS. (After Charters)

Nouns

1. Definition
   a. Proper
   b. Common
2. Inflection of nouns
   a. Number
   b. (Case)
   c. (Gender)
3. Syntax
   a. Subject of verb
      (case)
   b. Subjective complement
   c. Object of verb or preposition
   d. Indirect object

Pronouns (7 per cent of all errors found by Charters)

1. Definition
2. Personal pronoun
   a. (Gender)
   b. Number
   c. (Person)
3. Compound personal pronoun
4. Relative pronoun
   a. (Gender)
   b. Case
5. What

Verbs (57 per cent of all errors found by Charters)

1. Definition
   a. Kind
      (1) Transitive
      (2) Intransitive
      (3) Copula (verb that shows state of being)
2. Inflection
   a. (Person)
   b. Number

3. Tense
4. Can and may
5. Mood
6. Voice
7. Past participle
8. Infinitive

Adverbs (and adjectives)
1. Definition
   a. Adjective
   b. Adverb
2. Comparison

Prepositions
1. Definition
2. Their relation to the phrase

Conjunctions
1. Definition
2. Principal coördinate conjunctions
3. Subordinate conjunctions

Misplaced modifiers

Double negative (11 per cent of all errors found by Charters)

Syntactical redundance (10 per cent of all errors found by Charters)

Spelling

Sentence structure
1. What a sentence is
2. How to write a sentence

Parsing and analysis
1. Definition of parsing

Summary

Individual differences in composition seem to be wider and the amount of overlapping to be greater than in any other school subject. Within each grade from VII to XII inclusive there may be differences in quality greater than the difference between the standard for Grade IV and that for Grade X. Plans which are used to meet these differences are classification and special promotion according to ability; assigning units of work to be completed at the pupil's own rate (the

Dalton plan); diagnosing a pupil's needs and assigning him goals to be achieved by specially devised practice exercises which he completes at his own rate (the Winnetka plan); and diagnosing a pupil's errors and giving him individual corrective work and teaching (the Chicago supervised-study plan).

The objectives to be achieved in English composition have been carefully worked out. The more important objectives in written composition are the ability to write a courteous letter according to the forms in general use and ability to compose at first draft a clear and readable paragraph on a familiar subject; in oral composition they are the ability to answer questions intelligently and fully, the ability to collect and organize material for oral discourses, the ability to present effectively in a natural environment material already organized, and the ability to read aloud in such a way as to present the writer's thought and spirit. The accomplishment of these objectives requires that the time devoted to language shall be spent in corrective drill and in exercises in speaking and in writing rather than in an analytical study of the structure and form of language. The material which is useful in developing language habits comprises games, formal drills, pictures to be interpreted, selections to serve as correct models, selections to be rewritten in correct form, and selections of literature to be used for declamation and for interpretation.

It is not certain that any grammar should be taught; but if any is taught, it should be such as relates to the correction of the most common errors in language.

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CHAPTER XIX

HISTORY

Aims

It is generally agreed by those who have studied the purpose of history that its principal aim is to develop and train those capacities which make for good citizenship. But what the capacities are which make for good citizenship and what the best materials are for developing them are disputed questions. Some would have the child begin with Greek history or something still more ancient; then follow in chronological order the complete history of the development of European civilization, taking up Roman history, medieval and modern history, German and English history; and end with American history as the climax of the historical process. Others would begin with the present by analyzing the social problems of today, then search out those historical materials which are helpful in understanding and solving these problems and make them the basis of the course of study in history for the public schools. Which of these methods is the better adapted to the accepted purposes of history we shall leave for later discussion. But, in addition to the principal aim, historians claim for their subject such results as the appreciation of the present, the development of patriotism, or love of country, the cultivation of judgment, the ability to arrange and systematize facts, some skill in scientific thinking, skill in the selection and handling of books, the quickening of the imagination, and the ability to express oneself in well-chosen words. The psychologist sees the origin of most of these in the disciplinary conception of education and looks upon them

as desirable by-products for any subject that is well taught. Doubtless some of these (for example, love of country and the taste for good reading) apply more to history than to other school subjects. History has, in addition, some important values which are seldom mentioned by historians; namely, the development of a technique for the analysis and solution of social problems, the ability to understand historical references in reading matter, and the ability to participate in conversation about historical persons. But whatever the ultimate objectives or materials of history may be, it is certain that the immediate objective for the teacher will be the comprehension and retention of certain material.

Types of Performances in History

Performances in history are of many types and bring into action numerous abilities. They may be matters of information or of thought. Matters of information include such things as knowing the names of the person or persons connected with a certain event (such as the invention of the cotton gin or the Kansas-Nebraska Act), knowing the places of certain events (such as the Constitutional Convention or the battle between the *Monitor* and the *Merrimac*), or knowing the contents of certain legal enactments (such as the Monroe Doctrine or the Compromise of 1850), or knowing the time or the temporal relations of certain events. This last includes knowledge of the sequence of certain events, the number of events contemporary at certain intervals, the length of time between certain events, or the historic period in which a certain event falls. Matters of thought include judgments of the content of historical prose, or of the cause-effect relationship between certain events, or of the importance of a certain event as the cause or effect of another, or of the reliability of sources and evidence, or of the value of an event as illustrative of the dominant features of a certain his-

torical period, or of the qualities and motives that may be most fittingly ascribed to a given historical character. Each of these kinds of judgments (for example, the reliability of sources) depends upon the mastery of many facts which only an expert in the field can describe.

Influence of Age, Grade, and Sex

Performance in history, like that in other school subjects, is relative to age, grade, intelligence, and sex. In evidence of this we have the results of standardized tests such as those of Barr and Van Wagenen. Barr's Diagnostic Tests in American History contain five kinds of tests: (1) tests of ability to interpret historical prose; (2) tests of the temporal relations of certain events; (3) tests of the reliability of sources; (4) tests of the importance of certain events in reference to others; (5) tests of cause-effect relationships between events. The maximum score in each test is 20. Table CXIII gives the tentative standards for Grades VIII and XII.

Table CXIII. Tentative Standards for Barr's Diagnostic Tests in American History

Grades	Test 1	Test 2	Test 3	Test 4	Test 5
Eight (Scale 25)	7.2	7.1	5.7	9.6	5.4
Twelve (Scale 25)	10.0	8.0	9.0	12.3	7.5

Van Wagenen's American History Scales are on information, thought, and character. The information questions refer mostly to persons or things connected with certain historical events and to temporal relations, the thought questions are principally of the cause-effect type, the character questions require the selection of suitable adjectives to characterize qualities and statements to express motives. Each scale contains from twenty to thirty-two questions arranged in order of difficulty. From 0 to 3 credits are allowed for each

question, according to the correctness of the answer. The score is the number of credits in each scale divided by 3, which is practically the same as the number of questions correctly answered. Table CXIV gives the medians for boys and girls in relation to grade, and Table CXV gives them in relation to age. In Table CXV the age having the highest frequency in a grade is taken as the age for that grade.

TABLE CXIV. MEDIAN SCORES BY GRADE AND SEX FOR VAN WAGENEN'S AMERICAN HISTORY SCALES

	GRADE IV	GRADE V	GRADE VI	GRADE VII	GRADE VIII
Information A:					
Boys	5.59	9.98	13.63	15.21	17.68
Girls	4.36	7.63	10.34	10.40	13.93
Thought A:					
Boys	2.76	6.41	12.86	16.13	19.88
Girls	2.28	4.11	8.10	12.34	15.32
Character A:					
Boys	2.01	4.39	7.23	10.27	12.55
Girls	1.91	3.97	6.38	9.27	11.46

TABLE CXV. MEDIAN SCORES BY AGE FOR MOST FREQUENT AGE IN EACH GRADE

	AGE				
	9½	10½	11½	12½	13½
	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII
Information A	5.0	8.9	12.6	13.3	15.6
Thought A	2.5	5.8	11.4	14.8	18.0
Character A	2.5	4.6	8.0	10.1	12.3

It will be seen that the score for the information scale is about three times greater in Grade VIII than in Grade IV, for the thought scale the corresponding increase is seven times, and for the character scale it is six times. The age medians show similar ratios of increase in the age $13\frac{1}{2}$ over

the age $9\frac{1}{2}$. Within the grade, however, the score decreases as the age of the pupil increases. In Grade VI, for example, one pupil $8\frac{1}{2}$ years old has a score beyond the eighth-grade median, and ten pupils $15\frac{1}{2}$ years old have a median score that is nearly the same as the fifth-grade median. Such differences are due principally to brightness, but the general increase in relation to age and grade is due to maturity combined with training.

The sex differences in history are strikingly large. This appears not only in the difference between the medians in Table CXIV, but still more in the percentage of boys who equal or exceed the median of the girls of the same grade. In Grade VI, for example, this is 60.2 for the character scale, 80.6 for the thought scale, and 82.7 for the information scale. It would be difficult to account for these differences by any explanation based on training or on environment. In the average, girls are a bit superior in reading and in language abilities; and since performances in history depend largely on these, we should expect their superiority to appear in history, but it does not. There is also nothing in custom or in public-school teaching to emphasize the idea that history is principally a boy's subject, nor is there anything in the test to indicate that the questions are primarily for boys. The differences are probably due to some native impulses which are stronger in boys than in girls; such as the impulses to adventure, fighting, and action.

The Law of Repetition

We have seen that the law of repetition is the secret of speed in reading, of accuracy in arithmetic, of good form and speed in handwriting, and of correctness in spelling. What is its value in history? Half a century or more ago it was the principal method of learning history, for at that time history was memorized verbatim; but in recent years the idea most

emphasized in teaching this subject has been that of comprehension, and with this we have gone to the extreme of forgetting the value of repetition. Nevertheless repetition is quite as necessary for comprehension as for retention. It is next to impossible for a child to get in one reading the full content of a chapter in a history textbook. There are too many facts and too many sentences which must be balanced against one another in order to sift out the essentials. But something of history should be retained. If it is not retained, no further use can be made of it, either for conversation or for applying it to the solution of modern problems. For retention we know that frequent relearnings are necessary. Of this the law of forgetting is conclusive proof — 97 per cent forgotten after one hundred and twenty days, 80 per cent after thirty days, and 52 per cent after eight hours, according to the experiment of Radossawljewitsch. This is for nonsense material which has been completely memorized; that is, to the point of an errorless reproduction. For completely memorized meaningful material the forgetting is somewhat slower; but for meaningful material which has not been memorized but only comprehended, it would probably be faster. The only remedy for such a condition is repetition — repetition in the form of many relearnings or reviews.

Do Textbooks in History provide for Repetition?

If we examine textbooks in history for the amount of repetition provided we find only a slight amount of it. Out of three widely used current textbooks for Grade VIII which the writer has analyzed he finds two that provide for two repetitions, one in the reading and one in the review questions at the end of the chapter; and one which provides for three repetitions, one in the reading, one in the review questions at the end of the chapter, and one in a divisional review. In a book published in 1905 he finds provision for only one rep-

etition; there are no review questions. This would probably be sufficient if the eighth-grade child were expected to retain only six or seven essentials from the book, but such is not the case: according to the modern textbooks for the eighth grade the pupil is expected to master nearly a thousand facts. What the actual situation is may be seen from Table CXVI, which

TABLE CXVI. ANALYSIS OF THREE EIGHTH-GRADE TEXTS IN AMERICAN HISTORY

TOPICS IN INDEX	TEXT A	TEXT B	TEXT C
Persons	298	338	342
Places	247	292	251
Social groups	116	106	104
Political and military topics	52	45	68
Social topics	66	23	24
Economics topics	71	67	59
Inventions and machines	22	22	24
Legal acts	44	29	78
Total	916	922	950
Number of sections	564	695	511
Number of review questions	500	441	788
Number of exercises	296	135	129
Number of pages	534	533	662
Divisional reviews			7
Special attention to persons			120
Special attention to dates		76	32

shows the number of facts in three modern textbooks. To get a rather exact idea of the number of important facts in a history text, the writer counted the number of topics in the index and classified these according to the subject. He also counted the number of sections headed by a title in heavy type, the number of review questions, exercises, and pages, the number of divisional reviews, and the number of persons and dates to which special attention is called. The total number of topics in the index is nearly the same in the three books — 946 to 949. Of these, the greatest number refer to persons — 298 to 342. The next greatest number refer to

places — 247 to 251. Next in number are the social groups, such as Algonquins, Separatists, Supreme Court, of which there are over a hundred. Then follow topics that may be classified as political events, social data, economic data, inventions, and legal acts, of which there are from 22 to 82 in each group. It may be objected that not all the topics referred to in the index are expected to be remembered, that the purpose of the index is to enable the reader to find a fact in which he is interested, but this can hardly be applied to the number of sections or to the number of review questions and exercises. When an author devotes a separate section to a topic, he must consider it of some importance. The same is true when he asks a specific question about a topic or asks the pupil to do an exercise on it. If we base the number of important facts on the number of sections or review questions, we get from 500 to 788, but to these must be added many topics to which special attention is called in the exercises. These vary in number from 135 to 296. Therefore a conservative estimate of the number of topics which a pupil is expected to learn in the eighth-grade history would be 750, and a more liberal estimate would be 950. In spite of the fact that so many topics are emphasized, no special drill is provided for their mastery. If this is to be accomplished, the teacher must organize some form of supplementary drill. But upon what shall he drill and what form of drill shall he use? Here the textbooks give little help. One book names one hundred and twenty persons and thirty-two dates as important; another names seventy-six dates as important. It is easy to determine what should be said about dates, but what should be emphasized about persons, or places, or social groups, or legal acts, or inventions? It would be an economy if we knew the "minimum essentials" here, but we do not; hence the teacher must "use his ingenuity." A possible form of drill would be the following: on one side of a card could be placed the principal legal acts, such as the Kansas-Nebraska Act, the

Compromise of 1850, the Monroe Doctrine, the Stamp Act, and opposite these the main points of each in outline form. The same form might be used for inventions, social groups, places, and for each of the other classes of topics. These cards would be passed to the pupils, who would be asked to memorize them. In the test the teacher would ask for an oral or written reproduction of the substance of each topic that he names. A device of this kind would at least enable the pupils to get the skeleton of history.

The Law of Association

Applications from Reading

Since history is something to be comprehended, we may expect the law of association to play a major part in accomplishing this end. But, as with the law of repetition, we have few or no experimental results to guide us in determining its precise value. However, since the material of history is principally prose, we can apply such devices as have been found useful in increasing comprehension in reading. We can give advance questions on the content. We can give review questions. We can require the pupil to outline and summarize his lesson and can, by questions, direct his attention to the main points. We can ask him to make out a list of questions which the assigned reading answers, we can give problems for special investigation, or we can arrange a dramatization of a historical event, such as the Constitutional Convention or a convention nominating a presidential candidate, or we can ask him to draw a sketch of a historical scene such as Washington crossing the Delaware.

The chief devices used by textbooks are suggestive titles for chapters and sections, review questions, pictures, maps, and exercises such as supplementary reading or map-making. Some of these devices deserve special attention.

Suggestive Titles and Section Headings

There is no doubt that suggestive titles help the young pupil to get the content, but they are not all equally valuable. In one textbook the titles tell the pupils simply the topic discussed; another has the titles so arranged as to suggest the points of the paragraphs. For example, one book has the title "Why the English became Revolutionists" with the accompanying section headings:

After the War. Grenville's Plan. Stamp Act. Resistance to the Stamp Act. Repeal of the Stamp Act, 1766. The Townshend Acts. Resistance to the Townshend Duties. Boston Massacre, March 5, 1770. Tax on Tea. Committees of Correspondence. Boston "Tea Party." Etc.

The headings for the same subject in another book are grouped under general titles which suggest their import:

Causes of the American Revolution.

I. England Begins a Strict Control over Colonial Trade.

British Imperial Policy: *Navigation Acts, Trade Laws, Acts Forbidding Manufactures.* A New King and a New Course.

II. The Protests of the Colonies against Taxation without Representation.

Opposition to the Stamp Act; *Virginia, The Stamp Act Congress. The Colonists Give Other Evidences of Disapproval.* The Stamp Act Repealed, The Townshend Acts Passed. The Boston Massacre. The Tea Tax. The "Boston Tea Party." The Colonists Punished for Their Resistance.

In the second book the reader gets the idea that the Navigation Acts were a form of restriction of our colonial trade and that the "Boston Tea Party" was a form of protest against taxation without representation. He will consequently read the paragraphs for the amplification of these suggestions. In the first book he is unable to tell whether the "Boston Tea Party" was a favor or a protest until he reads the paragraph. Not having a special mental set for the main point, it takes him longer to find it, and he may miss it.

Review Questions in Textbooks

The review questions may also merely suggest the topics for review, or they may be specific and require a pointed answer. Some books use the former procedure, and some use the latter. Examples of each are given below:

Summary of Points of Emphasis for Review:
Compromise of 1850, why the Fugitive Slave Law caused Trouble, *Uncle Tom's Cabin*, what states did to nullify the Fugitive Slave Law, etc.
Specific Questions:
Name the important events and conditions that led to the Compromise of 1850.
Which of these were favorable to the North and which to the South?
Why did the South demand that the federal government pass a fugitive slave law?
In your opinion, considering the conditions that existed, was this demand justified?

The first type of questions requires oral direction by the teacher to be made effective; otherwise such a suggestion as "Review the main points about the Compromise of 1850" may bring from the pupil merely the response, "It was made by Henry Clay," or, "It was passed in 1850." But with the second type of question the pupil can do efficient silent study by himself. The questions are so pointed that he can hardly fail to get the essentials.

The Exercises in Textbooks

Map-Making

The exercises used by textbooks may be classified into four groups: map-making, information problems, thought problems, and dramatizations. Information problems and thought problems make up the bulk of the exercises. Maps aid com-

prehension in the way of clearness or visualization and of place-associations. One may read a dozen descriptions of the movements of Washington's army, of the routes of travel in the Western movement, of the cotton regions in the South, of the manufacturing centers in the North, of the corn belt, of the regions for iron, coal, and oil, and yet fail to get as clear an idea of them as he would get from a visualization made possible by a careful look at a map. Place-associations tie an event definitely to the ground, give one the feeling of its reality, and increase so far the chances for fixation, retention, and recall. There is a possibility, however, that a map will tie an event only to the map and not to the ground. The writer recalls traveling with a man on a train from Indiana to Chicago. As we neared the boundary he remarked in all seriousness, "Now we will soon see a red state." This man probably studied maps but never made any.

Our analysis of the maps in textbooks shows that they pertain chiefly to political and military topics, such as territories, boundaries, military campaigns, and routes of travel. This tendency is illustrated in a recent and widely used book which has seventy-one maps, all but three of which refer to these topics. Of the three exceptions, one is a relief map, and the other two refer to movements of population. But political and military subjects by no means exhaust the possibilities of map-making. There should be more maps on social and economic topics, such as maps showing density and racial distribution of population; resources of timber, iron, coal, oil, and copper; production regions for producing wheat, corn, cotton, wool, meat, fruit, and sugar; and regions for manufacturing steel, gasoline, textiles, shoes, and implements. Visualization is just as possible and just as necessary for clearness in these subjects as it is in a description of territorial expansion. By using maps, the locational facts about them may be learned much more easily than in any other way.

Information Problems

Information problems aid comprehension by adding detail and vividness to the topic in question. The degree of comprehension of a subject depends to a large extent upon the number of facts known about it. Next to the failure to provide for repetition, the greatest defect in textbooks in history is the failure to say enough about each topic to make it comprehensible. The average textbook seldom devotes more than thirty lines to a single topic, and more often it devotes only fifteen or ten.

One book, for example, has nine lines on Henry Hudson. It says that in 1609 he and his men sailed up the river that now bears his name. He was looking for a short passage to China, but he found something better, for the next year a Dutch trader followed him. While sailing up the river he treated the Indians in a way that had an important bearing on the struggle for the mastery of the continent. He made friends of the Iroquois by inviting some of them on board and entertaining them with the best eatables and drink.

