PSYCHOLOGY OF THE COMMON SCHOOL SUBJECTS

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TABLE OF CONTENTS

Chapter I—The Psychology of Handwriting 7
Chapter II—The Psychology of Spelling 22
Chapter III—The Psychology of Arithmetic 37
Chapter IV—The Psychology of Reading 55
Chapter V—The Psychology of Grammar 73

PREFACE

The following chapters are published preliminary to the preparation of a much more elaborate work along the same general lines. The demand for the material brought together in these chapters has seemed to justify its publication in advance of the completion of the larger work. No bibliography is included, although the literature of the subject is enormous and is rapidly increasing. Most of the recent literature has grown out of the development of the processes employed for measuring the results of teaching, and has not adhered very closely to the psychology of the processes employed in the subject itself. It is upon these psychological processes that we shall have to depend for the justification of the subject, and for our methods of teaching.

CHAPTER I

THE PSYCHOLOGY OF HANDWRITING

About six per cent of all the time that a child spends in school is devoted to learning how to write. Nearly all teachers, and nearly all parents who send children to school are of the opinion that a considerable portion of this time is unprofitably spent. It would seem that the results obtained are not so good as ought to come from the expenditure of this amount of time, if the methods and processes employed in teaching penmanship were the best that could be devised. Improvement in the processes of teaching must come from a more careful consideration of the mental processes involved in learning to write. The most satisfactory way of improving our methods of teaching is to consider more carefully the psychology of the subject.

Writing is the production of certain conventional marks that conform to an established pattern. Unless there is this conformity, the writing cannot be read, and it is valueless for any purpose. The form that is to be produced is not a matter of choice by the writer, but is determined by the people who may be expected to read it. There is not much opportunity for originality nor choice by the writer. Neither is there much that is legitimate in the criticism that children do not develop an individual, or characteristic handwriting.

This conformity to a universally known and accepted pattern constitutes legibility. Legibility is the first requisite of good penmanship. If writing is not easily legible, there is no value in any other quality it may have. Neither speed, movement, position, manner of holding the pen, which enter into the qualities of writing by which its excellence is often judged, and which constitute the principal themes for advice in books on penmanship, are worth anything. Any writing that conforms to the universally known pattern, so as to be easily legible is good writing, no matter how it is produced nor at what speed.

In order to bring about this kind of conformity, the pattern must be well known to the writer. He must know the

correct form, or the one that is universally recognized, and must have an idea of that form clearly in mind. When an idea is clearly entertained in the mind, it will work itself out into action, according to the well known Law of Dynamogenesis, than which there is no more important and far reaching generalization in psychological science.

In order for the law to operate, and the idea work itself out into action, the idea must be clear and vivid. If the idea is clear and vivid, it will find expression, and the proper form of the word or letter will be reproduced on paper. The difficult and most important part of the teacher's work, then, is to cause the idea of the proper forms of the words and letters to arise in the minds of the children.

The idea of the correct form of the word or letter that will be so vivid as to work itself out into action, is a combination of several, or many sensations. A sensation is the concomitant of a nervous impulse passing through some sensation center in the brain. A vivid sensation is accompanied by an impulse originating in a sense organ, or it is peripherally initiated. A faint sensation is accompanied by an impulse originating in the brain, or a centrally initiated impulse, and is not so vivid as is a sensation accompanied by a peripherally initiated impulse. A sensation generally originates as a vivid sensation, and is subsequently reproduced as a faint sensation. An idea is composed of faint sensations only, and this constitutes one difficulty in acquiring a motivating idea of sufficient vividness.

The first sensation that enters into the idea of the correct form of the word or letter to be written is the visual sensation. This sensation is acquired by attentively examining or looking at the correct form of the word. The process of securing the proper attention to the form of the word is one that exercises the ingenuity of the teacher. One method, once very popular, but now gone into complete disuse, was to require the child to analyze the letter into its elements, and to name these elements in their proper order. The elements so distinguished were the right curve, left curve, straight line, lower turn, upper turn, oval, pointed oval, lower loop, connecting slant and the capital stem. The requirement that the child should name the elements that entered into the construc-

tion of any letter had for its unconscious purpose securing attentive observation of the proper letter form.

But into the clear idea of the form of the letter or the word enter other sensations than those obtained through the eye. The idea of the written form of the word or the letter contains some muscular sensations, and these cannot be obtained from the copy, or from looking at the word. These muscular sensations can be obtained only by contracting the proper muscles in the proper order, and with the proper degree of relative strength. Consequently, the vivid motivating idea of the word that will work itself out into action can be obtained only by making the letter or the word in exactly the proper shape and in the proper manner.

This is the psychological reason that explains the futility and general ineffectiveness of using a copy book in learning to write. A copybook presents nothing except the completed result, while what it is necessary to teach is the process. The copybook furnishes nothing more than the visual sensations that enter into the idea of the letter or the word, while it is necessary to acquire the much more important sensations of movement and muscle.

For the old time copy set by the teacher, and for the copybook, it is much more satisfactory to substitute the writing on the blackboard, in the presence of the children, by the teacher, the proper form of the letters and words. It is particularly important that the children be thus taught, in order that they may know the proper place to begin to make the letter or the word, and the exact order in which the movements are to be made in order to produce the correct result. By repeated attempts to produce the correct form to be written, the correct muscular and movement sensations can be obtained which will enter into the idea of the word; and when this idea becomes vivid enough, it will lead to the production of the proper form.

All the sensations that enter into the idea of the word, such as we have been describing as of the kind which will work itself out into action, may be grouped under three heads; visual sensations, muscular sensations, and movement sensations. The movement sensations must be discriminated from the muscular sensations. The muscular sensations accompany the contraction of the proper muscles in the proper order with

the proper degree of relative strength. The movement sensations arise principally from the joints, and involve a time element. A rapid movement engenders sensations distinctively unlike those produced by a slow movement from the same organs.

It is largely around the question of movement that he debates concerning the proper methods of teaching writing have occurred. In these discussions there has never been any differentiation between the muscular and the movement sensations that may be acquired as constituent elements in the idea. Movement has often been discussed as if it were the only requirement for the production of good writing. This tendency has been described as "The Movement Dogma" in the Journal of Educational Psychology, (Vol. 12, p. 254) by Professor Frank N. Freeman. Psychologically, movement is important only because of the fact that the sensations of movement enter into the motivating idea whose expression is the correct form of writing.

The discussions of movement, without differentiating the muscular sensations from it, have centered principally around the application and distinctions of three kinds, called respectively the finger movement, the arm, forearm, or muscular movement, and the free arm movement.

The finger movement, as the name indicates, is the movement of the fingers, used principally in making the vertical lines of letters, and minute characteristics of such letters as s and r. It is the movement that the child in beginning to write is almost sure to adopt as the principal means of producing letters as directed by the teacher.