From this the pupil may at least learn that Henry Hudson discovered the Hudson River and that he made friends with the Indians. Is there enough given to make these facts impressive? What did Hudson do to entertain the Indians? Were all his relations with the Indians friendly? How did the scenes of the river impress him? If we knew these things, we should have a better opportunity of appreciating the reality referred to in the textbook. Turning to Hart's "American History Told by Contemporaries," we find a five-page account of these explorations by an eyewitness. This account is full of detail and makes the experiences of Henry Hudson vivid to us. A quotation will give us the tone of it:

> The *sixth*, in the morning, was faire weather, and our master sent John Colman, with foure other men in our boate, over to the north-side to sound the other river, being foure leagues from us.

They found by the way shoald water, two fathoms; but at the north of the river eighteen, and twentie fathoms, and very good riding for ships; and a narrow river to the westward, betweene two ilands. The lands, they told us, were as pleasant with grasse and flowers and goodly trees as ever they had seene, and very sweet smells came from them. So they went in two leagues and saw an open sea, and returned; and as they came backe, they were set upon by two canoes, the one having twelve, the other fourteene men. The night came on, and it began to rayne, so that their match went out; and they had one man slaine in the fight, which was an Englishman named John Colman, with an arrow shot into his throat, and two more hurt. It grew so darke that they could not find the ship that night, but labored too and fro on their oares. They had so great a streame that their grapnell would not hold them.

The *eleventh* was faire and very hot weather . . . wee anchored, and saw that it was a very good harbour for all windes, and rode all night. The people of the country came aboord us, making shew of love, and gave us tobacco and Indian wheat, and departed for that night; but we durst not trust them.

. . . . . .

The *eighteenth*, in the morning, was faire weather, and we rode still. In the after-noone our masters mate went on land with an old savage, a governor of the countrey; who carried him to his house, and made him good cheere. . . .

Our carpenter went on land and made a fore-yard. And our master and his mate determined to trie some of the chiefe men of the countrey, whether they had any treacherie in them. So they tooke them downe into the cabbin, and gave them so much wine and *aqua vitae*, that they were all merrie: and one of them had his wife with them, which sate so modestly, as any of our countrey women would doe in a strange place. In the ende one of them was drunke, which had beene aboord of our ship all the time that we had beene there: and that was strange to them; for they could not tell how to take it. The canoes and folke went all on shoare; but some of them came againe, and brought stropes of beades: some had sixe, seven, eight, nine, ten; and gave him. So he slept all night quietly.

The *two and twentieth* was faire weather: and in the morning our masters mate and foure more of the companie went up with

our boat to sound the river higher up. The people of the countrey came not aboord till noone; but when they came, and saw the savages well, they were glad. So at three of the clocke in the afternoone they came aboord, and brought tobacco, and more beades, and gave them to our master, and made an oration, and shewed him all the countrey round about. Then they sent one of their companie on land, who presently returned, and brought a great platter full of venison dressed by themselves; and they caused him to eate with them: then they made him reverence and departed, all save the old man thay lay aboord. This night, at ten of the clocke, our boat returned in a showre of raine from sounding of the river; and found it to bee at an end for shipping to goe in. For they had beene up eight or nine leagues, and found but seven foot water, and unconstant soundings. . . .[1]

Again, we read in a textbook an account eight lines long of the persecution of the Quakers. It says that the Puritans sent out of their colony those who demanded the right to teach and preach as they chose. When the Quakers, claiming this right, entered Puritan churches, denounced their beliefs, and called them "seed of the serpent," the Puritans banished all Quakers and threatened to hang them if they returned. Some came back, and the Puritans hanged four of them, thus putting an indelible stain on their colony. They were patient with people of different beliefs who remained quiet, but for many years they banished the Quakers and whipped them for returning.

History is full of stories of persecutions, hangings, and whippings. No doubt this account impresses the reader as just one of them, and is passed over in much the same way as we glance at a ten-line newspaper account of an automobile accident. But just as the accident is an intense experience to the victim, so a whipping or a threatened hanging was an intense experience to a persecuted Quaker. The reader may get some idea of this intensity by referring to Hart's "Con-

[1] From A. B. Hart's "American History Told by Contemporaries," Vol. I, pp. 123–125. By permission of The Macmillan Company, publishers.

temporaries" and reading the plea of Mary Dyer, a condemned Quakeress, to the General Court of Boston to repeal the laws which denied free passage to the Quakers, the account of the trial of a condemned Quaker, and a petition by the Quakers to the king enumerating their sufferings. The tone of the last is given in the quotation below:

THE WRONGS OF THE QUAKERS (1660)

. . . 2. Twelve Strangers in that Country, but free-born of this Nation, received twenty three Whippings, the most of them being with a Whip *of three Cords*, with *Knots at the ends*, and laid on with as much strength as they could be by the Arm of their Executioner, the stripes amounting to *Three hundred and seventy*.

3. Eighteen Inhabitants of the Country, being free-born *English*, received twenty three Whippings, the stripes amounting to two hundred and fifty.

4. Sixty four Imprisonments of the Lords People, for their obedience to his Will, amounting to Five hundred and nineteen weeks, much of it being *very cold weather*, and the Inhabitants kept in Prison *in harvest time*, which was very much to their losse; besides many more Imprisoned, of which we cannot give a just account.

5. Two beaten with Pitched Ropes, the blows amounting to an hundred thirty nine, by which one of them was brought near unto death, much of his body being beat like unto a jelly, and one of their own Doctors, a Member of their Church, who saw him, said, *It would be a Miracle if ever he recovered, he expecting the flesh should rot off the bones*; who afterwards was banished upon pain of death. There are many Witnesses of this there.

6. Also, an innocent man, an Inhabitant of *Boston*, they banished from his Wife and Children, and put to seek a habitation in the Winter; and in case he returned again, he was to be kept Prisoner during his life; and for returning again, he was put in Prison, and hath been now a Prisoner above a year.

. . . . . .

These things (O King) from time to time have we patiently suffered and not for the transgression of any Just or Righteous Law, either pertaining to the Worship of God, or the Civil Government of *England*, but simply and barely for our Consciences to

God, of which we can more at large give Thee (or whom thou mayest order) a full Account. . . .[1]

What the textbook lacks on account of brevity of statement, the student must supply by seeking a long story in supplementary reading which will give him vividness and detail. Usually these conditions are best satisfied by references to sources. Sometimes these are too difficult, and in that case secondary accounts are better. Since supplementary reading is highly important for increasing comprehension, the references to such reading should be carefully arranged. Some books give information problems but no references; some give references but no problems; some give both references and problems but do not indicate which references should be used for solving a particular problem; and some give the exact references, page and book, after each statement of a problem. Considering the smallness of a grade pupil's ability to help himself in reference work, the last method is the least help which an author of a textbook should be expected to give to his readers. It is also an advantage to have the problem fully stated, as this will help to arouse interest in it.

Thought Problems in Textbooks

Comprehension is always improved by directing thinking toward a specific goal. For this reason thought problems are a great help in understanding history. These may be of different types, such as giving reasons, making justifications, forming comparisons, applying a general principle, proving a statement, and drawing inferences. Questions requiring reasons usually begin with "Why"; for example, "Why were the problems raised by the acquisition of the Philippines different from those raised by the acquisition of Louisiana?" Here the student would proceed to state the important

[1] From A. B. Hart's "American History Told by Contemporaries," Vol. I, pp. 484–486. By permission of The Macmillan Company, publishers.

differences between the two peoples and countries and then show how these cause different problems. Problems in justification require the pupil to justify what is or what was; for example, the "open door" policy, the Monroe Doctrine, the war with Spain, the Fourteenth Amendment. Problems in comparison may be various: comparison of two characters (for example, Harding with McKinley, Lincoln with Jackson); comparisons of two cities or states or countries in trade, industry, population, education, religion, wealth, or what not; or comparisons of the consequences of a movement in two sections (the effects of the Industrial Revolution in the North and in the South, for example). Problems in application require pupils to take a general principle, such as a proposition in the Constitution, and apply it to specific cases; for example, the right of free speech, the right not to be deprived of life and liberty and property without due process of law, or the right to vote without regard to race or color. What "meaning" these have can only be understood through their applications to concrete cases. Exercises in proving a statement throw the student back on sources and evidence; for example, the statement "Captain Smith was saved from execution by the pleadings of Pocahontas." An investigation of the reliability of the evidence may lead the pupil to an appreciation of the difficulty of finding facts and to the belief that many statements in history are only probabilities. Problems in drawing inferences may be speculations of what would have happened if something had not been done (for example, what would have happened to the United States if we had not purchased Louisiana, or what would have happened to the slavery issue if there had been no compromises), or they may be guesses about unknowns from knowns (for example, from the stone implements used by Indians what may you infer about their knowledge of metals?). The purpose of assigning a problem should not be to give exercise in various types of thinking but to solve the problem. A comparison of Lincoln with

Jackson should not be made merely to throw into relief their likenesses and differences but to explain their official acts: Jackson's promptness in issuing a proclamation against the nullification acts of South Carolina and Lincoln's delay in issuing the Emancipation Proclamation. Similarly, a comparison of the economic resources of the North and the South should be made not merely to get this information, but to explain why the North won the war.

Dramatizations

Dramatizations aid comprehension in history by forcing attention to the points of view of men who lived in other times and to the details that made up their lives and problems. A class planning to reproduce the Republican Convention of 1860, which nominated Lincoln, will at once be forced to look up many details that they never thought of before: who were the men in the convention, what states they represented, who was the chairman of the convention, what parliamentary rules were observed, who made the nominating speeches, what they said, what men were nominated, why one candidate was more likely to win than another, what were the issues, who were the candidates against whom the party must win, what kind of clothes the delegates wore, whether there were any humorous incidents in the convention, what was the local color of the convention, and so on. All these things become intensely interesting after a class has decided to stage the event. If the reproduction is faithful to history, it cannot but make the understanding of the life and issues of that day both real and clear; but emphasize the thought that its faithfulness depends upon a careful study of the sources of the event.

Dramatizations may be either actual, such as the staging of the convention, or imaginary. In the latter the pupil imagines himself to be a historical character and then describes what he experienced and what he did; for example, he is told

to imagine himself George Washington and to give an account of Braddock's defeat. This is a valuable exercise if the pupil is required to read a good reference before he exercises his imagination. However, the book which gives this as a problem devotes only twelve lines to Braddock's defeat and fails to tell the pupil where he can find more about it. Under the conditions the pupil is apt to practice his imagination in error rather than in fact, and this is likely to be true of all dramatizations, whether real or imaginary. The same criticism applies to an imaginary diary of a historical character, which is another form of imaginary dramatization.

In addition to exercises in map-making, information problems, thought problems, and dramatization, other helpful devices in increasing comprehension of history are uses of models, visits to historical places, visits to historical relics in museums, visits to memorials, and holiday celebrations. In so far as these are available, they add detail, vividness, and reality to the events to which they refer, and give us assurance in our feeling of continuity with the past.

The Law of Satisfaction

Instincts appealed to by History

According to studies of the order of preference which children in Grades VII and VIII have for school subjects, history ranks among the highest. In most of the studies it ranks next to gymnastics, manual subjects, and drawing, and ahead of reading, arithmetic, language, spelling, nature study, and geography. It makes a wider appeal to human interests and instincts than do most of the subjects that are ranked below it. We can easily see some of the reasons for this. First of all, history is full of action; in fact, it is a record of little else but action. There is fighting, marching, exploring, migrating, hunting, inventing, debating, working, playing, and dying. These excite the imagination of youth and hold his attention.

They also appeal to the impulses of adventure, exploration, and curiosity. When men venture into strange lands or seas, there is always a risk, which makes it exciting, and always a curiosity about what will be found and seen. The same is true of the issue of an invention or of a congressional debate. The fighting instinct is also excited in history, not only by the accounts of military campaigns and battles but by the records of achievements in industry and in business. The latter, however, may more properly be said to appeal to the impulse of mastery, as do the records of achievements in statesmanship, in invention, in agriculture, and in exploration. There is likewise an appeal to ambition. Few can read the stories of our heroes without developing an ambition to do something equally great. The story of man after man who has risen to great heights from humble circumstances makes this ambition seem quite realizable. The hero interests us not only because of his achievements but because of his fame — the fact that he is the center of national attention and is made much of by others. This appeals to our instincts for social approval. History also makes an emotional appeal. We sympathize with the struggles of the early settlers at Jamestown and at Plymouth, we are sorry for the hardships of Howe in his effort to invent the sewing machine, and we are angry with the British for impressing our sailors when we were at peace. The successful issue of the spirited siege at Yorktown gives us joy, and the tragic death of Lincoln fills us with sorrow. Wherever the human and personal side is described, there is some emotional appeal, and no doubt this is a contributing factor to interest in history.

The Story Interest in History

History has what may be called the story interest, the interest supplied by a series of events leading to a goal. Such an interest exists in an account of a military campaign, an

exploration, an invention, a hotly debated political issue, or the negotiation of a pressing international or economic problem. In this connection history may be thought of as a great major plot with numerous subplots through which the major plot comes to fruition, the major plot being the development of the nation, and the subplots being all the important movements contributing to it.

The effectiveness of the appeals to the story interest and the instinctive interests depends in part on how history is written and in part on the pupil's mastery of reading. History cannot have a story interest unless the author writes a story about an event. It is difficult to tell a story in ten lines and that, as we have observed before, is as much as is given to hundreds of the events of history described in a textbook. They are like the old nursery rime

> I'll tell you a story
> Of Jack-a-Nory,
> And now my story's begun.
> I'll tell you another
> Of Jack and his brother,
> And now my story is done.

Balboa's discovery of the Pacific, De Soto's discovery of the Mississippi, Coronado's discovery of the southwest, Whitney's invention of the cotton gin, Howe's invention of the sewing machine, and many others are usually given in this fashion. Here is what a popular text says about Howe: "In 1846, Elias Howe, a poor man who had labored for years in a Boston garret on the verge of starvation, brought out the sewing machine. A little later Singer began to sell machines, . . ." A recital of facts after this manner kills nearly all the story interest and comes near being drudgery to the pupil. Neither does it give much excitement to the instincts or to the emotions. Its only saving grace is that the relationship to the Industrial Revolution is pointed out. We are also told

that it made possible the clothing industry, "which has become one of the big industries of the commercial world." If this is true, should not more than a sentence be given to the invention? Would it not be worth while to know how Howe got started in his invention, what his struggles with poverty were, what difficulties he had in getting material, what financial assistance he received, and how he eventually achieved success? The telling of these facts would give the pupil a story interest and would have a wide instinctive appeal as well as an emotional appeal. The textbook style of devoting short paragraphs to important events may, however, be given a story interest, or at least a problem interest, by relating the paragraphs to the achievement of some large goal; for example, a series of paragraphs on inventions may all be related to the establishment of the factory system. This method, however, gives little opportunity for appealing to instincts and emotions.

The other difficulty with the story interest, as well as with the instinctive and emotional appeals, is lack of mastery in reading, such as failure to understand hard and rare words. A chance look at a few pages in a grade textbook on the slavery issue discovered words such as *squatter, sovereignty, territory, resolute abolitionist, arsenal, revolt, rankled, treason, uprisings, protective tariff, vetoed, affront, free homesteads, industrial states.* Words of this sort would cause difficulty for most pupils of the eighth grade and would interfere with interest and comprehension.

Both the story interest and the instinctive and emotional appeals already discussed are supplied by the content of history when it is properly presented. The appeals used in the learning of history, in so far as this implies the mastery of facts for permanent retention, are much restricted; in fact, they narrow down to mastery, desire for social approval, self-activity, and mental manipulation. The devices for appealing to these are the same as those used in reading,

arithmetic, spelling, and handwriting. A record of progress based on scores in a standardized history test excites mastery and rivalry. Dramatization, the socialized recitation, and debates give the pupil opportunity for self-activity, invention, and display.

The Socialized Recitation

We have experimental evidence for the effectiveness of the socialized recitation. It is furnished by Miss Bessie Pierce, who conducted a controlled experiment at the University of Iowa High School. By means of tests an eleventh-grade class was divided into two sections of equal ability. Two teachers of equal ability were assigned to these sections, one teacher conducting the recitations by the question-and-answer method, and the other by the socialized method. In the latter the pupils were divided into two subgroups, each group being seated round a table with a leader at one end. Care was also taken to have the backs of the pupils to the teacher, who sat in the room as an unobtrusive listener, taking part only in case of dispute. The assignments were carefully made so as to eliminate questions by the teacher and to serve as an outline from which the pupils might carry on the recitation. At the end of four weeks the same fact examination was given to all the pupils. A record was kept of the number of oral recitations by each pupil, of the number of questions asked by the teacher, of the number of minutes spent in oral recitation, of the daily attendance, and of the number failing to recite. Table CXVII, on page 381, gives the results.

The average grade and the failures in the recitation are greatly in favor of the socialized method — a result, no doubt, due to the more vigorous responses by the pupils in this class. Another probable factor was the careful outline which guided the recitations of the pupils.

TABLE CXVII. THE SOCIALIZED-RECITATION METHOD VERSUS THE QUESTION-AND-ANSWER METHOD IN HISTORY. (After Pierce)

	SOCIALIZED GROUP	QUESTION-AND-ANSWER GROUP
Average grade in examination	87.4	70.0
Number of minutes spent in oral recitation	358	440
Number of questions asked by teacher	40	416
Number of recitations	182	240
Daily attendance	14	17
Number of failures in recitation	8	110
Ratio of number of questions by teacher to number of responses by pupil	39/172	416/226

INDIVIDUAL DIFFERENCES

Individual differences in history in regard to variation and distribution are similar to those in other school subjects. This may be seen from the range within each grade, the distances between the grade medians, the percentages of overlapping between one grade and each other grade, and the distribution curves. Table CXVIII gives the ranges and medians for the upper five grades as found by Van Wagenen for his History Information Scales A and B combined, in which the score is the number of questions answered correctly. The nature of the distribution, as well as of the overlapping, may be seen from the data and curve for Grade VI, Tables CXIX and CXX, on page 382, and Fig. 19.

TABLE CXVIII. GRADE RANGES AND MEDIAN SCORES FOR VAN WAGENEN'S HISTORY INFORMATION SCALES A AND B COMBINED

GRADE	NUMBER OF PUPILS	RANGE	MEDIAN
IV	492	0–25	9.03
V	423	4–35	16.60
VI	516	5–46	23.60
VII	413	6–48	26.26
VIII	460	11–51	32.20

TABLE CXIX. DISTRIBUTION OF SCORES IN GRADE VI FOR SCALES A AND B COMBINED

Score	5	6	7	8	9	10	11	12	13	14	15
Number of pupils	1	0	1	3	1	6	8	11	7	22	14
Score	16	17	18	19	20	21	22		23	24	25
Number of pupils	28	26	22	16	25	28	24		25	28	28
Score	26	27	28	29	30	31	32	33	34	35	36
Number of pupils	24	31	17	14	16	16	13	9	11	11	4
Score	37	38	39	40	41	42	43	44	45	46	
Number of pupils	1	5	3	2	2	3	2	2	2	1	

TABLE CXX. NUMBER AND PERCENTAGE OF PUPILS IN GRADE VI WHOSE ABILITY EQUALED AND EXCEEDED THAT OF THE MEDIAN PUPIL IN EACH OTHER GRADE. (After Van Wagenen)

GRADE IV		GRADE V		GRADE VI		GRADE VII		GRADE VIII	
Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
511	99	425	82.3	(516)		186	36	71	13.7

The table should be read as follows: 511, or 99 per cent, of the pupils in Grade VI equaled or exceeded the median of Grade IV.

THE WINNETKA AND DALTON PLANS IN HISTORY

The methods of adjusting the instruction to these differences are similar to those used in reading. If the differences are as wide as those in Table CXIX, there should first be reclassification. For the differences that remain we can use, on the one hand, some form of the Winnetka plan or the Dalton plan, which allow speed according to ability, or, on the other, some kind of enriched curriculum. The Winnetka plan as applied to history requires the setting up of a certain number of goals for each grade, an assortment of reading materials with which these goals can be reached, followed by the passing of tests which give the pupils the necessary number of

points required for that grade. The pupil is allowed a certain range of choice for this material and his own time for completing it. The essential difference between this plan and the Dalton plan is that in the latter the material which the pupil must cover is definitely blocked out for him and he is required to cover a certain number of these blocks. The plan of the enriched curriculum is easily realized in history. There are

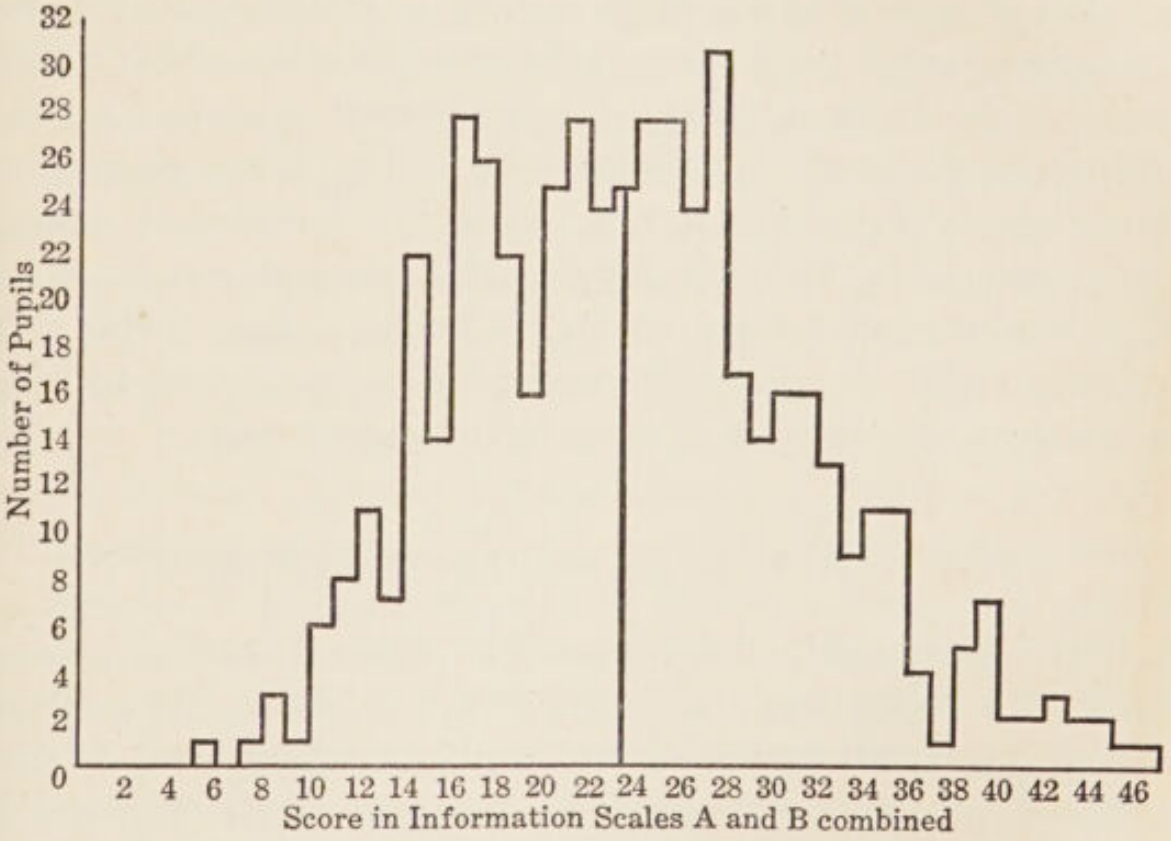


FIG. 19. Showing distribution of 516 sixth-grade pupils in the Van Wagenen History Information Scales A and B combined

enough references on every important topic in history to satisfy almost any variety or amount of interest. The bright pupil can always be asked to do library or home work on these. If definite assignments are made for him and if his achievements are systematically checked, there is no reason why this should not be a very satisfactory way of meeting individual interests.

We have experimental evidence of the modified form of the Dalton plan furnished by Miss Bessie L. Pierce, who divided

a class of eighteen pupils into two sections having equal ability. The pupils in one section received individual instruction; in the other they were taught as a group. Both sections received mimeographed assignments and sets of questions. The pupils of the individual class were told to complete these as rapidly as possible and to recite them individually, but those of the group class received a definite assignment each day and recited according to the usual classroom method. At the end of a semester the group class had earned 43 marks, 16 of which were above C, or average; the individual class had earned 56 marks, 36 of which were above C. The group class completed forty-five assignments, while the number of assignments completed by the individual class ranged from 21 to 60. There was good rivalry in the individual class. This was stimulated by the fact that each pupil was required to keep a graph of the number of assignments completed.

What Habits should be Formed in History?

What habits should be formed in history can be decided only with reference to the objective of history. As pointed out in the opening of this chapter, historians as well as students of the curriculum agree that the principal objective is the making of good citizens, together with the development of a number of desirable traits of character, such as open-mindedness, judgment, love of country, and the spirit of patient inquiry. But what specific habits must be developed in order to be a good citizen and what particular materials are most suitable to the development of these habits are unsolved problems. There is more disagreement by experts on the solutions to these questions than in any other school subject. These disagreements center both on the methods of solving the problem and on the solutions. The prevailing method has been what might be called the committee method, and opposed to this is the scientific method.

The Committee Method of Selecting a Curriculum

In the committee method of selecting a curriculum a group of teachers and professors who are specialists in subject matter get together and ask themselves what should be taught in the various grades. After a number of consultations and discussions they agree upon a program or course of study and recommend it to the schools. An example of this method is the Committee of Eight, appointed by the American Historical Association in 1905 to draw up a course of study in history for the grades. This committee recommended for the first two grades a study of Indian life and of stories connected with local events and with national holidays, such as Thanksgiving Day and Washington's Birthday. In the third grade the pupil was to hear stories of heroes of other days; for instance, Joseph, Moses, Ulysses. In the fourth and fifth grades the stories were to be on scenes and heroes of American history. In the sixth grade the child was to study the European background of American history, and in the seventh and eighth grades he was to study American history beginning with the discovery of America and ending with the present. When the child entered high school he was confronted with the program of the Committee of Seven, which recommended ancient history for the first year, medieval and modern European history for the second, English history for the third, and American history and civil government for the fourth. The latest committee to recommend a course of study in history was the new Committee of Eight, also appointed by the American Historical Association. This committee recommended a course of study consisting of four cycles which are adapted to the changes in school organization produced by the junior high school. The first cycle includes Grades I and II and is devoted to the stories of Indian life and the making of the United States; the second includes Grades III, IV, V, and VI and covers the entire field of American history, with an

additional course in civics for the last half of Grade VI. The subdivisions are Grade III, How Europeans found our continent and what they did with it; Grade IV, How Englishmen became Americans; Grade V, The United States from 1783–1877; Grade VI, The United States since 1877 (half year) and How we are governed today (half year). The third cycle covers Grades VII, VIII, and IX and is devoted to a study of American history in its relation to world history. In Grade VII the history of the world before 1607 is studied, Grade VIII taking up the story since that time. In Grade IX community and national problems are studied. The fourth and last cycle, which includes Grades X, XI, and XII, is devoted to the modern world: first, to a study of the progress toward world democracy since 1650, then to an intensive study of United States history during the national period, and, finally, to a study of social-economic and political principles and problems. The chief differences between this course and the course of the old Committee of Eight are the shortening of the biographical study of history, the lengthening of the time for United States history, the inclusion of more civics, and the increased emphasis on modern world history and the relation of American history to it. The central idea of both committees, however, seems to be to fill the pupil with all the history possible within the limits of his ability and time.

Criticisms of the Committee Method

Committee procedures and recommendations are open to the following criticisms: (1) they assume that history helps to make a good citizen, but never investigate whether it does, or what its shortcomings are, or how it can be improved, or by how much a person who has studied little history is less capable as a citizen than one who has studied a good deal of history, or what kind of history makes the best citizens; (2) the material is not selected with reference to any objec-

tively determined standard, but on the basis of the opinions of a few individuals; (3) the material is not tried out experimentally in classroom instruction before it is recommended for use, nor is it graded according to the results of such experiments in teaching; (4) the material is predominantly political and military, and most of it is more than fifty years removed from present activities and problems.

The Scientific Method of Selecting a Curriculum

The scientific method of selecting a curriculum aims to overcome these criticisms. It is characterized by an effort to find an objective standard with reference to which historical material may be selected, by selecting material which is socially valuable, by grading the material on an experimental basis, by providing for adequate review, and by measuring the results objectively.

Objective standards for the selection of historical material have been sought in those topics that are common to many textbooks, in the frequency of the allusions to historical events in magazines and newspapers during a given time, in analyses of the problems of political platforms during the last fifty years, in the frequency of the duties of citizenship mentioned by large numbers of leading citizens, in counts and analyses of the actual civic duties performed by a number of persons during a given time, and in the analyses of problems discussed in books on contemporary problems.

Merits and Defects of Proposed Criteria

Each of these proposed standards has some merits and defects. The method of finding the topics common to many textbooks tells us what is taught, but not what should be taught. It also gives us some idea of the peculiarities of individual books. Knowledge of the frequency of allusions in

newspapers or magazines to historical events or persons enables us to study principally that which has conventional or conversational value. It may or may not have practical value. Persistent problems in political platforms are undoubtedly important, but they are usually stated in such general terms that a great deal more analysis and study are needed before they can be understood or dealt with in a practical way. An analysis of the civic activities of a number of persons has the advantage of giving us a concrete idea of the work in which civic and historical information must function and to which it should relate, but such duties are principally local and often ephemeral and do not lead us into pressing national and world problems about which a private citizen should at least have intelligent opinions. On the other hand, a curriculum based on the large issues discussed in books by distinguished authors on contemporary affairs has a tendency to stress national and world problems which the private citizen can do little to solve and to ignore the common everyday problems upon which he is called to take action. All these, however, have this advantage: they lead us away from individual opinion, and when combined they have the advantage of eventually leading us to the selection of a curriculum which is not one-sided, and which has not only a scientific basis but also broad social value.

How the Criterion influences the Character of the Material

The nature of the criterion used for selecting historical material makes a big difference in the kind of material selected. Dr. Horn has counted the historical allusions in six important books on modern social problems and in sixteen articles on such problems in the International Encyclopedia. He then calculated the percentage of references which fall in the various historical periods of American history and com-

pared these with the results of a similar calculation made by Bagley and Rugg of the historical references in seven elementary textbooks published since 1912. He also counted the number of references to persons and calculated the percentage of references to political, military, social, and economic history in the materials analyzed. He discovered that over three fourths of the historical allusions refer to the period since the Civil War, that only three of the dates considered of fundamental importance by historians are mentioned, that the greater portion of the historical allusions are to social and economic topics, and that the frequency of reference to historical persons is very different from that ordinarily found in textbooks. In fact, Lincoln's name is not mentioned at all in these books or articles. Table CXXI gives the percentage of historical references devoted to various periods and Table CXXII gives the distribution of the references to the kinds of history.

TABLE CXXI. PERCENTAGE OF HISTORICAL REFERENCES DEVOTED TO VARIOUS PERIODS. (After Horn)

PERIOD	BOOKS	INTERNATIONAL ENCYCLOPEDIA	ELEMENTARY TEXTS
Unclassified		3.7	
Discovery and exploration	0.1	0.67	8.27
Colonization to 1764	2.5	2.00	19.62
1764–1783	3.8	3.50	13.69
1784–1812	1.8	6.00	14.17
1812–1861	4.7	11.00	21.00
1861–1916	85.7	74.00	24.67

TABLE CXXII. DISTRIBUTION OF REFERENCES TO POLITICAL, MILITARY, SOCIAL, AND ECONOMIC HISTORY. (After Horn)

SOURCE	POLITICAL	MILITARY	SOCIAL ECONOMIC
Committee of Eight	33	30	37
Modern history textbook	42	40	18
Books on modern problems	18.7	4.7	78
Encyclopedia articles	37.0	1.7	60

The names of the persons to whom references were made in order of frequency are Theodore Roosevelt, Adam Smith, J. S. Mill, Malthus, Napoleon, Karl Marx, Robert Owen, Gompers, Ricardo, Wilson, Washington, Louis XIV, Rousseau, Henry George, Thomas Jefferson, U. S. Grant, William Pitt, H. G. Wells, Gladstone, A. Wagner, Webb, Lassalle, Napoleon III, Gallatin, Andrew Jackson, Montaigne, Alexander Hamilton, C. D. Wright, and Bernard Shaw.

The study shows that if the function of history is to help the student to solve modern social problems, the materials now found in the textbooks are not well adapted to the purpose.

Rugg's Research as an Illustration of the Scientific Method in Curriculum-Making

A clearer idea of the scientific method in curriculum-making in history and other social sciences may be obtained by describing more in detail how a curriculum is selected on the basis of making it relevant to the solution of imperative contemporary problems. This criterion has been used by Dr. Harold Rugg and his co-workers in a promising piece of research. Dr. Rugg's first step was to select the problems and issues of modern social life; his second, to find the particular questions which must be answered in order to consider all the angles of each problem; his third, to select typical stories which illustrate the important points to be made and to collect such facts as are needed to discuss the questions; his fourth, to clarify and fix the essential matters and discover the basic generalizations that are needed to guide our thinking in the solution of social problems.

To find the important problems of modern social life, Dr. Rugg sought the important books on them. These were found by selecting from book reviews which had appeared during a period of seven years all those books that were referred to as of distinct merit, by canvasing several thousand books on

the shelves of the Columbia University library, and by writing to some eighty specialists on social problems and asking each to recommend a list of ten books which would be of use for obtaining statements of problems in his field. To obtain the particular questions in each problem he analyzed the books, found what questions a number of books had in common, and the number of pages given to each question by each author. This enabled him to find not only the question but also the important facts on each question. The selection of stories or episodes with which to illustrate these facts was largely left to the individual taste and judgment of the investigator. This was also true of the fourth step, the devices for fixing the important matters and for discovering the basic generalizations. The method allows little room for doubting the objectivity of the first two steps, but this can scarcely be said of the last two. In these, however, Dr. Rugg has achieved a happy success. He did not follow the traditional method of writing a little encyclopedia of all the facts, giving a little about each one; on the contrary, he selected typical and important facts and then found a story which illustrated them. These stories are rather long and detailed but are interesting to read. They stir the imagination, enable the reader to reconstruct the experience of the writer, and make a vivid impression on him.

The following account of the experiences of Jesuit missionaries in their explorations of the Mississippi Valley is typical of these stories or episodes. There may be some question as to how much such a story helps the reader to solve a crucial modern problem, but it is at least vivid and interesting.

How the courageous Jesuit fathers pushed out into the wilderness, facing starvation, torture, and death, in order to convert the Indians to the Christian religion is a long story in itself. They could see no good in the ancient Indian religions, they believed that they must save these people's souls, and they endured unnumbered dangers and difficulties in trying to do it. If they were

not very successful in their attempts, they were, nevertheless, pathfinders as were the traders. They prepared the way for French settlement and conquest.

Here is a glimpse of the Jesuits during a period of hardship among the Huron Indians in the neighborhood of Lake Huron.

The pestilence, which for two years past had from time to time visited the Huron towns, now returned with tenfold violence, and with it soon appeared a new and fearful scourge, — the small-pox. Terror was universal. The contagion increased as autumn advanced; and when winter came, far from ceasing as the priests had hoped, its ravages were appalling. The season of Huron festivity was turned to a season of mourning; and such was the despondency and dismay that suicide became frequent. The Jesuits, singly or in pairs, journeyed in the depth of winter from village to village, ministering to the sick, and seeking to commend their religious teachings by their efforts to relieve bodily distress. Happily, perhaps, for their patients, they had no medicine but a little senna. A few raisins were left, however; and one or two of these, with a spoonful of sweetened water, were always eagerly accepted by the sufferer, who thought them endowed with some mysterious efficacy. No house was left unvisited. As the missionary, physician at once to body and soul, entered one of these smoky dens, he saw the inmates, their heads muffled in their robes of skin, seated around the fires in silent dejection. Everywhere was heard the wail of the sick and dying children; and on or under the platforms at the sides of the house crouched squalid men and women, in all the stages of the distemper. The Father approached, made inquiries, spoke words of kindness, administered his harmless remedies or offered a bowl of broth made from game brought in by the Frenchmen who hunted for the mission. The body cared for, he next addressed himself to the soul. "This life is short, and very miserable. It matters little whether we live or die." The patient remained silent, or grumbled his dissent. The Jesuit, after enlarging for a time, in broken Huron, on the brevity and nothingness of mortal weal or woe, passed next to the joys of Heaven and the pains of Hell, which he set forth with his best rhetoric. His pictures of infernal fire and torturing devils were readily comprehended if the listener had consciousness enough to comprehend anything, but with respect to the advantages of the French Para-

dise, he was slow of conviction. "I wish to go where my relations and ancestors have gone," was a common reply. "Heaven is a good place for Frenchmen," said another; "but I wish to be among Indians, for the French will give me nothing to eat when I get there." Often the patient was stolidly silent; sometimes he was hopelessly perverse and contradictory. Again, Nature triumphed over Grace. "Which will you choose," demanded the priest of a dying woman, "Heaven or Hell?" "Hell, if my children are there, as you say," returned the mother. "Do they hunt in Heaven or make war or go to feasts?" asked an anxious inquirer. "Oh, no!" replied the father. "Then," returned the queriest, "I will not go. It is not good to be lazy." But above all other obstacles was the dread of starvation in the regions of the blest. Nor, when a dying Indian had been induced at last to express a desire for Paradise, was it an easy matter to bring him to a due contrition for his sins; for he would deny with indignation that he ever committed any. When at length, as sometimes happened, all these difficulties gave way, and the patient had been brought to what seemed to his instructor a fitting frame for baptism, the priest, with contentment at his heart, brought water in a cup or in the hollow of his hand, touched his forehead with the mystic drop, and snatched him from an eternity of woe. But the convert, even after his baptism, did not always manifest a satisfactory spiritual condition. "Why did you baptize the Iroquois?" asked one of the dying neophytes, speaking of the prisoner recently tortured; "he will get to Heaven before us, and when he sees us coming he will drive us out."[1]

Up to the present time Dr. Rugg and his co-workers have issued twelve three hundred-page pamphlets for Grades VII, VIII, and IX. The pamphlets are not devoted entirely to history, but also include the essentials of geography and civics, and are entitled The Social Science Pamphlets. The central topic in six of these pamphlets is the Industrial Revolution and its effects on modern life, particularly the

[1] Harold Rugg, Earle Rugg, and Emma Schweppe, Explorers and Settlers Westward Bound, pp. 125–126; The Social Science Pamphlets, No. 1, Vol. II. The quotation on the Jesuits is from Francis Parkman's "The Jesuits in North America," pp. 87–89. Little, Brown & Company, Boston, 1895.

growth of cities and the social problems incidental to city life; the development of transportation and of communication; the importance of coal, iron, and oil; the food resources of the country; the machine industries; and the interdependence of farm and city and of states and nations because of the life made possible by modern transportation and communication. One pamphlet deals with the westward movement, which is a land history of America and also of the period of discovery; two deal with the development of democracy, which is principally the political history of America; one deals with Americanizing the foreign-born, one with the problems of waste and conservation of America's resources, and one with international problems.

The character of this material again shows how radically history and other social sciences are changed when they are selected because of their relativity to modern life. It may be criticized because of its slight relativity to the civic duties of the rural population, particularly the everyday township, county, and state duties of the farmer and other private citizens. The reading of history and of the social sciences as a leisure occupation is also not emphasized, but it can scarcely be denied that these materials give us a kind of information which no good citizen should lack. However, the outcome of the conflict between the program recommended by committees of historians and that recommended by students of modern problems is a problem of the future.

Summary

The principal purpose of history is to train and develop those capacities which make for good citizenship, but it is uncertain what these capacities are and how they should be developed.