The arm, forearm, or muscular movement is a movement of the entire hand or arm, made with the muscle of the forearm resting upon the desk. By means of this movement, the hand and arm are carried forward in a horizontal direction in which the lines of writing are made. The finger movement does not allow the pen to be carried forward with any degree of facility, so an acquisition of the forearm movement is necessary before any particular degree of skill in writing can be attained.

The whole arm movement, or free arm movement, is one made without resting any part of the arm upon the desk. It

accomplishes little more than can be secured by the forearm movement, and is but little used in ordinary writing. Its principal use is found in writing upon the blackboard, or where writing of an unusually large size is to be produced.

In general, special teachers of writing, and commercially exploited writing systems, emphasize the forearm movement to the complete exclusion of the finger movement. The reasons for this exclusion are not convincing, and are psychologically unsound. In the first place, a complete elimination of the finger movement is impossible, so long as the pen is held in the fingers. If the pen is attached to some other part of the hand, instead of being held in the fingers, it might be possible to exclude it completely, and the writing so produced would show the effect of the exclusion. It probably would not be very good writing. Whenever the pen is held in the fingers, it is moved by an unequal pressure of the fingers on the opposite sides of the pen and this unequal pressure is in fact a finger movement. Professor Frank N. Freeman is perfectly correct when he says in the article referred to above, that the movement dogma is almost a flat failure. By the arm movement referred to above is meant the employment of the arm movement to the exclusion of the finger movement.

The attempt to justify the exclusion of the finger movement by psychological methods is unsound. It is often defended upon the doctrine that is sometimes described as from principal to accessory. By this is meant that the larger arm muscles develop first, and only subsequently the finer finger muscles farther removed from the nerve centers come into function.

There is little to support such a doctrine, and the conclusion is wholly unjustified. Children use their finger muscles freely long before they are called upon to learn writing and when they begin to write, they will invariably use the finger movement to the total neglect of the forearm movement.

But the forearm movement is necessary, and is a necessary complement to the finger movement. The forearm movement carries the pen forward along the line, which the finger movement cannot do, with any degree of facility. The movement sensations for carrying the pen forward must be secured, and must enter into the motivating idea of the proper form of

the words and letters that is to work itself out into action. This can be secured only by abundant practice on the forearm movement, with the attention specifically focused upon it. The over emphasis upon the forearm movement is perhaps justified in its results, even though it is psychologically and pedagogically unsound.

The practice of acquiring skill in the movements that enter into the motivating idea in writing, needs to be discussed under two heads: First, shall the acquisition of skill in making movements precede attention to the form of the letters and words. In practice, most of the commercially exploited systems lay much emphasis upon the preliminary acquisition of skill in movement, postponing until much later, the acquisition of the ability to make the proper form of the letters. Movement is considered an all-important element in writing, even taking precedence of the proper form, or legibility. Practice in making movement is ordinarily employed upon exercises other than the writing itself.

Needless to say this is contrary to all psychological principles. The movement that is desired is the movement secured in making letters and words of the proper form. Only such movements can enter into the motivating idea that will work itself out into action. Besides this fatal character of the movement that is just movement and nothing else, there is a lack of the proper motivation of the practice. It is scarcely less than a pedagogical crime to require children just beginning to write, or even before they have begun, to practice movements which for them, have no meaning.

The second phase of the discussion of movement, meaning principally the forearm movement, relates to the rapidity with which the movement shall be made. It is the practice of some teachers to require the movement to be made as rapidly by children who are beginning to write words and letters, as they would expect to have it made after the learning process has been accomplished. Rapidity of movement, in this method, takes precedence of accuracy of movement, correct form and legibility. But the movement that is made rapidly, but not in conformity to the proper shape of the letter, is not the one that can contribute to the idea whose acquisition is the necessary condition for good writing.

These three kinds of sensations, visual, muscular and movement enter into the motivating idea. They are not all attained at the same time. The first part of the idea is always the visual sensations. This is properly the case, for it is by the visual perception of the letter or the word formed that the result is tested. Hence arises the question, How shall the visual idea of the letter or the word be best secured?

This is strictly a psychological question, and the principles upon which the answer is based are well known. We have already said that an attentive examination or looking at the letter or word is necessary. In perceiving anything, two processes are always employed; the process of abstraction and the process of analysis. The process of abstraction consists in looking at one thing, or one part of a thing, to the exclusion for the time being, of all other parts. The process of analysis consists in looking at each part in its relation to the other parts. Drawing is an excellent method of study, because it necessarily involves and compels the application of both these processes. When we draw a thing, we draw one line at a time. For the interval in which we are drawing that line, we are excluding every other line. This is abstraction. But when we draw any line, we must draw it in its proper relation to the other lines, and this is the process of analysis. Even if we are not studying a thing by the process of drawing, these two processes of abstraction and analysis are necessarily involved in every act of learning.

Consequently it appears evident that the most successful method of acquiring a visual percept, or the visual sensations that will constitute a part of the vivid, motivating idea of a word or letter that will work itself out into action, is by draw-it. In order to draw a letter, or a word, the kind of attentive examination which is most necessary is secured.

In the process of drawing a letter or a word, the muscular sensations that enter into the vivid, motivating idea are secured. These muscular sensations come from the contraction of the proper muscles in the proper order and with the proper degree of relative strength. So by the process of drawing a letter or a word, the attention is fixed upon the form so as to secure the visual sensations, and at the same time the proper muscular sensations are obtained.

But drawing is not writing, and the sensations that are obtained by drawing a letter or a word, important as they are do not constitute the complete idea which will work itself out into writing. To these must be added movement sensations which can be acquired only by patient, attentive practice. This is the part in which the teaching that begins by drawing letters and words is usually weak. Practice is usually not carried far enough and persistently enough to develop an idea that contains sufficiently vivid movement sensations.

This is the point of the principal criticisms made by those who advocate a system of teaching that begins with movement, no matter how illegible and awkward the results. The argument is made that correct form can be secured more easily after a sufficient amount of practice on movement, than can movement be secured after a correct form has been learned. There is no evidence that such is the case, except the fact that some persons trained in movement first do become good writers, and that some other persons, trained to draw letters first do not become good writers. No one can prove that the results are universal in either case.

Psychologically the case is plain. Since the test of legibility, and correct form is the visual product, that measure of quality ought first to be attained. The amount of time devoted to the subject by which some persons become good writers when they begin with movement is very great. If the experiment were tried, of devoting the same amount of time beginning the other way, there can be but little question which would produce the better results.

The movement sensations that enter into the motivating idea are principally sensations determined by speed. In the present day teaching of penmanship, speed is considered an important element. It will be found as a general rule, that those persons in the writing class who write most rapidly, do at the same time write most legibly, and show a better quality of writing than do those who write more slowly. Hence it is argued that there is a direct relation between speed and quality.

When children are learning anything, those who are naturally the most capable are likely to learn any phase or part of it sooner than will the less capable children. Consequently

we should expect those who are the most capable, in the early stages of writing, to excel both in quality and speed. But it is only in the early stages of writing that this direct relation between speed and quality can be discovered. When a person writes for the purpose of saying something, it is not often that a direct relation exists.

It is easy to exaggerate the practical importance of speed. When handwriting is no longer the principal means of transcribing records, and conducting business correspondence, speed is not an essential quality of writing ability. Its importance depends upon something else than its practical utility.

Speed may be used as a measure of the completeness with which the movement sensations which enter into the motivating idea have been attained. When the proper movement sensations have been obtained, there will be little hesitation, delay, or resistance encountered by the nervous impulses as they traverse the cerebral centers involved in the act of writing. The qualification of speed is somewhat similar to the requirement sometimes enacted by some writing teachers, that the pupils shall sing the words of a song while they write on paper a wholly different series of words. The ability to do this shows how completely mechanical and automatic the writing processes have become.

Speed in itself and for itself has relatively little value. Each individual has a nervous rhythm to which his system is adjusted, and to crowd a person beyond a corresponding speed is a practice that cannot be defended. Persons in writing letters or other compositions, are generally able to write and to think at the same time. But it is easier to write faster than one can think and such speed is not to be commended. But speed in writing has its principal value in developing, or in indicating the development of the proper movement sensations in the motivating idea of the written word.

The visual sensations are obtained by an attentive examination of the letters and words to be written. The muscular sensations are obtained by practice, preferably slow drawing movements. The movement sensations must be obtained by abundant practice of rather rapid movements. The question then turns up on the kind of exercises that shall be employed in developing the movement sensations.

Nearly all special teachers of writing lay much emphasis upon special exercises other than the forms of the letters themselves, for the development of these movement sensations. Some commercially exploited systems of writing can scarcely be discriminated from each other except by the different exercises that are employed in cultivating movement.

Primarily, the practice for acquiring both the muscular and the movement sensations that shall enter into the motivating idea of a letter or a word, must be on the production of the word or letter itself. The same reasons that demand that the exercises by which the visual sensations are secured must be upon the letter or the word, apply with equal force to the attaining of the muscular and movement sensations. There is no such thing as a generalized movement that shall function in the idea of any special word or letter. Each movement and muscular sensation must be a specialized, specific sensation, acquired by producing a specific letter or word. It is true, that exercises of particular parts of a letter or word are helpful and economically useful. The form of the word or letter written may be defective in merely one or more elements. Focusing the attention specifically upon this one defective element will often be economically profitable.

The excessive practice upon exercises, so characteristic of commercially exploited systems, leads inevitably to a tendency to flourishing, which detracts from the legibility of writing. Some of the specimens described as beautiful, and scored high in consequence of the high grade put upon their position, movement, and speed, are really not so worthy of merit as some other specimens that are marked very low. The test of the correctness of any position, movement and speed is whether or not it produces legible writing. If it does not produce legible writing, then it is wrong, no matter how closely it conforms to accepted rules. Flourishing and shading, have both disappeared from the forms of writing now taught, because the element of beauty, to which they were supposed to contribute, has come to be judged of little value compared to the one essential quality of legibility.

The same thing may be said of slant. There is no good reason for refusing a high credit to specimens of handwriting that are vertical, or even backward slant, provided they are

easily read. Generally a slight forward slant will be more easily read than any other, because that slant is more common, and more nearly approximates the universally accepted form.

The fact that good penmanship depends upon the acquisition of a proper motivating idea that shall be so vivid and clear that it works itself out into action, will enable us to understand the deterioration of penmanship after it has once been acquired. The first idea that constitutes the motive in the production of any word or letter is the idea of our own act. The attention must be focused upon the particular movements that we are to make in order to produce the desired form. We are never very skillful so long as we have this idea for the motive. This is the motive in the period of the acquisition of the visual and muscular sensations. This is the motive in the period of the drawing of the letters in which each element is attended to separately.

But this first motive is displaced by another. The second motive, which displaces the first, is the idea of the result that is to come from our action. The attention is focused upon the correct form of the letter of the word, and we no longer attend to the movements that we must make. In this transition from one motive to another, deterioration in the correct form is likely to be seen. The transition is likely to be made too soon and practice in movement is likely to be discontinued before the proper movement is sufficiently fixed. This is the time of the plateau period, when for a long time no improvement in penmanship is apparent. If we persist sufficiently long with the first motive, that of our own movement, no plateau period will manifest itself.

The third motive, which ultimately displaces the second, is one which we may call the unconscious stimulus. It is illustrated by what we do when we are writing, thinking of only what we wish to say, and not at all about the process of saying it. We attend to the thought, and the writing expresses itself as the result of unconscious voluntary movement. This kind of movement is sometimes called automatic, or secondary reflex, neither name of which is to be commended, because both convey a false implication.

When this third motive is reached, displacing the second, there is likely to be another plateau period, or a period of

deterioration, or retrogression. The aim of all good teachers of writing is to make the motivating idea of the word or letter so vivid, that even when it appears as an unconscious idea, leading to the production of the desired writing, it will still work itself out into legible form. This means practice far beyond what would ordinarily be felt to be necessary for all practical writing purposes.

Several scales for the measurement of the quality of handwriting have been devised, the earliest one made and one of the best known being the Thorndike scale. Mr. Thorndike secured a large number of specimens of handwriting and submitted them to the examination of a large number of competent judges. A certain number of these specimens were then selected and arranged in the order of their excellence, as determined by the opinions of the judges. They were selected so that one specimen would be just as much better than the next as it was poorer than the preceding. The steps of excellence between the specimens were of equal magnitude. In the Thorndike scale there are fourteen degrees of excellence, the lowest one being marked 4 and the highest 18. This means that it is possible to have four degrees of excellence below the first specimen of the scale, but these lower degrees of excellence are not expected to be found in any series of specimens likely to be submitted for examination.

The Ayres three slant scale, the Ayres Gettysburg scale, the Starch scale, the Frasier scale are all made on the same general plan. The differences among them exist principally in the marks that are employed in designating the degrees of excellence, in the number and arrangement of the specimens of the scale, and in the shape and material of the paper on which the specimens are printed.

The method of using the scales is the same for all. The specimen of penmanship which is to be measured is slipped along the scale until a specimen is found which is believed to be of an equal degree of excellence with that of the specimen to be measured. The mark attached to the scale specimen is then taken as the measure of excellence of the specimen. Various devices are employed, such as slipping the specimen upward along the scale until it is certain that the point of equal excellence has been passed. Then beginning at the other end

of the scale, slipping the specimen downward until it is again certain that the point of equal excellence has been passed in the other direction. If the two points agree that specimen is taken as the measure. If not, the midpoint between the two is considered the measure.