Performances in history relate either to information or to thought. The former are concerned with knowing the names

of events and persons, the contents of documents, and the temporal relation of each; the latter are concerned with cause-effect relationships, with the reliability of sources, with the value of an event as illustrative of a dominant historical feature, and with the qualities applicable to historical persons. The amount and degree of each increase with the age, grade, and intelligence of the child. They are also dependent on sex, boys being noticeably superior to girls.

Learning and retaining the facts of history depends upon adequate use of the law of repetition. It is a great weakness of textbooks that they assume that history can be learned without repetition. They fail to include drill devices and rarely give the teacher any help in selecting the essentials that should receive drill. Their principal aim is to furnish facts and plenty of them. They give some assistance in comprehension by suggestive titles, review questions, and original exercises, but there is little agreement as to the kind of titles, questions, and exercises that should be used. The exercises include tasks in map-making which are limited largely to political and military topics and ignore social and economic topics; information problems which direct a pupil's attention to special topics, but far too little information is given in the book to make a selection possible; thought problems which direct a pupil's thinking to a certain goal; and dramatization, which forces attention to the points of view of men of other times but which often gives the pupil practice in error rather than in fact. The greatest weakness of textbooks in providing for comprehension is the lack of sufficient information on specific problems, persons, and events. However, as devices for increasing comprehension we may use all those that have been found helpful in reading.

History has the advantage of appealing to a wide range of human impulses and interests: to action, exploration, curiosity, self-assertion, sympathy, and the story interest. Text-

books, however, do not make their descriptions vivid and detailed enough to arouse these to the point of satisfaction.

An experiment comparing the socialized recitation with the traditional type was found to yield a much higher average grade in the final examination. Its favorable effects are probably due to the more vigorous responses required by this method.

Individual differences in history are no exception to the rule. Reclassification, unit assignments, and goal assignments may be used successfully in this subject.

There is no agreement as to what habits should be formed in historical study nor what materials should be used in developing them. Two methods have been used for selecting materials: the committee method and the scientific method. The first is open to the criticisms that it assumes that history makes a good citizen, that its material is selected on the basis of opinion, that it is recommended in advance of trial, and that little of it is related to modern problems. The second has devised a technique for overcoming all these defects. It has sought objective standards in topics common to many textbooks, in historical allusions in journals, in the problems of political platforms, in the duties of citizenship, and in the crucial problems of contemporary life. Each criterion is impersonal, but each leads to the selection of a content peculiar to the standard, different from that required for another standard. The crucial question seems to be, Shall history be history, or shall it be something that helps the living?

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CHAPTER XX

GEOGRAPHY

Aims

Geography, as the name suggests, is a description of the earth. However, not everything that is in the earth or on the earth is interesting to man. Consequently the description narrows down to those places which are most useful and interesting to man. It gives their locations, describes their products, how these are produced and used, how men live in the various places, why they live as they do, and what they exchange with other places. With this information as a foundation we should be able to understand how sections and countries depend on one another for their living and civilization, to develop a sympathetic attitude toward other peoples, to appreciate the sources and methods of production of all the things that contribute toward our economic life and well-being, to know how much we depend on the land for our life and therefore to form habits of conserving its products, to see the smallness of our own locations in relation to the great world outside, and to adjust ourselves better to the situations which geographical conditions set for us. It is true that often the only residuals of a course in geography are a knowledge of a limited number of locations and a memory of the unpleasantness of learning them, but these results should not blind our vision to its true place in the child's education. Few would dispute the right of geography to an important place in the elementary curriculum if the above objectives were realized. Even the realization of just one of them would alone justify the subject.

The Relation of Results in Geography to Age and Grade

The results we accomplish in geography, as in other school subjects, depend on the age and grade of the pupil. This may be seen in the grade medians of such standardized tests in geography as those of Buckingham and Stevenson, Posey and Van Wagenen, and Hahn and Lackey. Buckingham and Stevenson have two tests, one on place geography and one on information and problems. The place-geography test consists of two parts, one on the world and one on the United States. The list on the world contains forty-three locations to be given with reference to continents, sixteen with reference to oceans, and eleven with reference to countries; the list on the United States has forty-two locations to be given with reference to the states of the United States and eighteen with reference to rivers or large bodies of water. In the score each location correctly given counts as one point. The preliminary standard scores for Form 1, world test, are given in the following table.

Table CXXIII. Preliminary Standards for the Buckingham-Stevenson Place-Geography Tests; Form 1, World Test

Grade IV	Grade V		Grade VI		Grade VII		Grade VIII	
High	Low	High	Low	High	Low	High	Low	High
14.1	26.3	39.0	33.4	39.0	48.0	50.3	54.0	44.0

The information and problem questions are of the best-answer type, the pupil being required to check the best of four answers given to each question. Examples are as follows:

Which city is south of St. Louis?
Chicago, New Orleans, Denver, Cleveland.

Why is Birmingham becoming a rival of Pittsburgh in the production of steel?

1. Negro labor in the South is inexpensive.
2. Birmingham is situated in a region rich in iron and coal.
3. There is a great demand for steel in Alabama.
4. Manufacturing is becoming extensive in the South.

There are fifty information questions and twenty-five problem questions, each correct answer counting as one point. Table CXXIV gives the standard scores for the upper five grades in cities of over ten thousand.

TABLE CXXIV

	GRADE V	GRADE VI	GRADE VII	GRADE VIII
Information questions . . .	14	17	22	25
Problem questions	7	9	12	15

The Posey-Van Wagenen Geography Scale contains two types of questions, information and thought, graded in difficulty. The information questions call for knowledge of locations, sources of products, methods of production, names of locations of a certain character, and so on. Most of the thought questions require the pupil to draw inferences from certain statements given, although some require him to give causes for certain effects. The score is a number representing the difficulty of such questions as the pupil correctly can answer one half of. In division 1 the questions range in difficulty from a value called 55 to one called 84. The following questions represent the extremes and approximate midpoint in difficulty of the scale:

1. Value 55.

When it is winter here in the Northern Hemisphere, it is summer in the Southern Hemisphere.

When it is winter here, what season is it in the southern part of South America?

16. Value 70.

It costs very much less for the same weight of any material to be carried by boat than by train. At the same time, the train takes less time to go between the same two places.

How would you expect the iron ore moved in Minnesota to be sent to Buffalo?

30. Value 84.

As the population in any region increases in density more food is needed. This must be raised near by or else be imported. (*a*) In a densely populated region would you expect the land to be cultivated extensively, intensively, or carelessly? (*b*) Is the fertile land in densely settled regions likely to be more valuable or less valuable than in sparsely settled regions?

The medians for the upper five grades are given in Table CXXV.

TABLE CXXV. STANDARDS FOR THE POSEY-VAN WAGENEN GEOGRAPHY SCALE (END OF GRADE OR YEAR)

	GRADE V	GRADE VI	GRADE VII	GRADE VIII
Scores . . .	68	74	80	(86 [1])

THE LAW OF REPETITION

The extent to which the law of repetition needs to be used in learning something depends upon its quantity and its amount of meaning. The number of repetitions varies directly as the quantity and inversely as the amount of meaning. Geography as now taught is unfortunate in both respects: it has an immense quantity of facts, and these have comparatively little meaning. The inference suggested is that geography, like spelling and handwriting, is one of those subjects that has to be learned by the mechanical process of repetition. However, before we accept this view we must make an investigation of the number and nature of facts to be learned in the average two-book grade text in geography.

[1] Estimated for students who study geography in both the seventh grade and the eighth grade.

Methods of Determining the Number and Nature of the Facts in Geography Texts

Just how to find the number of facts that need to be learned in geography as now taught is a difficult problem. We may proceed on various assumptions to find out. We may assume that every topic in the index of a textbook refers to at least one fact; for example, "Boston" refers to at least one fact, namely, its location; so does the topic "farming," namely, that it is one of the great occupations. But this is a rather gratuitous assumption with reference to both topics. There are many important facts about Boston besides its location; for instance, its size, its growth, its history, its industries, its institutions, and its inhabitants. Similarly, there are scores of facts to be learned about farming besides the fact that it is an occupation. Under such conditions it seems not unfair to assume that a child must at least learn as many facts as there are topics in the index. We may also assume that each page reference in the index refers to at least one important fact; but it would not be fair to determine the number of facts in a school text by this measure alone, for the reason that some indexes are more carefully prepared than others, so that one text may have fewer topics in the index than another text and yet have nearly twice as many page references. We may also assume that each paragraph or each review question in a text refers to at least one important fact; but here, again, there are wide variations among authors, some having a uniform habit of writing larger paragraphs than others and some having a tendency to ask more inclusive questions. Or we may take each of these measures and assume that the true number of facts lies somewhere between the measure giving us the lowest number of facts and the one giving us the highest number.

The meaning or character of the facts is just as important as their number. An idea of the kind of facts that geography

gives may be most easily obtained by classifying the topics of the index in a text according to their most evident logical categories. Such an analysis will tell us more quickly and accurately than any other method what geography is about. The writer made such an analysis of Books I and II of three leading texts. The categories used and the number of topics falling in each category for each book are given in Table CXXVI. Some of the categories may need explanation. "Other land regions" refers to locations that are not mountains, valleys, plains, or islands; for instance, continents, deserts, capes, the cotton belt, the corn belt, Siberia. "Other water regions" refers to oceans, lakes, straits, falls, gulfs, bays, sounds, and the like. "Countries" are national units; "states and provinces" are political subdivisions of countries. "Peoples" refers to vocational or racial groups. "Vocational processes" refers to means of production in any occupation. "Cultural products" refers to such products of civilization as originate primarily from people and have their existence principally in thought, such as forms of government, religions, universities, books, etc. "Technical terms" are terms peculiar to geography that are not proper names, such as *divide, gully, bay, strait, climate, longitude,* and so on. It should be remarked that the classification is not entirely objective or mathematically accurate. The same term may often be classified in two or more categories, so that another person doing the same task would get somewhat different results. However, a study of the table gives us fairly accurate ideas both of the number of the facts that are now taught in geography in the grades and of their nature.

The Number of Facts in Geography Texts

Looking over the rows at the foot of the table we see that we should get an index of the minimum number of facts from the number of review questions, which varies from 655 to

TABLE CXXVI. ANALYSES AND CLASSIFICATION OF THE NUMBER OF TOPICS IN INDEX, PAGES, MAPS, PICTURES, PARAGRAPHS, AND REVIEW QUESTIONS IN BOOKS I AND II OF THREE GRADE TEXTS IN GEOGRAPHY

CATEGORIES	TEXT A		TEXT B		TEXT C	
	Book I	Book II	Book I	Book II	Book I	Book II
Mountains	38	56	47	46	44	46
Valleys	2	2	19	26	7	16
Plateaus	3	8	9	9	1	8
Plains	1		7	5	2	4
Islands	37	62	64	70	28	50
Other land regions	82	92	93	106	27	61
Climatic regions	5	9	8	20	2	4
Rivers	47	114	81	77	53	67
Other water regions	38	63	66	90	56	57
States and provinces	80	85	72	87	69	65
Countries	86	88	96	107	66	89
Cities	301	769	424	474	318	400
Soils and minerals	23	32	48	25	12	43
Plants (nonagricultural)		2	17	9	10	14
Animals	18	26	32	30	15	24
Peoples	14	44	53	24	11	19
Persons	2	20	63	2	6	4
Agricultural products	29	37	74	75	63	70
Manufacturing products	38	29	65	52	38	74
Transport means	8	9	30	14	10	25
Vocational processes	27	20	31	33	49	61
Cultural products	8	20	39	10	42	24
Technical terms	182	259	208	145	184	83
Number of topics in index	1069	1876	1646	1536	1113	1288
Number of page references in index	1475	3451	5422	8916	1902	5676
Number of pages in text	256	410	545	440	322	486
Number of maps	56	152	82	138	63	183
Number of pictures	364	456	420	590	262	316
Number of paragraphs	1300	1836	1226	1811	1080	1565
Number of review questions	1124	1451	814	979	655	704

1124 in Book I and from 704 to 1451 in Book II. Next come the number of paragraphs and the number of topics in the index. These run rather closely parallel, the paragraphs varying from 1080 to 1300 in Book I and from 1565 to 1836 in Book II, and the topics from 1069 to 1646 in Book I and from 1288 to 1876 in Book II. The maximum number is given in the number of page references, which run from 1475 to 5422 in Book I and from 3451 to 8916 in Book II. Since review

questions, topics in the index, and paragraphs usually refer to a group of facts rather than to a single fact, we may take the average of these measures as representing approximately the minimum number of facts in geography texts. And since page references usually refer to single facts we may take the average of these as representing approximately the maximum. This method would give 1149 as the minimum and 3702 as the maximum for Book I and 1443 as the minimum and 5681 as the maximum for Book II. Book I is usually studied in Grades IV and V; Book II, in Grades VI and VII. This would mean the teaching of from 500 to 1800 facts in Grades IV and V and from 700 to 2000 in Grades VI and VII.

Nature and Distribution of the Facts

Coming now to the nature of the facts we see that with the exception of "technical terms" over 95 per cent of the remaining topics may be classified into two groups known as locations and products. "Technical terms" comprise about 15 per cent of the total number of topics, whereas "peoples" and "persons" make up less than 5 per cent of the total. Of the locations "cities" constitute by far the largest single class, the number varying from 301 to 424 in Book I and from 400 to 769 in Book II. Next in order come "countries," "other land regions," and "states and provinces," of which there are from 27 to 107 in each group. Then come "mountains," "islands," "rivers," and "other water regions," of which there are from 38 to 114 in each group. "Valleys," "plains," "plateaus," and "climatic regions" constitute a small percentage of the locations. Of the products the most numerous are the agricultural, the manufacturing, and the mineral, the number varying from 15 to 75. "Cultural products" vary from 8 to 42, "animals" from 15 to 32, and "plants" (nonagricultural) from 0 to 17. "Vocational processes" are prominent, varying in number from 20 to 61.

Science and Human Nature in the Content

The prefaces in texts B and C claim that the textbooks are not only scientific but also have merit as literature. The nature of the content, however, is forbidding to both. Who can describe 400 cities, 67 rivers, 46 mountains, and 144 agricultural and manufacturing products, make good literature out of the descriptions, and organize it on scientific principles? Text B also makes a claim for being human. It has a human interest, but the content is not about human beings. Book I introduces the pupil to sixty-three persons, but this is merely a pedagogical device to add interest to the description of locations, products, and processes. All but a few of these persons are fictitious characters. How unnecessary they are for the real content of geography is shown in Book II, where but two persons are mentioned.

Geography as Dealing with Relationships between Man and his Environment

The analysis of the contents of the index also suggests a comment on the content of the so-called "new geography," which is defined as dealing primarily with the relationships existing between man and his environment. Present-day texts do not lend much support to this view. They deal almost exclusively with the environment and leave out the "man" side of the relationship. The most that can be said is that they describe such features of the environment as have some influence on man. But if a reader expects to get from a so-called "human geography" some insight into human nature he will be as badly disappointed as if he read a book on mathematics, geology, chemistry, or physics for such a purpose. The feature that impresses him most is that geography is a description of the earth. In fact, an author could hardly give an equal amount of space to the two sides of the relationship without writing a sociology or a psychology.

The Relation among the Facts of Geography a Spatial Relation

The most evident relationship among the facts in grade geography is a spatial one. The authors go over the world and tell a little about one place, and then about another, and so on until they complete the circuit of the globe. A spatial relationship is neither logical nor scientific and is almost wholly meaningless to a learner. Because of the nature of the subject a good deal of attention has to be paid to this factor, but it should be possible to organize the subject with more reference to some logical and scientific principle than is at present the case.

Summary of the Nature of the Facts

An analysis of popular textbooks thus leads us to the conclusion that geography is a subject which describes the locations, products, and vocational processes that have an influence on man. In it we learn almost nothing about human nature, customs, and institutions, or about man's technique of adjustment to his environment, or about his thought and emotional life, but we do learn a good deal about his economic life. The facts described have little relationship to one another except a spatial one, and this has the disadvantage of being almost meaningless to the learner.

The Need of Much Emphasis on Drill

It is now evident that both the number and the nature of the facts contained in geography make it necessary to put much emphasis on the law of repetition. Think of having to learn 769 cities or even 400 cities, 114 rivers, 92 land regions, 56 mountains, 85 states and provinces, 88 countries, 70 agricultural products, 74 manufactured products, 61 vocational processes, and hundreds of other such facts! If an author of a text expects a pupil to learn these facts he should furnish

some means for adequate drill. But just here is where text-books in geography have their greatest weaknesses. At the most only four repetitions are usually provided, two in Book I and two in Book II. Each book provides for one repetition in the reading and one in the review questions. What child can be expected to learn in four repetitions anything like the number of facts contained in geography?

The remedy for such a situation lies in three directions: first, in a great reduction in the number of facts to be mastered; secondly, in a better treatment of the facts; thirdly, in devices for drill in the essentials. The first two will be left for later sections. For the third we have as possibilities the use of outline maps, imaginary journeys, the topical summary, reviews of the places of production and the routes of distribution of important products, and the review of the order of vocational activities as determined by seasons.

Outline Maps

The outline map can be used for any variety of locational facts — cities, states, countries, rivers, lakes, mountains, geographic regions, mineral resources, manufacturing centers, transportation routes, distributions of populations and products, plants, animals, races, and vocational activities. It may also be varied indefinitely in scope; for example, to a single city or state, to a country, to a continent, or to the world. In form it usually contains enough of the features of a particular region to identify it; for example, a map for the United States usually shows the boundary outlines of the country and of the states, and the principal rivers. But it also may contain dots or other marks of the locations of particular cities or places which are to be learned. If these are given, the pupil's task is limited to naming these places; if they are not given, he must both name and locate the desired places. The method of using the outline may be as follows:

1. Study from some authoritative map or description the locations to be learned.
2. Locate these places on the outline from memory.
3. Compare with the authoritative map and check the errors.
4. Repeat this process until the reproduction is errorless.

This procedure may be used not only in the original learning but also in the reviews, which may be given as often as necessary for permanent fixation. Appeals may be made to the factor of rivalry by scoring on the basis of the number of trials necessary to reach a correct copy, on the number of correct locations on the first trial, or on the time required to finish the first trial.

Imaginary Journeys

Imaginary journeys are usually made to such places as interest people who travel for recreation. This requirement is not necessary, but it helps to make the proposed journey interesting. The imaginary journey has all the advantages of a project; it forces the pupil to get exact and detailed information from railway, steamship, and hotel guides in planning his route and it gives him an incentive for getting detailed information from original sources about the places to be visited. It is more interesting than the outline maps and furnishes information about a place which makes its location worth knowing. Its chief limitation is that it is time-consuming and cannot be used for all the important places.

The Topical Summary

The topical summary is an outline of important topics or locations, together with a summary of the essential facts about each topic. Each topic is placed on a card. The pupil memorizes the facts on each card and is tested for retention by giving them in response to the calling of the topic. This type of drill is not so time-consuming as the imaginary journey

and hence can be made more extensive. It is also a valuable supplement to the outline map, because it makes it possible to fix the facts which make locations important.

Reviews of the Places of Production and the Routes of Distribution of Special Products

Reviews of the places of production and the routes of distribution of important products have the advantage of giving both the location and their use. If the child studies these for such products as wheat, cotton, oranges, bananas, coconuts, coffee, canned fish, wool, iron, coal, petroleum, and fur, he will meet nearly all the places of importance on the earth. He will touch the principal climates, occupations, routes of travel, manufacturing processes, forms of transportation, cities, countries, land and water forms, that are described in geography texts. Furthermore, he will get a connected story about each product, a factor which is in itself a valuable aid to learning. He will also have the additional advantage of getting some novelty and variety with the review, for he will be relearning the old facts in new relationships.