The Freeman scale is somewhat different. It consists of five scales, each consisting of several specimens graded according to one particular quality. There is a separate scale for each of the qualities, spacing, alignment, slant, quality of line and letter formation. This analysis of the scale into different elements contributes much to accuracy of the measured product, but it renders the measurement cumbersome, and, the Freeman scale is not likely to be very generally used.

The Palmer scale consists of a series of five specimens for each of the eight grades. It is really eight different scales, and the specimens are graded according to several characteristics. The mark on each specimen is determined not only by the legibility, beauty and general excellence of the specimen, but also according to the speed, position and movement, and a different standard is established for each grade. The Zaner scale is somewhat similar, but the specimens of the scale are all printed on one sheet.

The claim is made that by the use of a scale much greater accuracy in judging papers can be secured. The present writer has been unable to verify that claim to any very noticeable extent, Time after time the writer has submitted a series of papers to different classes of competent judges, with the almost invariable result that the amount of difference in judging with a scale and without is almost negligible. He is curious to know how those who obtained different results secured them.

The following example may be taken as typical, for it does not differ widely from any of the rest. A class of 29 college students, some of them experienced teachers, were asked to mark ten penmanship papers, using no scale, or a mental scale, or a per cent scale, and to record their marks in per cents. Then they were asked to mark the same papers using the Thorndike scale. In order to bring the two series of marks into a comparable relation to each other, the Thorndike marks were multiplied by five and one half, making them very nearly

per cent marks. The range was taken, the average deviation determined, and the coefficient of correlation computed.

The range is the difference between the lowest and the highest mark placed on each paper. Using the per cent scale, the ranges of the different papers varied from 20 to 45. That is, one person marked one paper 50 and another person marked the same paper 95. The lowest range was in one paper that was marked 75 by one person and 95 by another. Using the Thorndike scale, the ranges varied from 22 to 49. One person marked one paper 50 and another person marked the same paper 99. The lowest range was in one paper that one person marked 66 and another person 88. When there can be such differences in judgment, it is evident that the term measurement applied to such a process, must be highly figurative.

In six cases, the range between highest and lowest was less when using the per cent scale, and in four cases it was less when using the Thorndike scale. The sum of the ranges was 315 when using the per cent scale, and 348 when using the Thorndike scale. So by a comparison of the number of ranges, and the amount of the ranges, there is a very slight advantage in using the per cent scale.

The average deviation is the average of all the differences between the marks put upon one paper by every person and the average of all the marks on that same paper. The largest average deviation when using the per cent scale was 8 and the smallest was 2.1. The largest average deviation when using the Thorndike scale was 7.7 and the smallest was 4. In five cases the average deviation was less when using the per cent scale, and in four cases it was less when using the Thorndike scale. In one paper it was exactly the same. The sum of the ten average deviations when using the per cent scale was 54.4, and when using the Thorndike scale it was 54.8. The amount of superiority shown by the per cent scale in these two comparisons based upon the average deviation is absolutely negligible.

Computing the coefficient of correlation between the results obtained by the two methods, we find it to be plus .637, which means that if a paper is marked high, above the average, by one method, the chances are about five to one that it will be marked above the average by the other method. The

conclusion must be that it makes little difference which method of marking is used, and that there is no great superiority in using a scale. Sometimes one method will show a slight superiority over the other in one respect, and in another case the other method will be slightly superior. The general result is that there is practically no difference in accuracy.

Persons can be trained in the use of a scale so that they will mark very close together. But with equal training in marking without a scale, or with the per cent scale, they will approximate each other's marks as closely. The difference in judgments of different persons upon the same specimen seems to be caused by the fact that they lay emphasis upon different qualities of penmanship. Some have marked a specimen zero because it was back hand, and others have marked the same specimen 90 because it was easily legible. Some have judged a specimen high because it was smooth and regular, and others have marked the same specimen low because it was small and hard to read.

Such limitations upon the accuracy in the use of a scale are apparent also in such scales as those for composition and for oral reading, in which the excellence of the specimen is determined by the general judgment of the examiner.

It would appear that so far as accuracy is concerned, there is very little advantage in using a scale. The use of a scale contributes somewhat to definiteness of description, and it is somewhat less fatiguing. A person can mark a greater number of papers before inaccuracy due to fatigue ensues when he is using a scale than when he is not using one. For these reasons a scale is to be commended, but we ought to be aware of its limitations.

COLLATERAL READING

1—Freeman, The Teaching of Handwriting.

2—Starch, Educational Measurement, p. 60-88.

3—Monroe, DeVoss and Kelley, Educational Tests and Measurement, p. 143-191.

CHAPTER II

THE PSYCHOLOGY OF SPELLING

Something more than seven per cent of all the time that a child spends in school is devoted to learning to spell. In many cases, the results are so meager as to lead many persons to believe that not all the time is profitably spent. In some schools that have no definite time for spelling, and in which no special classes are conducted in the subject, the children spell as well as do the children in other schools that spend more than the seven per cent average amount. All agree that the amount of time spent in any school in learning to spell is not an accurate index of the spelling ability of the children in that school.

Spelling consists in arranging the letters of a word in their proper order. The arranging may be done orally or in writing; hence we have two kinds of spelling, oral and written. Since the practical application of spelling is always in writing, the function of oral, as well as written, spelling, is to lead to more nearly correct spelling in writing.

Spelling consists in reproducing the idea of the word that is in the mind of the speller. If the idea is clear and vivid, it will work itself out into action, according to the law of dynamogenesis. The problem of the teacher, then, is to find the most economical method of inducing in the mind of the child, the clear, vivid idea which will work out into action.

An idea consists of several or many sensations. A sensation is the concomitant of a nervous impulse that originates in a sense organ, and is transmitted through some sensation center in the brain. When an impulse traverses the same sensation center without originating in a sense organ, it is a faint sensation, and the impulse is centrally initiated. But before there can be a faint sensation, there must previously have been a vivid sensation of the same kind. All the sensations that constitute an idea are faint sensations.

The sensations that enter into the idea of a word that will work itself out into action, and will find expression in the proper spelling, are primarily of four kinds. First, the sight

sensations, which are obtained by a careful examination and scrutiny of the written or printed form of the word. Second, auditory sensations, obtained by hearing the word properly pronounced. In the process of studying a lesson so as subsequently to know how to spell the words, the pupil ought to hear the words pronounced correctly by the teacher, and then ought to hear his own voice properly pronouncing them.

There are two kinds of muscular sensations that enter into the motivating idea. They are muscular sensations from the vocal organs when the words are properly pronounced, and muscular sensations that arise from the muscles that are employed in writing the words. The words of no lesson can be considered as having been properly studied until all these sensations have been obtained.

In some persons the sight sensations will be most important. Such persons will learn to spell a word better by seeing it than by hearing it. Other persons will learn to spell a word better by hearing it. There is a real place for oral spelling in any spelling class. But both visualizers and auditory minded pupils will probably be benefited by both processes of study, while in the case of other persons, both methods are nearly necessary.

The practice of assigning one page, or one lesson on a page of a spelling book, to be studied by the children, or a list of words on the blackboard, provides in a very inefficient way for only one kind of sensation, that obtained from the eye.

After a sufficiently vivid idea of the word has been obtained, the next psychological problem is that of remembering it, so as to fix the spelling permanently, and so that it shall forever after be available for use. This is an application of the ordinary laws of memory. The first law is that of initial fixation. When a word is first learned, it should be learned by giving to it the greatest possible amount of attention. The reason for this is clear. When we give the utmost possible amount of attention in the process of learning anything we drive the largest possible amount of nervous energy through the brain center. This large amount of nervous energy modifies the nervous arc to such an extent that subsequent impulses encounter less resistance, and consequently a much feebler nervous impulse will go through.

Peripherally initiated impulses are much stronger than centrally initiated impulses. Consequently, the study of a word should always be by means of peripherally initiated impulses. The sensations entering into the percept of the word whose reproduction constitutes the idea must be vivid, and as many as possible. The word must actually be seen attentively, it must be heard, and it must be pronounced and written.

The same thing may be described in another way. It may be described by saying that we must get the clearest possible notion of the word. We must get exactly the form of the word, not merely something like it. These are other statements of the fact that we must drive the largest possible amount of nervous energy through the brain center the first time.

The second rule for remembering the spelling of words is to associate the spelling of the new word with as many other things that we already know as possible. If two words are spelled nearly alike, or differ in only one significant respect, it will be found that the two words can be learned more easily together, than can either one alone. They are associated by the law of contrast, and experiment shows that association by contrast is more influential than is almost any other relation. The words sieve and seize are easily learned together, but are very difficult when taken singly.

Words that are similar may be learned together. This leads to the formulation of rules for spelling. A rule for spelling is nothing more than a statement of the similarities existing between words. But since a rule for spelling does not have the force of a statute law, many exceptions may occur, and these exceptions are always offered as positive objections to the learning of rules. Really, there is no more economical method of learning to spell the words that constitute the exceptions to any rule, than by committing that list to memory. It is much easier to learn them in that way than it is to learn them individually.

In learning rules, it is most essential that the rule be thoroughly learned. Nearly all the testimony concerning the futility of learning rules for spelling arises from the fact that the persons who testify have not learned the rules thoroughly.

Associations for individual words may easily be made. A mispronunciation is frequently a very effective association

One woman can never be sure how to spell crocodile, until she pronounces it with the accent on the second syllable. The word desiccate will quickly lose its terrors if it is wrongly accentuated in a person's own mind, on the second syllable. If the g in paradigm is sounded, the spelling is forever fixed.

The etymology, or derivation of words is often a most effective association in fixing the spelling. The difference between the origin of ferrule and ferule can be made to establish the spelling of the two words so that the association shall be permanent. If one knows that ferrule, the iron ring at the bottom of a cane, is derived from ferrum, the latin word for iron, there will not be a disposition to leave out one of the r's. While if one knows that a rule, with which we draw a straight line, is an abridged form of ferule, an instrument of punishment used by school teachers, and was originally a substitute for a branch, or switch, from a plant, ferula, growing in the vicinity of the old latin schoolhouses, and similar in its associations to our birch, or hickory, there will not be the confusion with the ferrule of the two r's. So cynosure, and daguerreotype will have their forms definitely fixed when the derivation of each is known.

The meaning of words is one of the characteristic associations by which the spelling may be fixed. It is here mentioned last because its relative importance has been much over emphasized. It is true that children ought to know the meaning of the words they learn to spell. It is also true that children will spell a larger percentage of a list of words whose meaning they know than of a list whose meanings they do not know. But this relation between the meaning and the good spelling is not a causal relation. The greater familiarity of the list of words whose meaning is known is associated with the fact that this greater familiarity leads to a correct spelling. The meaning is of less importance, as a means of fixing the spelling, than probably any one of the other associations previously mentioned. We may know the meaning of many words we are unable to spell, and we are able to spell many words whose meanings we do not know.

The third law of memory is that of attentive repetition. Repetition without attention is of little or no value. The amount of attention involved in the repetition is a direct

measure of the repetitive value. This law is applied in reviews and in spelling contests.

The above discussions represent the psychological basis of learning to spell. The conscious application of these psychological principles will increase the efficiency of the teaching of spelling a great deal. But the greater part of the present inefficiency of the teaching of spelling is due in a very large measure, to the neglect of some more general principles concerned in all learning and teaching.

It cannot be said, with any degree of certainty, how much of the time spent in studying spelling is wasted. It would, perhaps, be a fair guess to say that ninety per cent of the child's time devoted to spelling does not accomplish the result intended. Nine tenths of the time is unprofitably spent. The greater amount of the wasted time is due to the fact that we try to teach the pupil to spell so many words that he already knows. When we assign a page of a spelling book to be studied, and then examine, or test, the children on the words of that page, we are causing him to study a list of words, probably nine tenths of which he already knows how to spell. We are causing him to spend nine tenths of his time unprofitably. More than this; we are failing to cause him to concentrate his attention upon the words whose spelling he does not know, and whose spelling he needs to learn. He fails in the initial fixation of the words he does not know how to spell.

This initial fixation is one of the most important elements in the process of learning to spell. Consequently, some device is needed to sift out the words in any lesson that the child does not know how to spell from those that he does know. This is the first problem that the teacher of spelling needs to solve. Let us suggest one device for sifting out the words that to be studied from those that do not.

Suppose the teacher should pronounce ten words to a class. Let the class spell these ten words as best they can. The teacher collects the papers, marks them, checks all the misspelled words, and returns them to the pupils. Each pupil is to understand that his spelling lesson for the next day consists of the words that he has misspelled. He needs to pay no attention to the other words, because he already knows how to spell them. Thus the child studies only those words that he

needs to study. The next day, the teacher pronounces the same list of ten words, and an additional list of ten new words. The record of the two spellings of the same list will indicate the degree of improvement made by each pupil. In this way, the words the pupil needs to study are sifted out, and attention focalized upon the words he does not know how to spell.

The immediate objection to any plan of this kind is that the pupil ought not to see a misspelled word, and this plan makes him misspell a word before it can be assigned as a lesson. The objection has no real validity. Before a child has learned how to spell a word, he is in the position of having misspelled it. He does not know how to spell it. No doubt he has often seen the correct form, but the correct form has not fixed itself and does not fix itself in the attention and memory of the child as the objectors assume that it should.