Review of Vocational Activities as Influenced by Seasons

Examples of the order in which vocational activities determined by seasons occur are rather limited, but they have the advantage of throwing into relief the geographical element of climate as determined by the position of the noon sun. Examples are naming states of the United States and parts of Canada, Europe, Asia, South America, and Australia in the order in which the wheat harvest occurs, naming them in the order in which the planting of potatoes or corn occurs, and naming them in the order in which sheep-shearing occurs. All these devices have to be worked out for each grade. Strange to say, none of them are contained in present-day

grade texts, which unnecessarily restrict drill to the monotonous question-and-answer method. But variety in drill is possible in geography and should be used to make the study of it efficient and interesting.

Summary

Geography describes those portions of the earth and its products that have an influence on man. It should enable us to understand how sections and countries depend upon one another for their living and civilization, to develop a sympathetic attitude toward other peoples, to appreciate the sources and methods of production that contribute toward our economic life, to know how much we depend on the land for our life and to form habits of conserving its products, to see the smallness of our own locations in relation to the great world, and to adjust ourselves better to the situations that geographical conditions set for us.

Information and comprehension of geographical material increase with the age and grade of the pupil.

Because of the great number of facts and their often meaningless character, we must depend much on the law of repetition for learning geography. The number of facts contained in the average two-book grade text varies from 2582 to 9383, the number depending on the method by which they are determined. This requires the teaching of from 500 to 1800 facts in Grades IV and V and from 700 to 2000 in Grades VI and VII. An analysis of these facts shows that they refer principally to locations, products, vocational processes, and the economic life of man, and that they contain almost nothing about human nature, customs, and institutions, or about man's technique of adjustment to his environment, or about his thought and emotional life. The principal relationship among them is a spatial one, and this has the disadvantage of being almost meaningless to the learner. Because

of these conditions there is need of greater emphasis on drill; but, except that a fact described is given one review question, textbooks furnish no drill devices and no helps to the teacher for selecting the topics on which pupils should receive drill. Drill devices may, however, be found in outline maps, imaginary journeys, cards having topical summaries, reviews of the production and distribution of special products, and reviews of vocational activities as influenced by seasons. The effective use of these is conditioned by a prior sifting out of the essentials.

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CHAPTER XXI

GEOGRAPHY: THE LAWS OF ASSOCIATION AND OF SATISFACTION

Is Geography Meaningless?

Because of the great number of facts discussed in geography their organization is a matter of difficulty and easily lends itself to a serial description which is monotonous and often meaningless. Locational geography is necessarily of this sort, for there is no logical principle that allows us to give a connected story of five hundred cities. To the extent that a geography text limits itself to locations it becomes an almost meaningless subject and therefore hard and uninteresting to learn. Since large portions of many of our geography texts are devoted to locations, there are some reasons for classifying geography as a meaningless subject. An endless number of quotations could easily be found in current geography texts to support this view.

The authors of Book I, text D, tell us that "everything has been approached, and received its entire construction from the point of view of man's interest in it." But when we start reading it we begin to wonder what the meaning of "interest" is. In opening the page beginning the discussion of the north-eastern states the reader is required to start with a series of map questions, as though these contained an inherent and exciting interest. He is asked to name these states, to write their names, to tell which states have no seacoast, to name the state that extends farthest east and north, the one that extends farthest south, and the one that extends farthest west; to find the natural boundaries between these states;

to find the mountain system that crosses them; to find the states that have no mountains; to name and locate the chief rivers; to find New York City; to find with the aid of the scale how far it is from Boston to Philadelphia; to walk toward New York City; and to tell in what direction he would have to sail to reach England.

After this exercise the description of these states begins. We are told that the six farthest north and east are called New England; we are asked to name these, to find the names of the other three, to look at the map and see what a small part of the United States they are; we are told that together they are much smaller than Texas, but that they nevertheless constitute one fifth of the whole number of states. We are asked to find the smallest of these states and are told that it is the smallest in the Union; we are also told that one of the New England states is almost as large as the other five together, we are asked to find which one it is; and we are told that even so it is much smaller than New York. We learn that in spite of their small area the northeastern states contain over twenty-one million inhabitants, or about one fourth of the people of the United States; that one of them, New York, has more inhabitants than any other state in the Union and that it contains the largest city in the New World; and that Pennsylvania is next to New York in population as well as size.

We are then informed that it would be interesting to find out why so many people have been crowded together in such a small section and what kinds of work have attracted them. The next lines tell us that the occupations are the same as elsewhere, namely, farming, lumbering, fishing, mining, manufacturing, and commerce, but that some of these are more important than others, and that we shall find out which they are. The reader now becomes curious to learn something about these industries, to find out how raw materials are worked into finished products and what uses are made of

them. But in the next ten pages he finds little besides the mention of the towns in which each industry is located. We are told that Manchester, Lowell, New Bedford, Fall River, Lawrence, and Brockton are important cotton-manufacturing centers; that Lynn, Brockton, and other cities manufacture hides into boots, shoes, gloves, and leather goods; that a great amount of metal is shipped into New England for manufacture into needles, watches, jewelry, firearms, fish-hooks, nails, wire, and countless other things; that Worcester, Bridgeport, Springfield, Hartford, and New Haven are engaged in such manufactures; and we are asked to find the location of these cities. So the story goes on until the naming of the principal cities for each industry is completed.

Book II differs from Book I chiefly in the fact that it gives more of the same content. Instead of having 14 lines on textile manufacturing and 7 lines on metals, it has 88 lines on the first and 44 on the second. The single paragraph on textiles is therefore expanded into five with the following subheads: (1) extent and variety of cotton, (2) method of cotton manufacture, (3) method of woolen manufacture, (4) where cotton and wool are obtained, (5) chief cities engaged in textile manufacturing. Under (5), of course, we meet some new cities which had not been mentioned in Book I. These are Biddeford, Lewiston, Auburn, Augusta, Nashua, Dover, Pittsfield, Taunton, Pawtucket, and Woonsocket.

By reason of more facts being stated in Book II we have a corresponding increase in the number of review questions at the end of the section. In this volume they are grouped by states. Those on Maine illustrate the type. The pupil is asked to draw the coast line of Maine; to tell why it is irregular, to find the principal rivers; to tell what cities are situated on each; to tell whether he should expect to find much fishing along the coast, and why; to give as many reasons as he can why so many people resort to the Maine coast and woods in summer; to describe lumbering in Maine;

to name the cities that are engaged in producing lumber; to tell what stones are quarried in the state; to name the largest city and to tell how it compares in size with Boston and Providence; to tell what other cities are mentioned in the text and to locate them on the map; and to draw an outline map of Maine, locating the principal rivers and lakes, the capital, and other leading cities.

Text A, Book I, treats the New England states under the following topics: map study, surface, drainage, and soil; climate of New England; manufacturing cotton and woolen goods; manufacture in metal; paper; farming; forests and lumbering; quarrying; fishing; country homes and summer resorts; commerce and cities. These topics might lead us to expect a long story on each industry describing the sources of the raw materials, how they are made into finished products, and how the finished products are distributed. If this were done, the book might be interesting to read. But, contrary to such an expectation, we have the old story of the names of the towns engaged in each industry.

We are told that cotton and woolen goods are among the chief manufactures of New England; that the former are manufactured at Fall River, New Bedford, Lowell, Pawtucket, and many other cities, the latter in some of the same cities but principally in Lawrence and Providence; that the manufacture of leather into boots and shoes is also a great industry, the chief cities for this industry being Boston, Lynn, Brockton, Haverhill, and Manchester; that although there is little mining in New England, many articles are manufactured from metal: jewelry at Providence, cutlery and silverware at Meriden and Bridgeport, watches at Waltham and Waterbury, and hardware at New Haven, Bridgeport, Hartford, Worcester, and Springfield.

Book II of Text A is a mere expansion of Book I. With the exception of subtopics the table of contents is the same. The continents, countries, and states are taken up in the same

way and in the same order. The same political divisions are the units of presentation. Even the subtopics for each political unit are the same. For example, the headings we meet in the discussion on New England are again map study, surface, climate, manufacturing, the cotton industry, and so on. The principal difference is that the paragraphs in Book II are longer. Thus Book II has 65 lines on the textile industries as against 22 in Book I, 38 lines on metal manufactures against 25 in Book I, and 50 lines on the paper and pulp industry as against 25 in Book I. We are told a little more about the process of production. In Book I we learn that paper is made from wood, but in Book II we get the additional information that the trees are felled, the bark is removed, and the trunks are cut into blocks about two feet long. However, few new principles are brought to light, and there seems to be an absence of effort to reveal the relations of cause and effect to general geographic principles. Again we have the location of the industries emphasized. We are told a second time that Fall River, New Bedford, Lowell, Manchester, and Pawtucket are the great cotton-manufacturing centers, but we get the new information that there are also large mills in Taunton, Nashua, and Lewiston.

Text C begins the northeastern states with a description of New York City. There may be some question whether this city is not too great and complex for comprehension by the average fourth-grade child from the village or country, but in any case it has the advantage of being the most striking phenomenon in this section of the country. The discussion of its great population leads to the question of how it is supported. Transportation and manufacturing are named as the chief occupations: transportation because of its harbor and its gateway to the West; manufacturing because of the supply of raw materials, particularly Pennsylvania coal. We are then given brief descriptions of the kinds of manufacturing in the northeastern states: iron and steel in Pennsylvania, and

metal, woolen, leather, and cotton goods in New England. The latter came to New England because the early settlers could not import them and so had to learn to make them. We are then told how the city of Washington differs from the industrial cities of the northeast, after which the farming and fishing industries in these states are described, but with slight emphasis on their importance as sources of the food supply for the population. The section closes with twenty-eight review questions and eight suggestions for extra work.

Although this content is excellent in many respects, nevertheless there are numerous traces of the old-fashioned locational material, which means little to a young pupil. For example, after describing New York we are told that just across the river there is another vast population in Newark with 400,000, Jersey City with 300,000, and five other cities having an average of over 50,000 each; that only ninety miles south is Philadelphia, the third city in size in the United States, having, together with the neighboring cities of Camden, Trenton, and Wilmington, a population of over 2,000,000; that about ninety miles southwest from Philadelphia is Baltimore, the eighth city in size in our country; and that about two hundred and fifteen miles northeast of New York is Boston, the seventh city of the United States in size, having with Cambridge and other cities close by a population of more than a million. Although description of this sort is not very interesting, it has the merit of being restricted to the larger cities, a fact which is a big improvement over earlier texts and a corresponding relief to the reader.

Book II of this text follows the traditional custom in being almost a duplication of Book I, except that it has more detail. The tables of contents for the two books are almost identical. The continents are taken up in exactly the same order; so are the countries and states of the continents, exactly the same political units being followed. Even the major problems are the same. For example, in the northeastern states we

again meet the explanation of the density of the population as the principal problem. Transportation and manufacturing are again given as the principal occupations. The same reasons — location and raw materials — are again given for each. We are told again about Pennsylvania coal and about the manufacture of iron and steel around Pittsburgh and of metals, textiles, and shoes in New England. Again we meet with the differences of Washington from the other cities in this section and with a description of the agriculture and fishing. The differences are principally in the amount of detail. For example, Book I gives us 17 pages on this section, whereas Book II gives 34. Book I has 58 lines on the coal industry as against 93 in Book II, 49 pages on the iron industry as against 170 in Book II, and 60 pages on textiles and leather as against 169 in Book II. The new detail is principally the process of production: how coal is mined, how iron ore is smelted and manufactured into iron and steel, and how cotton and hides are manufactured into finished products. There are also some new topics, such as the cement and glass industries, the nature of a manufacturing town, and the development of a railroad, but these merely fill in the picture. Nowhere is there much attempt to reveal new and more general principles or to show in a casual way the relation of a wide array of facts to fundamental geographic factors, a most essential procedure if geography is to be made scientific and meaningful.

Meaningful Geography Texts

Fortunately not all grade texts in geography are devoted chiefly to a monotonous description of locations. Several recent texts have adopted the wise policy of discussing fewer topics and telling longer stories about each. They also have made an effort to bring out cause-effect relationships and thus make it possible for the pupil to use his reasoning powers

in learning the subject. Both these features make the subject more meaningful and therefore much easier to learn.

Some of the more recent books in discussing New England, for example, show how manufacturing became the leading industry there by telling how the harbors, water power, and skilled workmen favored the location of the industry. Some of the factors which brought about manufacturing were fishing and trade. For instance, the early settlers engaged in fishing because dried fish was one product that Europe demanded, because they had easy access to the sources of supply, and because agriculture was difficult. The fishing industry established shipping and trade, which in turn made it easy to establish a market for manufactured goods. Another factor in the development of manufacturing was the lack of good agricultural lands. Following this discussion we are told about surface features, climate, and soil.

Political Geography in Book I and Regional Geography in Book II

In at least two of the series of geographies Book I is based on political geography, and Book II on regional. For each section in Book I we have a discussion of the major industries in which the population is engaged. Then we have a general description of surface features, climate, and the like. So far as possible the topics are presented in a cause-effect sequence. Book II is not a repetition of the same things with more details, but is organized on an entirely different basis; namely, the geographic region. The most characteristic method of treating the regions is to show how the geographic nature of each region controls its industries. A description of the physiographic and climatic features of each region and their causes is followed by an account of the industries as influenced by these factors. A good example is the treatment of the territory of the central states.

We are told how the region was made by the glaciers and then put in condition for agriculture by the forest-clearing, roads, and railroads of the white man. It is shown how the soil, surface, and climate made possible the agriculture and favored the cultivation of corn and small grain. The abundance of corn makes possible the raising of many farm animals. The crops and animals together determine the leading manufacturing of the region; namely, farm implements and meat-packing.

Emphasis on Cause-Effect Relations, Interest Order, and Mental Level

The possibility of making the content of geography meaningful, scientific, and psychological is not lost sight of. Meaning is brought out by giving full discussions, and the treatment is scientific because a number of facts are related in a causal way to some principle. In New England the influence of natural resources (abundance of fish) and of natural advantages (harbors, rivers, and waterfalls) is shown upon industry. In the central states the influence of surface, soil, and climate is shown upon agriculture and type of manufacturing.

The content is also psychological, for two reasons: (1) the topics are presented in an interest order and (2) the material is adjusted to differences in mental level. The traditional order of topics — location, area, surface and drainage, industries and products — is not followed. It is much more interesting to a child to learn about industries and how people make a living than to memorize a number of locations, boundaries, distances, areas, courses of rivers, and so on, because he has some background for understanding how other people make a living; furthermore, a connected story can be told with reference to each industry, and a human interest is involved.

Locational Material

It is small wonder that when locational material is the principal content of a series of geographies, the pupil approaches Book II with indifference if not with positive dislike. It is quite possible to read an occasional page devoted to locations without a loss of interest, but when most of the pages are of this sort, the pupil might almost as well spend his time in learning rows of nonsense syllables. Although the learning of locations is an important objective in the study of geography, it should be subordinate to the things that make the locations worth knowing. It is well enough to know that Lowell is an important cotton-manufacturing town, but it is far more important to know the value of cotton goods for human comfort; to know where and how cotton is grown, spun, and manufactured into cloth, how it is distributed throughout the world, and to what extent human beings depend on it for clothing. After a pupil learns this he may be interested in learning the locations of the principal mills, for he then has a background to which he may link such information and with reference to which it means something. If locational information could be introduced in this manner, the interest of pupils in geography would undergo a great change; but to have to learn dozens of locations as a part of the day's lesson without any further ado is about as dull and meaningless a task as could well be devised. This feature is undoubtedly responsible for the fact that geography is classified by most pupils as the most uninteresting of all the subjects now taught in the schools.

Reason for a Two-Book Text

The only reason for covering the world twice in geography with two books is the wide difference in mental level between the pupils of Grades VI and VII and those of Grades IV and V. The device of giving more details in Book II but of retain-

ing the same organization is no adequate adjustment for this difference. In fact, the additional details often make Book II easier to understand than Book I, for they make the thing described more concrete and easier to visualize. Increasing the number of details increases the difficulty of learning only by making necessary a more complex and extended organization. A better device for increasing difficulty is to increase depth and bring to light more general and hidden principles.

Book II might very well follow both these devices, but its emphasis should be on the second. The causes of surface features, the movement of the ice cap, the controlling influences of climate, the dependence of present civilization on minerals, and the dependence of man's food supply on soil and water are topics which require a much higher mental level than do descriptions of ways of making a living. It may be that some of these topics are too difficult for pupils in the upper grades; but the idea is that the second book in geography should not be a mere description of more details than are given in the first book, but that it should relate the numerous facts in a causal way to important geographic principles. That is to say, it should be rational and scientific as well as descriptive. Such a treatment will not only make the subject much more useful to the pupil but will also be a much more adequate adjustment to the differences in mental level existing between the pupils of Grade VII and those of Grade IV.

Devices for making the Teaching of Geography Meaningful

If the teacher selects a textbook in geography that makes the subject meaningful, his task will be much easier than if he selects one that is devoted chiefly to locations; but the subject can be made meaningful even with such a text if the teacher uses it principally for reference and depends much

upon supplementary material and devices of the proper sort which are largely independent of any text. The controlling principle in such devices should be to select readings and materials that make possible the reconstruction of the experiences of first-hand observers. They should be for the child an open window through which he can look out upon the world and see in his mental eye what is there and what goes on there. If this is the ideal, it will be readily seen that the descriptions in our texts are far too scant to make anything like it possible, and that the teacher must rely chiefly on supplementary readings, pictures, inductive teaching, maps, models, collections of products, topical studies, projects, problems, advance questions, booklets, collections of exhibits, pamphlets from commercial firms, dramatizations, an interest order of presentation, and the selection of the proper unit of presentation. Some of these deserve discussion.

Examples of Scant and Full Descriptions

The inadequacy of the text may be seen from the following account of the forests and cities of Brazil:

> A large part of Brazil, including much of the valley of the Amazon and its tributaries, is covered with dense tropical forests, through which one can scarcely make his way without first cutting his path. Few people except Indians live here, and, although large boats can go far up the Amazon and its tributaries, there is not a single large city in this entire valley.
>
> The most important cities are on the coast, by far the largest being Rio de Janeiro, the capital. Bahia and Pernambuco, farther north on the coast, are second and third in size among the cities of Brazil, and the fourth is São Paulo, which lies to the southwest, back from the coast. Rio de Janeiro is the second city in size in South America. Which is the first? It has a splendid harbor, and is a very busy seaport.

This quotation constitutes a little over a third of the total number of lines devoted to Brazil. By way of comparison,

study the following description of Rio de Janeiro and its environs.

Before commencing to describe the many important States of the Union, it is opportune to say something of Rio de Janeiro, the Federal capital.

The collection of one and two story dingy buildings which formed Rio de Janeiro during the early colonial period, bears no resemblance whatever to the splendid city of to-day. The capital has undergone an extraordinary transformation during recent years, and nearly all the narrow thoroughfares and dirty houses of earlier times have now been replaced by broad avenues, streets, and parks, lit by electric light and crossed by tramways.

The view of Rio from the sea is magnificent: a large city facing the blue waters of the bay and encircled by green-clad hills, upon the summits of which stand numerous white mansions surrounded by prolific growth, forms the foreground, while the distance is often obscured by the hot blue haze which hangs over the Serras da Tijuca and Gavea.

The extension of the port of Rio, and the other improvements which have been carried out, make it one of the finest harbours on the east coast of South America.

The maritime quarter of the city is certainly not encouraging, for here are the stores, warehouses, and other unsightly edifices of a busy port. The narrow streets are full of jostling Italians, Portuguese, and Spanish labourers, and the pungent odour of coffee and tobacco, combined with the hoot of sirens of steamers in the bay, while showing the commercial activity of Brazil's capital, make this portion of the city unbearable during the heat of the day.

The cosmopolitan crowds, the busy docks, and the odour of seafaring requisites, all pass away as if by magic when the magnificent new thoroughfares of Rio are entered. Here we have broad and busy streets, lined on each side with fine shops, some exhibiting all the latest Parisian creations, and others specimens of the jeweller's art.

A walk up the Avenida Central, or through Ouvidor Street when the sun is sinking beneath the western horizon, and the cool breeze of the evening makes exercise possible, affords a typical

scene of the Federal capital. Ladies in fashionable costume accompanied by the élite of the male society of Rio, brilliantly lighted cafes, and in the distance the crowded foyer of a theatre, recalls to the spectator similar scenes in Lisbon and Madrid.

Another notable thoroughfare is the Avenida Beiramar, a fine, well-paved esplanade, facing the bay, lined by rows of trees, and illuminated at night by numerous arc lamps.

Visitors to Rio should certainly visit the Botanical Gardens, which contain a magnificent collection of tropical trees, shrubs, and plants. The old palace of the Emperor, which, like that at Fontainebleau, has now been converted into a state museum, is also worth a visit; not only for its historic past, but on account of the lovely grounds which afford cool shade during the heat of mid-day.

At present the capital, with a population of over one million, is one of the healthiest cities in the world, notwithstanding its geographical position. The sewerage system has been completely remodelled, and care has been taken to ensure that the sanitary regulations are rigidly carried out. The stagnant pools and swamps along the shore, which used to spread malaria and yellow fever, are now filled in, and one may walk with comfort and security along the fine promenades which have been constructed over what was once, perhaps, the most pestilential swamp in this State. The city possesses a model Health Department, and epidemics of yellow fever are a thing of the past.

Across the bay of Rio lies the seaside town of Nictheroy, which is the favorite summer resort of the inhabitants of the capital. All the year round steamers ply daily between these two places, and throngs of holiday makers may be seen crowding the decks eager for a breath of the ocean to temper the sweltering heat.

The "Harrogate" of Brazil is the small town of Petropolis which is situated up in the mountains some few miles from the capital. This clean, pretty, little hill-resort is as unique as it is exclusive. The streets are lined on each side with pink and white magnolias; and small streams, with cool grassy banks, run down the centre of many of the fine avenues.

At Petropolis is situated the summer residence of the President; and white stone mansions standing in beautiful grounds show that many wealthy Brazilians have followed the President's example.

The climate is cool even during the hottest months of the year, and in winter the wind is often cold enough to necessitate the use of an overcoat.

The railway journey from Rio to Petropolis affords an endless panorama of beautiful scenery, the line winding among mountains clothed from foot to summit in the rich green of tropical growth, the valleys and hillsides covered with coffee, sugar, and other plantations and the white bungalows of the estate-owners nestled amid the tangled foliage. As the train mounts higher the scene becomes more wild, gorges filled with trees and rugged mountain crags stand out in bold relief against the blue sky, until at last the heights of the Serra do Mar are reached and the train enters the small white station of Petropolis.[1]

Such descriptions as these may be considered adequate. They meet the requirements of enabling the reader to reconstruct the traveler's experience and to visualize the thing described. Because they do this they are interesting and enjoyable and make it possible for the reader to learn something besides words.

The Use of Pictures

If descriptions of the kind given above are accompanied by pictures, the reader acquires a still more concrete and clear view of the objects described. If he turns to Volume XXXVIII of the *National Geographic Magazine* he will find thirty-nine fine views of the city of Rio, some of them airplane views and some the close-ups of buildings and street scenes. With this sort of material before him he is not likely to come to his geography class with sighs, but with an interest akin to that of going to a "movie." It is impossible, of course, for a textbook to devote such an amount of space to all the cities or regions named on the map, but this is not necessary. Educationally it is more valuable for a child to have a detailed view of one city in a foreign country than to know only the

[1] Charles W. Domville-Fife, The Great States of South America, pp. 41–44. G. Bell and Sons, London, 1910.

names or the locations of two dozen. Moreover, only typical scenes need to be treated in this way. If in the sections on South America details were given of Rio de Janeiro, the Amazon, the tropical forest, a coffee ranch, a cattle ranch on the pampas, and one Andean country, the child would have sufficient background to appreciate short accounts of other places in that continent.

The Use of Models and Projects

Better than pictures but less available are models of the objects described. If these are made by the pupils themselves and are constructed according to scale, the pupil comes as near as possible to a substitute for first-hand observation and experience. Construction by the pupils forces them to become fully informed before beginning the model, gives them an incentive for attending to details and getting accurate information, enables them to show their ingenuity and initiative in planning and searching, appeals to their self-assertion, and gives them an opportunity for showing the results of their labors and so winning the admiration of others. The use of models may be combined with that of pictures, supplementary reading, and collections of products in a project which has for its object the understanding of some particular country. An ingenious use of such a project is illustrated in the following quotation from Miss Roxana M. Adams of California.

THE GEOGRAPHY OF SWITZERLAND TAUGHT THROUGH CREATIVE EDUCATION

A Project in the Sixth Grade

The Project: To make a representation of the Swiss Alps to show how the Swiss with very few natural resources adjust themselves to the environment and convert obstacles into advantages.

"Joe, you fix the tunnel so that the trains can go under the mountains on their way to Italy."

While Joe, the engineer, tunneled under the Alps, Frank and John made the glacier between the peaks. Meanwhile, Frances and her assistant placed the cattle and the goats on the mountain side.

This scene, not at all imaginary, took place in a sixth grade where the project method is used.

On a table two mountains of clay were made, and on these mountains were placed all the representative things of the country of the Alps. The whole model was about three feet long and two feet wide.

By the use of salt, water, and flour a glacier was made between the two peaks, and descending from the glacier was a swift-running stream. Along the stream where the icy waters flowed very swiftly, there was a little mill, turning out "white coal" to make up for Switzerland's lack of real coal.

At the base of the mountain, surrounded by forests, terraced vineyards, and fields of barley and rye, was a monastery from which the great St. Bernard dogs sailed forth after winter snow storms. High above the tiny chalets were the goats and the cattle whose milk the farmer folk convert into cheese and the famous Swiss Chocolate. At the summit of the peak there was a tiny cavalcade of tourists roped to their guide, who had just reached the summit where he planted the red flag that told the universe of their achievement.

Around the room there are pictures of the tourists, mountains and glaciers, and at another table there are silk and embroidered products as well as examples of Swiss wood-carving.

Laws of Learning in this Project

The laws of learning made use of in this project were (1) that an interest order of presentation was followed, (2) that the pupils had incentives for acquiring the important geography information about Switzerland, (3) that sufficient details were furnished to make their ideas clear and accurate, and (4) that the making of the model supplied a social incentive for securing the admiration of others as well as a visible form for expressing their self-assertion and achievement. Interest in Switzerland was first aroused by asking the pupils

to read a good story, Spyri's "Heidi," which led them into the life and customs of the Swiss. They were then asked what more they could do to make their ideas clearer, and from the discussion the project of modeling the mountains out of clay was developed and accepted. Having accepted this project, the questions how the mountains should be made and what should be put on them, immediately became pressing and interesting. Here was an incentive for doing some supplementary reading. The teacher satisfied it by suggesting a good reference, Allen's "New Europe." The pupils discovered that there should appear goats, a waterfall, tourists, railroads, cattle, Alps, a well, St. Bernard dogs, a glacier, a chalet, trains, a stream, hotels, patchwork fields, and a bear. This led to a search for materials out of which to make the objects. In getting the proper proportions the pupils became interested in pictures and scales and map studies of Switzerland. Usually nothing is more dull than the long list of "map questions" with which the study of new countries begins in the traditional textbook; but at this point of the project nothing was more interesting than questions on area, surface, mountains, rivers, climate, altitude, and latitude. Of course, some natural resources had to be represented in the model. To put these in, the pupils had to familiarize themselves with the concept of natural resources. Therefore a review of resources studied in other countries was in order. After that the pupils were prepared to study the particular resources of Switzerland and the uses made of them. This led to studies of industries, transportation, and the type of people that is necessary for overcoming the obstacles of a mountainous country. Having the necessary information for constructing the model they could complete it, understand the symbolism of the whole and of every part, and be ready for a test of the factual information acquired during the work. Then came the satisfaction of making an exhibition to visitors and winning their admiration. Such is the interest order throughout a project. In

itself it furnishes an incentive for completing each step. The steps are completed by finding details, and these in turn lead to the formation of clear and exact ideas. The social incentive is supplied by the prospect of a public exhibition, which in turn furnishes an incentive for another project.

Why Such Study is Meaningful

Such a study of the geography of Switzerland is meaningful. It enables the pupil to visualize the country clearly, to understand the selection of dairying, wood-carving, watch-making, and chocolate manufacture as the industries best adapted to its natural environment, to see why it is an independent and democratic country, to appreciate its beauty and why it attracts tourists from all over the world, to understand better the symbolic character of models and to gain still more in understanding that of maps. The essential conditions of these results is fullness of detail well organized.

The Use of Inductive Teaching

An effective method to use in connection with fullness of detail is inductive teaching — developing concepts from facts. In this method it is necessary for the teacher to decide in advance what concepts are to be developed and what facts are to be selected and studied for the purpose. The facts, of course, will be obtained from photographs, maps, readings, and collections of products. An unusually successful adaptation of inductive teaching for the fourth grade is described by Miss Edith R. Parker.

The Objectives to be Realized

Miss Parker began a project the object of which was to develop an idea of the world as a whole and to provide a background for later geography in the way of enabling pupils

to read maps, to become familiar with the meaning of *continent* and other geographic terms, to understand the influence of distance from the equator as a determining factor in the character of the environment and in the adaptation of men to the environment, and to apply these concepts to the home environment.

The Methods Used

The general procedure was (1) to study specific habitat groups in specific regions, (2) to study these groups in such a sequence as to facilitate the sensing of the fact that distance from the equator influences the climatic character of the region, (3) to supply in connection with each region studied vivid imagery of natural environment and human activities within that region, (4) to provide imaginary journeys as transitions from region to region, (5) to work out simple map symbolism in connection with each region studied, and (6) to build world maps by putting together the maps of each region studied.

The Starting Point

To begin with, the teacher appealed to the curiosity of the pupils by asking if they would like to visit in their imagination many parts of the world ("yes"), whether they would like to visit places far away or at home ("far away," in all cases), and whether they would like to keep a blackboard record of their travels ("yes"). For the last a fourteen-inch circle of tag-board paper was used, shaded to give the appearance of a sphere.

First Study

The teacher selected for the first study the region of the Tigris and the Euphrates. The pupils began by studying pictures of boats on the Tigris, villages of reed houses, villages of flat-roofed clay houses, men at work in irrigated fields, barren stretches of land, women carrying water in jars, men building koofas and kaleks (native boats), mounds of

ruins of ancient cities, houses of grass and date palms. Since these things were new to the children they asked many questions about them. With these as a foundation the teacher developed the idea that the men built boats of reed and pitch and houses of clay or grass because these materials existed in the region. The houses were flat-roofed because of the scant rainfall and had few windows because of the need of shade from the hot sun.

The Use of Airplane Views in developing Ability to read Maps

The pupils were shown airplane views of the city and other places and learned that by piecing these together they could get a picture of the entire region. The teacher told them that by drawing a diagram she could show them what they could see by visiting the surrounding regions. She then showed them a wall map of the region and found out that they could make out many of the places which they had seen; that is, they could read maps.

A Device for Developing the Relative Size of the Region of the Tigris and of the World

The next step was to transfer the wall map to the circular tag boards. Small hectographed copies of this region were pasted on the proper spot. This made the children aware that the world must be very large and also curious to know what else the teacher would put there. A few symbols were put on the small copy. These were chosen by the pupils after they had clearly in mind the things to be represented by them.

The Study of Egypt and the Delta

The pupils next made an imaginary journey to the southwest and studied Egypt. By making comparisons with the Tigris region it was possible to cover this in much less time. The journey across Arabia developed the idea of *plateau*.

The idea of *delta* was developed by exploring the low hills on the lower Tigris, the remains of an ancient city. The explorers found clay tablets; one of these recorded the fact that at the time it was made the city was on the gulf. Now it was seventy miles from the gulf. The swamps below the ancient city were studied and their origin explained from the sediment carried by the river. This enabled the pupils to recognize the delta of the Nile when they were shown a map of Egypt.

The Study of Tropical Africa

A journey was next made to the home of Bingwa in tropical Africa. From pictures of the region the ideas were developed that the people here need few clothes because of the shade from the trees. But the people of Egypt and the Tigris need clothes and turbans because of the hot sun and the severity of the sand storms.

The banana tree was emphasized as the symbol of this kind of climate.

The Mediterranean Countries, Switzerland, Norway, and Lapland

The pupils next made a journey up the west coast of Africa to the Mediterranean and stopped from place to place to study characteristic scenes from the shores of Spain, France, and Italy. At this point a wall map of Europe was unrolled just enough to show the regions studied. The children recognized what it was and could identify Italy, Greece, the delta of the Nile, and the Tigris. They learned the meaning of colors as representing elevations. Permission was now given to unroll the map and travel north to Switzerland, Norway, and Lapland. By the time these visits were completed, the pupils had seen concrete human responses to a tropical environment, to the Mediterranean environment, to a lowland

environment in a coastal region, and to a highland environment. Each region was added to their world record as they completed it, and in each the position of the noon sun was emphasized.

How the Idea of "Continent" was Developed; a Journey to the South Pole

The idea of a continent was now developed by passing a paper around and asking the children to write all the things that Europe suggested. Next the things peculiar to Europe were struck out and the remainder was left to characterize a continent. At this point the idea that there were four other continents was explained; but before the children were permitted to draw these on their records, they took a trip with Amundsen to the south pole. They discovered the position of the sun in that region and also that the long day in Antarctica occurred at the same time as the long night in northern Norway.

The Meaning of "Equator" and Other Continents

The meaning of *equator* was now developed and also the idea of how distance from the equator influences geographical conditions. A primary geography of the Transvaal was studied to check the pupils' ideas of how the home of a little girl in South Africa would differ from Bingwa's home.

From a globe the children now found out in what direction they would reach the other continents from Europe and saw that they had to put the picture of the western continents on the other side of their globe-picture maps. They now asked many questions about their home region, such as Why do we build so many kinds of houses and wear the kind of clothes we do? These were prompted by the generalizations which they had drawn from their studies up to this point. A study of their own continent now followed.

Why this Teaching is Meaningful and Interesting

This kind of teaching makes geography both interesting and meaningful. It is interesting because it is motivated throughout by curiosity. There is a curiosity to visit strange lands the world over, a curiosity to see what the next country is like, a curiosity to find out what the unrolled map shall reveal, and a curiosity to discover what is needed next to fill in the globe-picture record. This curiosity is satisfied in part and also intensified by selecting a mode of presentation which is concrete, giving visions through pictures, and a content which is itself appealing to the child — the actions of human beings in each region. The content is made meaningful (1) because the teacher explains each concrete response as an adaptation to the natural environment; (2) because only simple modes of living are studied; (3) because all the types of responses in the different regions are explained by and connected with one general controlling principle — the influence of distance from the equator; (4) because all the important concepts are developed inductively out of a rich background of vicarious experience. The last device was the most important one in the project. It is shown in developing the ability to read maps from piecing together airplane views, in developing the idea of *delta* from a photographic study of the delta of the Tigris, in explaining the influence of distance from the equator on climate and life after the children had studied specific regions at varying distances from the equator which represented the principal types of climate, and in developing the concept of the world by building a globe piece by piece after each had been studied. This method gave the children concrete ideas of the area of each region and also of its comparative size in relation to the rest of the world.

Advantages of Type Study

The advantages of type studies are also illustrated in Miss Parker's plan. Such studies give concrete views of the world through a detailed study of a small number of typical regions. Although most of the world was left unstudied in this project, nevertheless the children obtained a far more meaningful view of the world than if they had studied all countries a little.

The Use of Topical Studies

Topical studies have two advantages: they permit the completion of a certain logical unit and they permit its study in the form of problems. The study of the north-central states, for example, may be broken into a number of problematical topics, such as the following: What are the characteristics of the climate and soil of this region? What do these states contribute to the food of the nation? What proportion of the corn of the nation is raised in these states, how is it raised, and how is it used? What are the principal manufactures of these states, and why are they located there? What is the story of the manufacture, distribution, and uses of automobiles in these states? How do the packing-houses gather, prepare, and distribute meats? Why is Chicago the second city in size in America? and so on. The interest in topics of this sort may be increased by asking half the class to prepare answers to what they suppose the questions will be. In this there will be considerable rivalry in securing the best questions or answers. Both sides must master the content in order to formulate either, although the side that has the questions usually thinks that it has the easier task. In connection with studies of crops or manufactures considerable interest may be developed by preparing exhibits illustrating different stages of the process in question. Manufacturers often prepare exhibits showing their method of production, manufacture, and

distribution. These are accompanied by an explanatory booklet. In this way a far clearer explanation of the process is given than can be obtained in a textbook. Children are delighted to collect such exhibits and to study them.

The Use of Dramatization

Because of the nature of its content dramatization cannot be used in geography to the same extent as in reading or history. That which is easy to dramatize — human action — forms only a small proportion of the content as compared with the part that is difficult to dramatize — countries, mountains, rivers, cities, and processes of production. But yet nature worshipers dramatize and personify natural processes such as winds, seasons, rivers, and thunder, and the same may be done by children. An interesting dramatization is to have a pupil describe himself as a location or other object so well that the others may guess what river, mountain, or country he is. Other things which may be dramatized are characteristic national customs, costumes, traits of character, exchange of products, and foreign commerce. The scenery would show the architecture and many of the products of each country. For example, if children were to dramatize a Japanese tea party, the actors and actresses would demonstrate the manners of a tea party, their garments would show the costumes, and the scenery would picture a Japanese home with its architecture, furniture, and surroundings. The value of such a project is that it gives the child a motive for finding the details of Japanese life.

The Order of Topics

The order in which topics are studied in geography influences its meaning. Texts disagree on what the first topics should be. One starts with "The Ball we live on"; a second, with "How People Work"; a third, with "The Importance of

the Soil"; a fourth, with "The Eskimo." Hence the first pictures may be of the moon, of a herd of dairy cattle, of a factory with people going to work, of a swamp from the Congo, or of an Eskimo girl holding a pup. In spite of this disagreement about the first topic, the texts agree pretty closely about the order of important topics. The first thirty to seventy pages are devoted to general, or world, geography designed to give the child a view of the earth as a whole: its elements, such as land, water, air, plant and animal life, and some of the striking phases of human life and work on it. Then come the continents of North America, South America, Europe, and Asia. Africa and Australia vie with each other for last place. First, a general view is given of each continent as a whole, followed by more detailed views of its parts. North America and Europe are studied by countries in such general divisions as western, northern, southern, or eastern. The United States is treated in detail in all the books. The most frequent method is to begin in the northeastern corner and end in the southwestern, although one book has ventured to begin with the north-central part, then to go west, then to go back to the southeast, then to travel north and end in New England. In four out of five texts examined by the writer, Book II follows the same order of topics as Book I. The fifth text treats Africa next to Europe and North America and ahead of South America and Australia. In treating the United States it begins with the southeastern corner, then travels northwestward to the north-central region, then westward to the Pacific, and then back to the northeastern corner. In general, it may be said that the order of procedure is from whole to part: first the world, and then the continents as wholes.

The controlling factor in determining the most meaningful sequence of topics in geography should be the child's background of experience and his interest. Although the experiences of fourth-grade children differ widely because of their

location, family, and ability, it is certain that among the things most foreign to their minds are the earth as a whole, continents as wholes, and countries as wholes. Because these objects are so foreign they have neither interest in them nor curiosity about them. On the other hand, what they do know in detail is home life. This, then, should be the starting point for geography. But should it be their own home life or the home life in far-away countries? Their own home life is uninteresting because of its familiarity and daily humdrum, but they will have a great curiosity in types of homes that are strikingly different. The home of an Eskimo child, or of a child on the Congo, or of one in the desert of the Tigris is therefore a better beginning point. Such a child has the same things as an American child — shelter, meals, beds, playthings, and so on. These he can understand. He is interested in them because the things are different in form. A further advantage is that the contrasts throw into relief the controlling geographic factors. It is necessary, of course, to get the concept of the earth and of continents as wholes, but these should be arrived at inductively out of a rich background of experience and should therefore be end results instead of starting points. The method followed by Miss Parker described above is an almost ideal model of meaningful sequence. Although concepts of the earth or of a continent or of a country as wholes should be end results of a course of study, it is not necessary that the teaching of these be postponed until the end of the study of geography, but only that they come at the end of a cycle. The first cycle might very well end with the earth as a whole; the second, with a country such as the United States as a whole; the third, with a continent such as North America as a whole. These cycles should differ in depth, but the controlling principle in all should be that concepts are derived inductively from a rich background of understood facts. The acceptance of this principle would require a complete reversal of the prevailing order of sequence.