Another extremely wasteful process of teaching spelling is the process of having children learn to spell words by writing them in sentences. In order to acquire practice in spelling a word, the pupil is required to write a dozen or more words to show that he knows how to spell one. Besides being a wasteful process, it is unpsychological in the fact that it does not demand the focalization of the attention upon the word whose spelling is to be fixed, but by the very nature of the method, dissipates the attention, and fails to fix the spelling of the word to be learned.

The reason always assigned for this practice is that the children must know the meaning of the words they learn to spell, and they must learn to use them in sentences. But the learning of the meaning does not fix the spelling, and as shown above, the meaning is of less importance than several other associations.

Another reason by which it is sought to justify the practice of spelling in sentences, is that if children are drilled only in writing words in columns, they misspell some of the same words when they write them in sentences. The fact is that there is a very large carry over from column spelling to sentence spelling. Those words that are misspelled in sentences when they are spelled correctly in columns, are those whose motivating idea has not become sufficiently vivid to work out into action. Sufficient drill in the initial fixation, association

and attentive repetition will manifest itself in a hundred per cent carry over.

When a child spells words in sentences, there is less concentration of the attention upon the spelling of the word to be learned. The attention is dissipated among the spelling of the other words, upon the meaning of the sentence, upon the capitalization and punctuation, and frequently upon the penmanship. When learning to spell, concentration upon the word to be learned is the first and most important process. Spelling in sentences is less exact than is spelling in columns, because of this dissipation of attention. Spelling in sentences is not justified by any psychological principles that operate in the teaching of spelling.

It is doubtful if the new methods of measuring the efficiency of the teaching of spelling have contributed very much to decreasing the wasted time in teaching spelling. The Ayres scale consists of the one thousand most common words in the language, grouped into 26 columns, the words in each column being of approximately equal difficulty, and the percentage of the words in that column that the children in any grade may be expected to spell is indicated at the top. The tendency has been to use this list as a spelling book, and drill upon this thousand words. There is nothing in the list itself to suggest that the children should study only those words whose spelling they do not know.

These commonest words are likely to be learned incidentally, as the result of repetition, without very much special teaching in school. When tried by these tests, the incidental method is likely to give almost as good results as the ordinary spelling drill in school.

The Ayres scale and other scales of a similar kind are likely to suggest that the spelling of the children ought to be limited to the commonest words. The argument is often advanced that there is no need for children to know how to spell the words they do not expect to use, or the words which are not already in their vocabulary. The argument is not only fallacious, but vicious, leading to disastrous results in the spelling of the children, and limiting the development of their vocabulary. Instead of limiting the conscious teaching of spelling to the commonest words, which already constitute the vocabulary

that the children use in their writing and speaking, these words might almost be neglected, or learned incidentally At the most, attention is necessary only to the most difficult of the list, such as are indicated by Mr. Jones' Hundred Spelling Demons.

The child's spelling ought not to be limited to the commonest words, nor to his speaking and writing vocabulary. The ideal aim is to cultivate in the child the habit of stopping in his reading, when he comes to a new word, and fixing the spelling of that word at that time. It is by reading, principally, that the vocabulary is enlarged, and the spelling ought to keep pace with his reading vocabulary. The spelling ought not to be limited by the child's writing and speaking vocabulary, but by his reading vocabulary.

Consequently, the principal effort in drill in spelling is upon the words that are found in the child's reading vocabulary, and not in his writing and speaking vocabulary. The difference between good spellers and poor spellers will be described in terms of this list of words, very indefinite in extent and very diverse in character.

Spelling ability is easily measured. The measure is definite and clear. The first requisite in measuring spelling ability is the construction or acquisition of a scale. The construction of a spelling scale will illustrate the essential processes in the development of a scale for the measurement of any teaching product.

The first kind of a spelling scale is a definite list of words to be spelled that has been standardized by having them spelled by a great many children. From the spelling of this number of words, it can be predicted with a good deal of assurance, what any other particular group of children will do. If the group of children whose spelling ability is to be measured spell more words, and make a higher score than the standard score, they may be described as being above grade. If they make a lower score, and spell fewer words, they are below grade. This kind of a scale is represented by the Buckingham spelling scale, which consists of two lists of twentyfive words each, which have been carefully standardized for the several grades. In a scale of this kind, the same words are given to

children of any age and of any grade. The difference is in the standard score adopted for each age or for each grade.

The second kind of scale is that represented by the Ayres spelling scale referred to above. The one thousand most common words were given to many thousand children to be spelled. The difficulty of each word was judged from the number of times it was misspelled by this large number of children. Then the words were grouped into 26 columns, named from the 26 letters of the alphabet. Words of approximately equal difficulty were placed in the same column, and the average per cent of correct spellings that was made by any grade in school was placed at the top of the column.

In order to measure the spelling ability of any room, a series of twenty words is taken from some one column, preferably a column in which the children of the same grade as that to be examined have made about 75 per cent. The percentage of correct spellings made by the grade to be examined indicates whether that grade is up to the standard or not.

The Buckingham extension of the Ayres spelling scale is made in the same way. Mr. Buckingham added to the one thousand words of the Ayres scale, 535 other words, selected because they were commonly found in spelling books used in school. These 535 words were standardized in the same manner that the Ayres list had been, and the new words added to the appropriate columns. Besides, four columns were added to contain the more difficult words. This makes the Buckingham extension available for the testing of pupils of a higher grade of spelling ability than the words of the Ayres scale were designed to do.

The Iowa spelling scale is made after the same model as the Ayres scale. The words were taken from the written correspondence of Iowa people, and represent the words most commonly used in such correspondence. There are almost three thousand words in the list, and the words have been standardized and grouped into 26 columns after the manner of the Ayres list.

The above mentioned scales are good scales for testing spelling ability and are very useful. They do not, however, represent a complete sampling of the English language, and are limited to the commonest words. They are therefore, not

tests of the absolute spelling ability of any group of persons. Mr. Starch has devised a scale upon another plan, that would appear to be a more satisfactory spelling scale.

Mr. Starch selected the first word on every even-numbered page of Webster's International Dictionary. This made a list of 1186 words. From this list he dropped all obsolete and highly technical words, reducing the list to 600. These 600 words were arranged in the order of their length, and consequently, approximately in the order of their difficulty, the shortest words being placed first. This list of 600 words was divided into six lists of 100 words each. The first list included the first, seventh, thirteenth words, and so on. The second list included the second, eighth, fourteenth words, etc. So there are six lists, each list as difficult as any one of the others, and each list representing a fair sampling of the entire English language.

There are other spelling scales, but the above represent the principal methods employed in devising spelling tests. The above scales are the best known and the most used.