The Unit of Presentation

The unit of presentation is an important factor in making geography meaningful. Outside of continents the prevailing unit is political, but in recent years a few texts have appeared in which it is geographical. There are advantages in both units. First, the political unit is used almost entirely in reading matter outside of geography, such as newspapers, magazines, and books. Whenever an event or a news item of importance occurs, it is always located with reference to some city and state or country and not with reference to a plateau, a valley, a mountain range, or a climatic belt. Since one of the uses of geography is its help in locating such events, the political unit of presentation is the more helpful. Secondly, the political unit is itself an element of geographic control. This is shown in the difference in farming, manufacturing, transportation, dwellings, cities, educational institutions, literacy, and behavior of people living in the same geographic region but in different countries. Examples are Russia and Poland on the one hand, and Germany on the other; Mexico and the southern United States. The superiority of Germany and the United States to their neighbors in these things is due not to the geographic region in which they are, but to government, the political and social unit in which the inhabitants live, and to race. Thirdly, the educated American adult has little interest in the geographic regions of foreign countries. It matters little to him that Berlin, Warsaw, and Moscow are all in a great plain, but it is a matter of interest that Berlin is in Germany, that Warsaw is in Poland, and that Moscow is in Russia. His interest in places may be political, commercial, or cultural; but whatever it is, it is by countries rather than by geographic regions. Fourthly, political boundaries are definite, and boundaries of geographic regions are not. According to geographers many elements go to make a geographic region:

surface features, natural resources, soil, temperature, rainfall, length of growing season, and native vegetation. Regions determined by these elements do not begin or end on a line, and usually have wide overlappings. Therefore it is partly a matter of choice which region shall be selected, how it shall be mapped, and what its influence is. On the other hand, the geographic region has many advantages for instruction: First, if the political unit has been used in the lower grades, it makes possible a new method of treatment in the upper grades and consequently avoids a great amount of useless repetition. Secondly, where a geographic region covers a number of states which have the same industries, kind of population, and form of government, it is a great economy to treat such a region as a unit. The process of growing, harvesting, cleaning, and weaving cotton is the same in Alabama as in South Carolina, and so one description covers both states. Thirdly, the dominant industries or features of a region can be explained in detail and can be followed logically from beginning to end; for example, the cotton industry, the meat industry, or the beauty of a mountain region. Fourthly, the material can be organized with reference to scientific principles; for example, climate and rainfall determine what the crops and industries shall be in the great plain running from the Gulf to the Arctic Ocean. Since the principal cause of the abundance of meaningless material in current geography texts is lack of organizing principles, presentation by geographic units is a matter of the foremost importance. Fifthly, many political units contain a variety of geographical regions and cannot be comprehended as wholes in any logical sense. For example, California is partly in the temperate zone and partly in the subtropical zone. Its rainfall in different parts varies from none to over sixty inches a year. Its elevation varies from below sea level to over ten thousand feet. Some regions are best adapted to orange-growing, others to wheat-growing, others to grazing, others to mining,

and still others to forestry and the manufacture of lumber. The geography of this state must take account of its regions. California is in no sense a geographical unit, but only a name for a form of government covering various regions. Since both political and regional geography have so many merits, both forms should be studied in the grades. So long as two books are accepted as the traditional form of texts in the grades, it would seem fitting to devote one book to political geography and the other to regional geography. From the standpoint of meaning, regional geography is the more helpful when government and race are not differentiating geographic factors, as in the United States and Canada; but in the countries of Europe and Asia, where government and race are important differentiating factors, the political unit appears the more helpful.

The Law of Satisfaction

The study of geography is satisfying to the extent that it is meaningful. We have seen, however, that this quality is conspicuous for its absence in the traditional grade text, but some recent texts show that even geography can be made a meaningful subject. The long discussion on the law of association with the numerous devices as applied to geography should convince even the most skeptical that it contains a content very rich in meaning and that there are many ways of making its teaching rich. Each of these devices also helps to make the subject interesting and satisfying. It makes a strong appeal to curiosity if the new country or region is described fully enough so that the reader can visualize it. The appeal to self-assertion and initiative is equally strong if the pupils are permitted to go outside of the text and make models, collect pictures and products, produce dramatizations, or make up questions and answers on a certain topic. Mastery and rivalry may be appealed to by having games.

For example, the teacher may have a large number of cards having the questions printed on one side and the answers on the reverse side. She reads a question, and the pupil who answers it first wins the card. The pupil's object is to win the largest number of cards. The same game may be played by choosing sides. There also may be races in finding locations, in naming states and countries, in giving cities of a certain character — capitals, steel cities, oil cities, commercial cities, and the like — or in naming the products or natural resources of a certain state or country.

Geography also provides ample opportunity for exercising the imagination, as in puzzle games, in which the pupil is required to put together a dissected map; or in guessing-games, in which one pupil describes an animal, plant, mountain, river, city, country, or something else, and the other members of the class are required to name the object described; or in store games, where the pupils represent different countries and exchange the principal products of their foreign commerce. There is little opportunity for appeals to hate, love, sympathy, patriotism, and other action, as in history; but to an ingenious teacher who is willing to go outside of the textbook, geography is by no means a difficult subject to make interesting and satisfying.

Summary

The law of association is concerned with devices for making geography meaningful, but one's first impression from reading grade texts is that it is a meaningless subject — names of cities, rivers, mountains, and what not. But there are some meaningful texts which have adopted the wise policy of discussing fewer topics and telling longer stories about each. They also choose topics in which there is a human interest and describe them in such an order as to bring cause-effect relationships to the foreground. Two of these discuss political

geography in Book I and regional geography in Book II. The first has the advantage of giving the kind of information that most adults want; the second has the advantages of being more scientific, of being adjusted to a higher mental level, and of revealing something new and more hidden. Besides selecting a meaningful geography, a teacher can use a number of devices for making the subject more meaningful. The ideal of these should be to provide the child an open window through which he can look out on the world and see in his mental eye what it is and what goes on there. The first device is to give full and detailed descriptions of important and typical places and topics and to supplement these with illustrative pictures and models; a second is to use the project method of teaching. Some requirements for making it effective are that it should relate to a significant topic, that it should follow an interest order of presentation so as to give pupils an incentive for acquiring facts and details, and that it should give some opportunity for imaginative play and creative invention on the part of pupils. A third device is the use of inductive teaching, in which concepts are developed out of a rich background of vicariously experienced facts. Such a method is restricted to types of regions, but it is better to understand a few than to have a merely verbal knowledge of many. A fourth method is to use topical studies in which there is emphasis on logical relationships; a fifth, to use dramatization; a sixth, to have textbooks in which the order of presentation is from part to whole and from facts to principles, instead of the reverse, which is the accepted order; a seventh, to have the unit of presentation political in Book I and regional in Book II.

The best way to make geography interesting and satisfying is to make it meaningful. Puzzle games, guessing-games, and projects give ample opportunity for exercising the imagination.

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CHAPTER XXII

GEOGRAPHY: SELECTING CONTENT FOR GEOGRAPHY, AND WHAT HABITS SHOULD BE FORMED IN GEOGRAPHY

Since the number of facts contained in the popular two-book text in geography, as measured by the total number of page references, runs all the way from five thousand to fourteen thousand there is evidently need of a great reduction in order to make the mastery of some of them possible. Efforts have been made to find objective methods of selecting the important facts by finding the consensus of the judgments of experts, by calculating the frequency of geographic references in newspapers and magazines, and by a combination of a number of measures, such as frequency of mention in newspapers, magazines, and books, population, area, volume of commerce, amount of bank clearings, and others.

A Study based on the Judgments of Experts

A study to find the judgment of experts was made by R. H. Whitbeck. With the assistance of seventy-five teachers, principals, and superintendents from twenty or more states he prepared a list of locational facts which was then gone over by a committee of six textbook writers who marked the cities that should be thoroughly taught. Those that two or more agreed on numbered sixty-three: twenty-five in the United States, sixteen in Europe, eight in Asia, six in the western continent outside the United States, and eight in Africa, Australia, and scattered islands. The interesting fact is that although the same judges put as many as seven hun-

dred cities in their textbooks without any statements on their relative importance, they agree that less than one fifteenth of this number should be well learned.

Studies based on the Journal Method

Studies based on the journal method have been made by Bagley, Thomas, and Washburne. Bagley counted 2237 references in eighteen issues of the *Outlook* and the *Literary Digest*, distributed over a period of seven years, ending with 1913. He calculated the percentage of references to locational, political, commercial, social, and historical geography. The distribution of emphasis was found to be practically the same as in textbooks: 53.5 per cent to locational matters, 25.1 to political matters, 5.8 to commercial matters, 4.8 to social matters, 1.7 to historical matters, and 8.9 to local or transitory matters. The order of the emphasis of the continents was found to be the same as that in textbooks. Of the European countries England had the highest frequency. Then came in order France, Germany, Russia, Italy, Turkey, Austria-Hungary, and Spain. The seven most frequently mentioned foreign cities in order were London, Paris, Berlin, Rome, Constantinople, St. Petersburg, and Vienna. The order for the five most frequently mentioned American cities was New York, Washington, Boston, Chicago, and Philadelphia. The references to surface features were few, but the most important rivers were the Hudson, Ohio, Missouri, Rhine, Nile, Danube, St. Lawrence, Potomac, La Plata, Seine, Niagara, Rio Grande, Columbia, Amazon, and Congo. The study is too restricted to give us much of an idea what to teach in geography; its importance is that it shows us one measure by which the important facts may be found.

The study by Thomas followed the same method, but was made upon samplings of the *Indianapolis News*, the *Danville Gazette*, and the *Youth's Companion* between 1911 and 1918.

The distribution of emphasis on different types of geography was found to be approximately the same as was reported by Bagley. The order of importance of twenty-nine cities in the United States was determined, but this would not be the same if more journals were used, or measures other than frequency of mention. Washington ranked first, Indianapolis second, and Providence, which has about the same amount of population and commerce as Indianapolis, was not even mentioned. This is due to the local character of the journals used. The great value in selecting such journals is to find the relative value of the items in home geography.

The most extensive investigation using the journal method was made by Washburne and his co-workers. They counted 81,434 allusions to geography and history. They selected fifteen issues from each of eighteen journals appearing over a period of years from 1905 to 1922. Of these, four were literary, such as the *Atlantic*; five were popular fiction, such as the *American* and the *Ladies' Home Journal*; five were reviews of opinion, such as the *Literary Digest* and the *Nation*; and five were newspapers, such as the *New York Times*. The topics were ranked according to the number of "periodical years" in which the allusion occurred, and three other measures when the first one produced equality of rank. A periodical year consists of one or more allusions appearing in one periodical in one year. Thus, if George Washington appears in three periodicals in one year or in one periodical for three years, his score is "three periodical years." The other three measures were range of years (the number of years between the first allusion and the last during the eighteen years studied), the number of articles containing allusions to the items in question, and the gross number of allusions. In this way 61,616 items were found that had a score of more than six "periodical years." The first 50 items, with the figures that determine their rank, are given in Table CXXVII.

TABLE CXXVII. FREQUENCY RANKS OF FIFTY OF THE MOST COMMON HISTORICAL AND GEOGRAPHICAL ALLUSIONS. (After Washburne)

ALLUSION	NUMBER OF PERIODICAL YEARS	NUMBER OF YEARS BETWEEN FIRST AND LAST ALLUSION	NUMBER OF ARTICLES IN WHICH ALLUSION OCCURS	GROSS NUMBER OF ALLUSIONS
America (the United States)	103	18	1211	5903
England	103	18	1155	3315
France	100	18	1390	3848
New York City	100	18	911	2386
China	98	18	353	750
London	95	18	629	1303
Germany	92	18	674	3015
Boston	92	18	297	564
New York State	86	18	594	1090
Paris	86	18	516	1494
Italy	86	18	428	1140
Japan	86	18	267	902
Great Britain	83	18	400	1539
Europe	81	18	837	1995
United States	81	18	650	1725
Rome	81	18	202	604
California	81	18	193	269
Russia	78	18	362	1730
Ireland	78	18	288	674
Spain	78	18	279	649
Greece	78	18	264	761
Washington, D. C.	75	18	457	899
Chicago	75	18	350	618
Indians (American)	75	18	240	814
Africa (including North and South Africa)	75	18	216	441
Theodore Roosevelt	74	18	257	617
Congress	72	18	255	632
Scotch, Scotland	72	18	216	337
Canada	72	18	216	199
Philadelphia	72	18	213	354
Abraham Lincoln	72	18	142	160
Harvard	70	18	137	236
Switzerland	69	18	124	176
Atlantic	66	18	172	193
Holland	66	18	169	460
Woodrow Wilson	65	18	380	789
India	63	18	151	255
Egypt	63	18	130	286
Hudson River	63	18	124	121
Jew, Jewish	63	18	109	460
Australia	63	18	103	174
New England	63	18	178	247
President Taft	62	18	170	411
Poland	61	18	175	281
Berlin	61	18	133	219
San Francisco	61	18	121	165
George Washington	61	18	109	216
Civil War	59	18	148	162
Austria (and Austria-Hungary)	59	18	193	429
Maine	59	18	80	86

Such a method of determining the order of importance of geographical topics is probably far superior to that of any individual judgment. It at least gives us a measure of the amount of interest that an educated reader has in them, and schools should prepare the child to participate in the things that appeal to educated people generally. But the interest that educated people have in a topic as subject matter for reading is not a measure of its importance in a particular science or course of study. For example, in Table CXXVII Paris ranks above Rome and Europe, and the last two have nearly the same rank, but Rome is two places below Europe. Yet no geography or history would give more space to Paris or Rome than to the continent of Europe. Probably more space would be given to Paris than to Rome in a modern history or geography, but the reverse would be true in a book on ancient history. Presumably the measures of importance of a place in geography are not the same as the measures of its importance in history, and both are different from its importance as a subject matter for reading. At best the journal method is only one of a number of factors that determine the importance of subject matter for a particular course of study.

Studies based on a Combination of Criteria

Studies based on a combination of measures to determine the relative importance of items in geography were made by Branom and Reavis and by Rugg and Hockett. The first two ranked fifty-two countries of the world according to data secured from the Statistical Abstract of the United States for 1915. Six criteria were used: area, population, total imports, imports from the United States, total exports, and exports to the United States. Each country was then ranked according to its position in each of the criteria; for example, if it ranked in the first fifth in area and in the third

fifth in population, it was given a score of 5 for area and a score of 3 for population. The sum of these quintile ranks determined a country's total score. In this manner the order of the first twenty-one countries was as follows: United States, Great Britain, Germany, France, India, Austria-Hungary, Russia, Canada, Italy, Japan, China, Brazil, Argentine, Netherlands, Mexico, Belgium, Australia, Spain, Sweden, Egypt, and Turkey. These were considered the "essential" countries, and more space was to be given to them than to other countries. In determining a minimum list of cities the authors decided that the largest city in each of the "essential" countries, each city of two hundred thousand in the Western Hemisphere, and each city over eight hundred thousand in the rest of the world should constitute the list. These criteria resulted in a list of sixty-six cities. The method used in this investigation appears better for geography than Washburne's method, for there are six criteria instead of one, and these have intrinsic value for geography. But the factors, area and population, may give certain countries, such as Russia and India, a higher rank than the interest of American pupils would justify in relation to countries near home, such as Mexico and Canada. Limiting the minimum list to twenty-one may also exclude certain countries which may be worth while studying for the light they throw on geographical principles; for instance, Switzerland, Norway, Persia, the Congo, and Chile. The method also stresses commercial interests at the expense of political and social interests.

The study by Rugg and Hockett is the most extensive and scientific determination of the relative importance of map locations that has yet appeared. Their investigation included all types of locations, such as cities, countries, sections, and regions, states of the United States, islands, bodies of water, mountains, ports, railroads, and production regions. Seventeen criteria were used in all. The first

eight were used as a combined measure to yield a ranked list of cities, countries, sections, states, islands, bodies of water, rivers, and mountains; the remainder were used for finding the importance of specific types of locations, such as ports, railroads, and production areas. The criteria used were (1) bank clearings; (2) exports and imports; (3) population; (4) area; (5) frequency of mention in magazines from 1919 to 1923; (6) frequency of mention in critical journals; (7) frequency of mention in books by frontier thinkers; (8) the data of Washburne's study; (9) freight tonnage handled in the United States ports; (10) total commerce in world ports; (11) miles of railroad track operated; (12) total operating expenses and revenue for railroads; (13) percentage of world's output of important minerals; (14) amount of traffic carried over ocean lines; (15) percentage of population engaged in manufacturing; (16) areas of dense population; (17) areas of production of agricultural goods.

The tables on pages 455, 456, and 457 show the order of rank of some of the locations by groups.

This study is about as complete as is necessary for the purpose of instruction in the public schools. The principal modifications necessary are the demands of home geography, of geographic principles other than location, of the interest and capacities of the learners in different grades. The authors of this study do not mean that all the locations given should be studied. With respect to cities, countries, and regions they give altogether 110, 61, and 80 respectively; but given their order of rank, the teacher can select as many of these as time permits. For example, after having studied the city, state, river, mountains, and ocean nearest home, the teacher can then take up the study of other locations in their rank order as given in the tables. If he doesn't wish to follow the rank order he can at least select such places given in the table as interest him most.

TABLE CXXVIII. THE FIRST THIRTY CITIES OF THE UNITED STATES RANKED IN ORDER OF IMPORTANCE

1. New York
2. Chicago
3. Philadelphia
4. Boston
5. San Francisco
6. Detroit
7. St. Louis
8. Washington
9. Pittsburgh
10. Los Angeles
11. Cleveland
12. New Orleans
13. Baltimore
14. Kansas City
15. Brooklyn
16. Seattle
17. Minneapolis
18. Cincinnati
19. Buffalo
20. Milwaukee
21. Indianapolis
22. Denver
23. Portland, Oregon
24. Omaha
25. Atlanta
26. Newark
27. Memphis
28. Columbus
29. Toledo
30. Louisville

TABLE CXXIX. THE FIFTY MOST IMPORTANT FOREIGN CITIES IN ORDER OF RANK

1. Paris
2. London
3. Berlin
4. Vienna
5. Rome
6. Moscow
7. Constantinople
8. Petrograd
9. Tokyo
10. Peking
11. Brussels
12. Manchester
13. Versailles
14. Athens
15. Budapest
16. Warsaw
17. Shanghai
18. Liverpool
19. Hamburg
20. Madrid
21. Smyrna
22. Munich
23. Dublin
24. Buenos Aires
25. The Hague
26. Bagdad
27. Milan
28. Mexico City
29. Geneva
30. Leipzig
31. Genoa
32. Toronto
33. Copenhagen
34. Vilna
35. Prague
36. Venice
37. Glasgow
38. Belfast
39. Stockholm
40. Vladivostok
41. Frankfort
42. Angora
43. Mosul
44. Jerusalem
45. Riga
46. Montreal
47. Singapore
48. Hongkong
49. Barcelona
50. Calcutta

TABLE CXXX. THE FIRST THIRTY COUNTRIES OF THE WORLD IN ORDER OF IMPORTANCE[1]

1. United States
2. France
3. Germany
4. China
5. Great Britain
6. Russia
7. Japan
8. Italy
9. India
10. Turkey
11. Canada
12. Poland
13. Egypt
14. Greece
15. Spain

[1] Only countries that are members of the League of Nations or eligible to membership are included.