The methods of making different spelling scales may be illustrated by an examination of the following list of fifty words. The words are all taken from Reed's Word Lessons, a very popular spelling book, still in common use. The only basis for selection was the supposed difficulty of the words.

emanate
euphony
excavate
funereal
hemorrhage
incisive
indigenous
inoculate
vaccinate
coalesce
confectionery
coterie
cynosure
daguerreotype
desiccate
Deuteronomy
Pentateuch
pleiades
pneumatic
polygamy
resuscitate
rhetoric
rhythm
sanitary
sanative
scurrilous
dissyllable
trisyllable
isosceles
paradigm
metonymy
separate

diocese	scintillate
anaesthetic	propagate
anonymous	liquefy
assimilate	ecstasy
labyrinth	celibacy
menagerie	satirize
mercenary	hypocrisy
mnemonics	technical
paroxysm	flaccid

These words were pronounced to ten classes of first year college students comprising 498 different students. The average per cent of correct spellings was 48.1. The list as it stands might be considered a standardized spelling test. Any first year college class, or high school senior class that made an average of fifty per cent on this list might be considered up to grade in spelling ability.

Another thing appears as the result of giving this list to be spelled by college classes of different years. Without any special drill in spelling, there will be a rather steady improvement in spelling in different college years. It is possible to discriminate rather confidently, the different years of college classes by the average percentages they make in spelling this list of words.

This is true only when we consider the average of large college classes. It is not true when we compare individuals in the classes. The extreme range in any class is very great. Among the 498 pupils who spelled this list of words, there was one person who spelled 48 correctly, and one other person who was able to spell only 3.

But not all the words are of equal degrees of difficulty. Some are much more difficult than others, as may be judged by the number of times each word was misspelled. Reducing the number of times each word was misspelled to per cents, and placing the most difficult words first, we may make the following arrangement:

	%		%
desiccate	93.5	paradigm	87.6
metonymy	91.8	emanate	83.0
daguerreotype	91.1	Pentateuch	82.8
mnemonics	89.5	cynosure	80.0

hemorrhage	79.3	dissyllable	44.5
liquefy	79.2	funereal	44.1
flaccid	78.6	menagerie	43.1
scintillate	75.0	propagate	42.9
pleiades	73.8	confectionery	42.3
celibacy	73.4	polygamy	42.2
resuscitate	72.8	diocese	37.0
ecstasy	71.8	rhythm	33.3
scurrilous	71.4	pneumatic	27.7
anaesthetic	70.6	trisyllable	27.4
sanative	69.1	labyrinth	25.6
paroxysm	65.1	mercenary	19.8
hypocrisy	62.8	assimilate	16.8
indigenous	60.2	technical	14.3
coalesce	55.0	euphony	13.8
anonymous	49.8	vaccinate	11.1
Deuteronomy	48.6	incisive	10.4
isosceles	48.0	excavate	8.9
satirize	47.8	rhetoric	5.1
coterie	47.3	sanitary	4.3
inoculate	44.6	separate	3.6

The above list of percentages of incorrect spellings shows how important it is that the difficulty of every word in a spelling test shall have been previously measured and how valueless is any examination in spelling on any test list in which this preliminary measurement has not been made. No teacher is able to judge, before putting it to the test, what is the relative difficulty of the different words.

Having measured the difficulty of the words, we may make a spelling scale in either one of two ways. The words in the list above are grouped into ten groups according to their degrees of difficulty. We may select a number of words from one group and test the pupils by means of them. If we use the group of words beginning with mercenary, in which the percentage of misses is from 10 to 20, we shall expect to find that a class of first year college students who make a percentage of correct spelling of 85, may be described as being up to grade. If we use the list of words beginning with anonymous, in which the percentage of misses is from 40 to 50, we

shall expect to find a class of first year college students up to grade if they make a percentage of correct spellings of 55. In such a list, the words are assumed to be all of equal difficulty, or a,pproximately so, and the measure of success is determined by the number of words that are spelled correctly.

But there is another method of constructing a scale that is employed more frequently in arithmetic than it is in spelling. If we select one word from each group, beginning with the least difficult, we may have a list of words like this.

separate	coalesce
mercenary	sanative
pneumatic	liquefy
diocese	mnemonics
anonymous	desiccate

In a list like this, nearly all members of the class will spell the first words, which are easy, and nearly all will fail to spell the last words which are difficult. The ability to spell may then be judged by the distance down the list that the pupil is able to go in his correct spelling.

This kind of a scale is one which justifies clearly the name scale. The analogy is with the beam of a weighing scale, along which a weight, technically called a pea, is slipped until it just balances the thing to be weighed on the platform. But the difficulties are such that its practical application is undesirable. A pupil may spell the first four words, miss the fifth and sixth, and spell the seventh and eighth. In such a case, the entire theory on which the scale is constructed is overthrown, and the spelling ability must be described in other terms than those employed in developing the scale. Practically, in a case like this, the seventh and eighth words, that are spelled correctly, would be considered as the fifth and sixth, and the student's spelling ability would be marked 6.

The subject of incorrigible spellers has not here been touched upon. It seems as if there are a few persons who cannot learn to spell, no matter how great the effort employed by them. Sufficient study has not been devoted to such cases to understand how they differ from ordinary poor spellers, but it appears that differences do exist.

COLLATERAL READING

1—Rice, the Futility of the Spelling Grind. Forum, vol. 35, pages 153 and 409. (Two articles).

2—Cornman, Spelling in the Elementary School.

3—Wallin, Spelling Efficiency.

4—Starch, Educational Measurements, p. 89-100.

5—Ayres, The Measurement of Spelling Ability.

6—Freeman, Psychology of the Common Branches, p. 118-131.

7—Monroe, DeVoss and Kelley, Educational Tests and Measurements, p. 112-144.

The following list of spelling books have been consulted for the purpose of illustrating the development of the teaching of spelling. The date is the date of publication.

1—Webster, Elementary Spelling Book, 1783.

2—Hazen, Speller and Definer, 1829.

3—Wright, Analytical Orthography, 1842.

4—Cobb, Spelling Book, 1844.

5—William G. Webster, Sequel to the Elementary Spelling Book, 1845.

6—Swan, Spelling Book, 1852.

7—Watson, Independent Speller, 1859.

8—Sanders, Spelling Book, 1860.

9—Worcester, Spelling Book, 1861.

10—McGuffey, Eclectic Spelling Book, 1865.

11—Adams, Advanced Speller, 1866.

12—Comly, Spelling Book, 1866.

13—Hazen, Euphonic Speller, 1855.

14—Edwards, Analytical Spelling Book, 1872.

15—Swinton, Word Lessons, 1872.

16—Patterson, Spelling Book, 1874.

17—Reed, Word Lessons, 1884.

18—Rice, Rational Spelling Book, 1892.

19—Pollard, Synthetic Speller, 1894.

20—Shearer, Combination Speller, 1894.

21—Hicks, Champion Spelling Book, 1909.