TABLE CXXX (CONTINUED)

16. Belgium
17. Ireland
18. Mexico
19. Rumania
20. Hungary
21. Austria
22. Czechoslovakia
23. Australia
24. Netherlands
25. Jugoslavia
26. Bulgaria
27. Switzerland
28. Persia
29. Brazil
30. Sweden

TABLE CXXXI. FORTY OF THE MOST IMPORTANT SECTIONS AND REGIONS OF THE WORLD ARRANGED IN ORDER OF IMPORTANCE

1. Europe
2. England
3. America
4. Africa
5. Asia
6. South America
7. Balkan States
8. Prussia
9. Morocco
10. Siberia
11. Mesopotamia
12. Far East
13. Armenia
14. Near East
15. Alsace-Lorraine
16. Serbia
17. Macedonia
18. Asia Minor
19. Arabia
20. Manchuria
21. Central America
22. Albania
23. Korea
24. Algeria
25. Syria
26. Ukraine
27. East Africa
28. Palestine
29. Shantung
30. North America
31. Galicia
32. Silesia
33. Bavaria
34. Lorraine
35. Bosnia
36. Latin America
37. Sudan
38. Ulster
39. Bohemia
40. Scotland

TABLE CXXXII. TWENTY RIVERS OF GREATEST IMPORTANCE IN ORDER OF RANK

1. Rhine
2. Nile
3. Danube
4. Mississippi
5. Hudson
6. Volga
7. Euphrates
8. Yangtze
9. Saar
10. Jordan
11. Thames
12. Tigris
13. Scheldt
14. St. Lawrence
15. Amazon
16. Congo
17. Somme
18. Colorado
19. Clyde
20. Amur

TABLE CXXXIII. THE TEN MOST IMPORTANT MOUNTAINS IN ORDER OF RANK

1. Alps
2. Caucasus
3. Rocky
4. Ural
5. Carpathian
6. Andes
7. Everest
8. Appalachian
9. Himalaya
10. Mt. Blanc

TABLE CXXXIV. THE TWENTY-FIVE MOST IMPORTANT BODIES OF WATER IN ORDER OF RANK

1. Pacific Ocean
2. Atlantic Ocean
3. Mediterranean
4. Dardanelles
5. Black Sea
6. Adriatic
7. Baltic
8. Arctic
9. Bosporus
10. Suez Canal
11. Panama Canal
12. Great Lakes
13. North Sea
14. Caribbean Sea
15. "The Straits"
16. Ægean Sea
17. Red Sea
18. Kiel Canal
19. Niagara Falls
20. Caspian Sea
21. Persian Gulf
22. Hudson Bay
23. Lake Superior
24. Gulf of Finland
25. Lake Erie

TABLE CXXXV. THE TWENTY-ONE MOST IMPORTANT ISLAND GROUPS IN ORDER OF RANK

1. Philippine Islands
2. West Indies
3. Hawaiian Islands
4. East Indian Islands
5. Porto Rico
6. Sicily
7. Samoan Islands
8. Long Island
9. Sakhalin
10. New Guinea
11. Cyprus
12. Malta
13. Formosa
14. Manhattan
15. Crete
16. Sardinia
17. Virgin Islands
18. Heligoland
19. Guam
20. Åland Islands
21. Madagascar

SHORTCOMINGS AND MERITS OF THESE STUDIES

The principal shortcoming of all these studies is that they give only locations. These were studied first because they are the easiest. What are the essentials with regard to climate, plants and animals, peoples, technical terms, agricultural and manufactured products, and principles of interpretation? At present we have no answers to these questions. Furthermore, these materials give us only items of information or verbal habits. How shall we form habits of conservation, a sympathetic attitude toward other peoples, and attitudes of appreciation of the beauties of nature? These are problems for the future. However, the studies which have been made point out the method of solution; and if they should show as decided a reduction in the num-

ber of facts as the studies on location, we may expect to be able to teach pupils enough about the topics to make them understandable and to teach them also as parts of an organized science. On the other hand, we may expect pupils to learn them to the point of mastery and to be able to use them outside the schoolroom.

Summary

Since the number of facts contained in the average two-book text in geography is far too great to be mastered, objective methods have been sought for finding the essentials. Those which have been used are the consensus of the judgments of experts, the frequency of geographic references in journals, and a combination of a number of measures, such as frequency of mention in journals, population, area, value of commerce, and amount of bank clearings. The first method has not yet been tried on an extended basis, but one study made by this method showed that even geographers agree that less than one fifteenth of the cities which they mention in their textbooks should be learned. The journal method is far superior to an individual's opinion, but at best it shows us only the amount of interest which educated people have in a topic as subject matter for reading, and this does not give us its value in a particular course of study. The journal method would give the same rank to a topic in different subjects. Studies based on combinations of criteria are much better, but at present these have been limited to locations. Nor do we yet have objective standards for determining the essentials of climate, plants and animals, peoples, technical terms, products, principles of interpretation, habits of conservation, and attitudes of appreciation of the beauties of nature. There is a rich field of research for finding the essentials of these topics according to some objective standard.

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CHAPTER XXIII

GENERAL CONCLUSIONS AND FURTHER RESEARCH

The reader who has had the patience and interest to follow the text to this point will wonder what general conclusions can be drawn from such a varied content. For one thing he should have an increased faith in science. He should be fairly well convinced by this time that methods of teaching and learning should be based on experiment rather than on experience. The old adage that experience is the best teacher is only half a truth. Experience is at best only a guide for the individual. Its lessons may be true for others, and they may not. There are many personal and situational elements which are responsible for the truth of such a statement as "I have found this to be a successful method of teaching or learning." When someone of a different personality and in a different situation uses that method it often turns out to be a failure, possibly for the reason that the peculiar personal and situational elements which made it a success for the first teacher were lacking in the second teacher. However, when a method of teaching or learning has proved successful in a carefully controlled experiment, the influence of the personal equation has been reduced to a minimum, and the details of the method, materials, and situations are so accurately described that someone else can reproduce the procedure in its essential elements so that its success is reasonably certain. If it is successful, it must be because of the method rather than because of subjective elements. In other words, experiment forces the reduction of a method to an objective basis. Because of the large number of sub-

jective elements in methods found to be successful in personal experience they should be taken merely as a suggestion for others or as problems for experimentation rather than as objective and reliable truths.

This brings us to a second inference, namely, that science is not contrary to experience, but rather is experience accurately described and measured. Many of the methods described in this book as successful from the standpoint of scientific experiment will be recognized as such from the personal experience of teachers. If this is the case, it does not indicate that experiment is unnecessary, but rather that personal experience may be right. In fact, we must always look to personal experience as a source of invention and discovery as well as a source of error. It is a source of discovery, for new ideas are always born in some individual's mind; and it is a source of error because the new idea may be an imaginary one rather than an induction from facts, it may not be correctly remembered, and the results to which it leads may have been overestimated, may not have been observed at all, or may have been due to an unobserved factor. The value of science is that it checks the sources of error and selects those items of experience which can be described, measured, and safely transmitted to others.

If science is valuable for selecting and verifying methods that are worthy of transmission to others, it follows that teachers should make experiments on the value of their methods. They have unusual opportunities for such work. They have the pupils, the materials, the schoolroom, and they are on the job while doing an experiment. By arranging carefully controlled experiments they can justify their own procedures, discover many new ones, and make their results available for others. Of course there are some difficulties, such as interruptions with the fixed schedule and course of study, unfamiliarity with quantitative methods, carelessness about technique, and lack of free time for these

extra duties. Moreover, some superintendents feel that if one method is presumably correct, it is an injustice to subject a certain group of pupils to a different method of teaching just for the purpose of obtaining proof. Carelessness about technique is fatal to the purpose of experimentation, but the feared loss from the possible use of the wrong method is not so serious. Often the presumably correct method is the wrong one, and, if so, the experiment brings something better to light. More often, however, the difference between two methods is only one of amount or degree, either of which satisfies the administrative requirements of the course. Appreciation of this fact, together with knowledge of the value of experimentation, rapidly reduces the objections from the administration.

Another general conclusion from the study of this book is that the adoption of a scientific attitude in all elementary teaching is desirable. This means that all concepts should be developed from facts, or concrete objects. The danger of all teaching with the aid of textbooks is that it becomes verbal and separated from life and reality. If we could keep the attitude that all words are abstractions from life and reality and could acquaint our pupils with a perception of this relationship, we should not only be making gains for the cause of science but also be able to eliminate much of the deadwood in our curricula and so keep before ourselves the proper perspective on education — the improvement of adjustments to life situations.

The most important conclusion from this work, however, is the need of further research on the problems of teaching the elementary-school subjects. Again and again we had to leave a question unanswered because of the lack of experimental results. These questions cannot be answered by the investigations of any one person or institution, but only through the coöperative efforts of many investigators. In the hope that some of his readers will be inspired to lend

their time and talent to the solution of the problems of elementary education, the writer will here state some of the problems which in his opinion are in need of solution by the methods of experimental science. He will not include problems of administration, since these do not fall within the field of psychology, but will include some curricular problems because they are so closely tied up with the problems of learning and teaching.

Needed Research in the Laws of Learning

There have been numerous investigations of the law of exercise, so that now it is comparatively easy to write a long chapter on this law and its sublaws and also to make many practical applications to the learning of school subjects. Many more investigations are needed in this field, as we shall point out later, but in addition we ought to spend a good deal of time investigating the laws of association and satisfaction. The writer's experiments suggest that the secret of economical learning lies in the observation of relationship in the material to be learned or in the formation of associations with this material; but in spite of this importance comparatively few experiments have been made in the field of associative learning. These associative processes should be studied in connection with all kinds of materials: prose, poetry, nonsense, vocabularies, numbers, geometrical figures, movements, and each school subject. We should study them analytically, and classify them; we should find out what effect they have on learning and on retention, which kind of associations are most helpful to the learner, how they are influenced by the age, mental level, brightness, and mental set of the learner, how they are influenced by the length of the lesson and the length and frequency of the study period, and to what extent they are dependent on native and other uncontrollable factors. Such investigations would

enable us to understand and improve what we call comprehension, thought, or reasoning processes, which now can be only very imperfectly controlled.

The Law of Satisfaction or Effect

As pointed out in the introduction, there is some doubt as to how the law of satisfaction works, hence it rests at present on faith rather than on fact. The law was brought into prominence by Thorndike, who sees in it a source of easy learning, good retention, the elimination of errors, and the selection of the correct ideas or movements. In spite of the importance that he attaches to it, he has given us no quantitative and clear-cut proofs of the law as an actual law of learning. This is very strange in view of his eminence as an experimentalist and his many contributions to scientific psychology and education. A very refined and complicated technique would be required to prove the law in the case of animals, but it would not be difficult in the case of human beings. We could experiment with interesting and uninteresting content in materials of equal difficulty. In arithmetic, for example, we could compare the ease of learning to solve reasoning problems about marbles, candies, dolls, pet animals, and the like, with those about flour, wheat, furniture, fertilizer, bolts, and bricks. The result might show only small differences in the ease of learning the two kinds of materials, and such differences as were found might be due to the greater number of associations in the interesting content. If so, we should have to try some other techniques. The difficulty of the problem, however, should not prevent us from seeking experimental proof. After we have further light on the laws of association and satisfaction we shall probably be able to reach a more satisfactory theory of learning. We know that frequency, recency, intensity, and the observation of relationships influence the quickness of learning and the degree of retention, but we know compara-

tively little about their relative importance or how they explain short-circuiting, combination, and the formation of new connections.

Needed Researches in Reading

In addition to researches in the general laws of learning, we need to make many researches in each school subject. In reading we should investigate, in connection with the law of repetition, what the minimum frequency is with which a new word should appear in a reader for each grade in order to insure quick and certain recognition. If we knew this for one hundred words for each grade, we could draw some valuable inferences with respect to drill and the construction of selections. In connection with the law of association we need to know a great deal more about effective methods of developing comprehension. Just what to do to make a child understand is a difficult problem. We should have some experimental proof of the influence of interesting content, of comparative effect of silent and oral reading, of the use of meaningful material, of the influence of selections written with words chosen from the pre-school child's spoken vocabulary, and of the attitudes and mental sets of the child. We should also know how these factors influence speed. In connection with the law of satisfaction we should know the relative effects on speed and comprehension of different emotional and instinctive appeals in the content. Probably the greatest problem in this field is the development of a technique for creating a permanent interest in informational reading. In this connection there is an important curricular problem of developing an interesting series of informational readers. We should also develop a technique for learning to read visually. As already stated, there is no reason why meaning should not attach as directly to the visual form as to the auditory form; but, as a matter of fact, few people can get the meaning of a word without recognizing its pronunciation.

Needed Researches in Arithmetic

In arithmetic we know pretty well the order of difficulty of the basic combinations, but we do not know how many repetitions should be given to each combination, how often they must be reviewed, nor how long the review should be. Moreover, we do not know how the minimum number of repetitions is influenced by the age, mental level, and brightness of the child. We should also have this information for each of the important topics in arithmetic. How much time, for example, should we spend in teaching long division, how much on decimals, at the first learning? How often should the subject be renewed, at what intervals, and how long should each review be? What allowances must be made for the age, mental level, brightness, and industry of the learner? There are also numerous problems in the most economical methods of learning fundamental operations. To what extent should higher-order habits be developed in addition? Shall we teach pupils to add three digits at a time in column addition? Shall we teach them to add two columns at a time? In spite of the number of discussions and investigations of the most economical method of subtraction we do not yet know for certain which is the most economical method. Further experiments are needed. Kirkpatrick's experiment suggests that memorizing tables is not an economical method of learning multiplication. Just what is the best technique to use? Is the method of multiplicative division enough better than the traditional one to justify us in using it for all sorts of problems in division? There are also important investigations to be made in connection with learning to solve reasoning problems. We do not know to what extent ability in this function is subject to improvement by instruction and just what should be done to improve it. An analysis of the unit habits involved in the solution of various kinds of reasoning problems would be helpful; so would

a detailed analysis of the types of error made in them. We also need to know a great deal more about the method of diagnosing special difficulties with all sorts of arithmetical problems and to find some standardized methods of overcoming these difficulties, if there are any. Then, too, we should be able to standardize the difficulty of reasoning problems in relation to mental level and brightness. Possibly this would help more than anything else in overcoming the difficulties with them. So far we have very little experimental proof of effective methods of making arithmetic more meaningful or of the value of such methods. We should have experimental proof of the value of inductive teaching versus deductive teaching, of making arithmetic concrete, of making explanations full and detailed, of avoiding trifling problems, of using simple language and interesting content, of training in problem analysis, of the project method of teaching, of games, and of the different instinctive appeals which can be made in arithmetic. In the meantime, with the curriculum, we have the problem of the most effective grade placement of the essentials and that of finding the most suitable material for Grades VII and VIII if the essentials are to be covered in the first six grades.

Needed Researches in Handwriting

In handwriting the problems are not so numerous as those in some of the other school subjects, but it would be rash to suppose that the solution to all its problems is found in learning to do a few formal drills with a rigid hand and fingers moved by the arm from a body in a fixed position. In fact, we should have some experimental proof of the necessity of making formal drills a part of the course in handwriting. We also need to know the number of repetitions necessary to learn each letter in the primary grades; the order of the difficulty of the letters; the order in which

letters and words should be learned to provide for the greatest amount of facilitation; the most suitable adjustments to the age and grade of the learners in size of letters, type of movement, and kinds of material; what are the best techniques and instruments for diagnosing and remedying special difficulties in handwriting; a number of devices for adjusting the teaching of handwriting to individual differences; and what kind of writing is the most hygienic for the pupil. On most of these questions we have merely opinions, with very little information based on careful experiments.

Needed Researches in Spelling

We have a good deal of experimental information on spelling, but there is need of still further research. We do not know what is the minimum number of repetitions that should be given to each word in each grade; what allowances must be made in each class for differences in brightness, mental level, and attitudes or interest; how often a word should be reviewed, and at what intervals; what is the most economical number of words to be taught daily or weekly in each grade; what are the most common special difficulties with spelling; what are the reliable techniques for diagnosing and remedying these difficulties; whether it is worth while to teach more than three thousand common words in the grades; and whether there are other impulses besides mastery to which an appeal may be successfully made in the teaching of spelling. We also need to make more experiments on the mode of presentation and on the value of teaching the meanings of words.

Needed Researches in Language

The field of language instruction is just beginning to be opened by scientific experimentation. We have some experimental information of the value of teaching grammar and

foreign language, but for the most part schools have paid little attention to the experiments. Therefore we need to make more of them or else preach a great deal more about those that have already been made. We also know a great deal about the common errors in spoken and written English, but we know little of effective drill devices for permanently eliminating them. We need a variety of types of drill also for eliminating common errors in punctuation and capitalization. We need experimental information of the most effective techniques to be used in the socialized recitation and in supervised study, and of the value of imitating desirable qualities in models. In connection with the latter we need careful analyses of the most desired qualities in business letters, expositions, essays, short stories, the novel, and other forms of composition. English composition is proverbially dull. Can we find an effective technique for developing an interest in it so that this matter is not a secret of the ingenuity and personality of the teacher? How to diagnose and remedy special difficulties in composition is also a matter about which we have little scientific information. In what grades are language games most effectively used, and what games should be used? What grammar, if any, should be taught? Should it be taught as a subject in itself or incidentally in relation to language exercises? Should language instruction consist primarily in the giving of information by the teacher or in the doing of language exercises by the pupils? On all these questions there is an abundance of opinion but little experimental information.

Needed Researches in History and Geography

In the field of history the writer was able to refer to two experiments giving quantitative results. In geography he found one, but it was done so poorly and the results were so inconclusive that he refrained from a reference to it. There-

fore, in writing the chapters on these subjects he had to follow the dubious path of speculation from principles established for other subjects. First of all, there is no agreement about the content or the particular objectives, nor as to whether these subjects should be limited to giving information or whether some definite habits of thought and action should be developed in connection with them and what particular habits should be formed. The greatest problem, therefore, in connection with these subjects is in the curriculum. In the matter of teaching and studying history we need to know how many repetitions the content in the important topics should have so that the pupils shall be able to use it, how often a topic should be reviewed, and at what intervals. We should construct a number of drill devices besides the traditional review questions and have experimental information on the value of using them. We need experimental information of the value of using different forms of suggestive titles and section headings; of the long story as against the short; of collateral reading; of assigning map, informational, and thought problems; of problem assignments as against page assignments; of assignments with advance questions as against assignments without advance questions; of the best type of organization in the textbook — the chronological, the topical throughout the history of the nation, or the topical by so-called historical periods; of various techniques used in supervised study, in the socialized recitation, and in assigning collateral reading; of properly adjusting the material of each grade to its mental level; of analyzing the technical vocabulary; of using dramatization and projects and of making a proper selection of topics for these devices; and of the use of models and of visits to historical places. Should the content of history appeal only to reason and should it be simply matter of fact? Or should appeals be made to a wide range of impulses, and, if so, to what impulses should

the greatest appeal be made? All these questions are capable of an experimental solution, but so far we have only opinions about them.

In geography we have most of these problems over again. With respect to the content we have the problem of finding what should be taught about the important locations, what are the essentials of plant and animal life and of human life, what technical terms should be used, what agricultural and manufactured products should be taught, what should be said about climate, and what principles of interpretation should be used and taught. We need a drill service for fixing the essential facts. Those that were suggested in the text should be worked out in detail for each grade, and experiments of their value should be made. We need experimental proof of the value of long and varied descriptions; of inductive teaching as against deductive teaching; of the part-whole method of describing countries and continents as against the traditional whole-part method; of using pictures, models, and samples of products; of assignments with advance questions as against assignments by pages; of problem assignments as against page assignments; of the different types of organization in the textbook — the political and sectional, the regional, and the topical; and of the value of two descriptions of the world differing in difficulty as against a single, more detailed description. If the latter, should it progressively increase in difficulty, should it be limited to what now exists, or should it be in part historical? It is to be hoped that the next decade will bring solutions to these and many other equally important problems, not only in the elementary school but also in the high school and the college.

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