CHAPTER III

THE PSYCHOLOGY OF ARITHMETIC

About sixteen per cent of all the time that a child spends in school is devoted to learning arithmetic. Some form of arithmetic is usually begun in the first grade, and it is continued without interruption throughout the eighth. It seems quite evident that not all the time is profitably spent. Much criticism is directed at the public schools because the children, when they have completed the eighth grade, are not able to add, subtract, multiply and divide rapidly and accurately.

The teaching of arithmetic is much better than it was thirty years ago. It is not too much to say that the teaching of arithmetic has improved two hundred per cent in that length of time. The opportunity to improve it as much more still exists, and this improvement can come about only through a better understanding and a more consistent application of the psychological principles involved in the subject itself.

The subject of arithmetic naturally divides itself into three parts; or four, if we consider certain portions of the arithmetic that are usually taught as belonging to the subject. These four parts are: First, the development of the number concept; second, the manipulation of the instrument, sometimes described as the fundamentals; third, arithmetic proper, or the solution of problems; fourth, practical arithmetic, or the application of arithmetic to practical affairs.

These four parts are totally distinct from each other, and different psychological principles are involved in learning them. The first thing necessary is the development of the number concept and upon our understanding of what number is will depend our methods of developing it. It may safely be assumed that the better the number concept a person has, the more successful will his subsequent study of arithmetic be.

Number has been regarded by some philosophers in the past as an intuitive idea. By an intuitive idea is meant an idea that is furnished by the mind, and is not derived from experience. It was believed that when the mind needed to use one of these intuitive ideas, it was there, present, ready for

use. It was believed that the mind could not be a mind without the possession of these intuitive ideas. Such opinions are not held now, at least by those who have given attention to the matter. No psychologist today upholds the doctrine of intuitive ideas, but teachers in general proceed with the teaching of arithmetic as if the number concept were an original idea which the child gets without any teaching.

Up to a certain point, all of us have a number concept. Beyond that point the numbers are only symbols. The number that any of us can actualize in thought is almost incredibly small. There is very little to guide us in estimating the extent of the number that we can make real to ourselves, but investigations into number forms may furnish some suggestions. Investigations into number forms show that very few number forms extend beyond 100. Those number forms that extend beyond 100, show a decided change in their nature beyond that point. In general, too, it appears that in almost any number form, the character of the form is different for the first twenty, twentyfive, or thirty numbers from what it is for the subsequent numbers. From this it may be plausibly argued that somewhere from twentyfive to one hundred is the extent of the numbers that we can actually realize. Beyond that point, the numbers are largely symbolic.

Additional suggestions may be derived from another source. If we ask a class how large the moon appears to be when it is just rising, and is on the horizon, we shall get answers that to some it appears to be one foot in diameter, while others may give an estimate as great as four feet. An answer of forty or sixty feet always elicits exclamations of astonished surprise.

The moon is about one half a degree in diameter. It is on the circumference of a circle that would contain 720 moons. Therefore, if the moon appears to be one foot in diameter, the circumference of the circle on which the moon is located would be about 720 feet, the diameter would be about 240 feet, and the radius about 120 feet. Therefore, a person to whom the moon appears to be one foot in diameter, judges it to be about 120 feet distant from him. If the moon appears to be three feet in diameter, the person has judged it to be about 360 feet distant, or about the distance of a short city block. If it ap-

pears to be sixty feet in diameter, the person has judged it to be something more than a mile distant.

It is probable that this unconscious judgment of distance represents about the total amount of distance that the person is able to actualize in thought. All distances beyond that are symbols, or contain a very large symbolical element. A little child reaches for the moon, showing that it has practically no notion of distance. There is no doubt that the primary concept of distance is obtained through a process of muscular effort.

Another theory of the acquisition of the number concept asserts that it is obtained by counting. Counting is principally the repetition of a series of number names, and this in itself does not lead to a development of the number concept at all. But when properly carried on, counting consists in the establishing of a one to one correspondence between a series of objects and a series of number names. This, however, does not develop the number concept, for there is no assurance that a child who counts up to five, means when he says five, the entire group, or consolidates the several counted objects into one whole.

Another theory is that number arises from the perception of grouped objects. But the perception of grouped objects can give in itself only the conception of more or less. Before grouped objects can be conceived as number, there must have been acquired all that is learned in counting. Counting must precede the perception of grouped objects as number.

Still another theory regards number as a ratio, and that the number concept is obtained by the perception of the ratios that exist between quantities. But before a ratio can be established between two quantities, they must have been measured. Measurement is a necessary condition for the perception of ratio.

Measurement is a process of perceiving a relation between a whole thing and a part of the thing; or between one thing and another thing employed as a standard. It is a process of equating one thing against some part of the same thing, or against some other thing of the same kind. This is true whether the thing that is measured is a group of similar objects or a single homogeneous quantity.

Number is an abstraction. The thing that is abstracted is always a quality. In obtaining the number concept, the quality that is abstracted is given to the quantity by measurement.

That measurement gives to a quantity a quality that it did not have before is easily seen by an example. If we measure a pile of lumber, we place the boards that have been measured in one pile and those that have not yet been measured in another. As we measure one board, we remove it from the pile that has not been measured to the one that has. The boards in the two piles differ from each other in some respect that causes us to separate them. The quality that causes us to separate the boards in one pile from those in the other has been given to them by measurement. It is this quality of the boards that is abstracted and gives us our idea of number.

Before the concept of number can be obtained, there must have been processes of measurement. The persons who have had the greatest amount of experience in measuring and weighing will generally be found to have the best conceptions of number, and it is safe to predict that they will generally exhibit the greatest proficiency in arithmetic.

This furnishes us with the principles to employ in the teaching of arithmetic. The first years of a child's school life should have his arithmetic work devoted to exercises involving weighing and measuring. If no formal arithmetic were taught in the first three, or the first four grades, but the arithmetic time be devoted to weighing and measuring, the subsequent progress in arithmetic would be much facilitated.

The weighing and measuring in the primary grades for the purpose of developing the number concept ought to employ the metric measures almost if not quite exclusively. It would be an advantage if no other measures were tolerated, at least for the first years. The reason for this is that the metric system has for its base the number 10, which is the base of the decimal notation almost universally employed in arithmetic. The expression of the measurements made by the metric system renders the employment of the decimal notation easy and convenient.

The number concept may be developed by other measures, but when so developed, there is a difficult incongruity in expressing the results in the decimal notation. The number

concept may be developed by folding papers, but when so developed the adoption and use of the fractional notation is almost inevitable. Much time may be saved and much better results may be secured by developing the number concept through the weighing and measuring by means of the metric units.

The use of the common or English measures makes difficult the subsequent adoption of the decimal notation. The principal, and in fact the only, objection to beginning the number work of children with the metric measures, and using them instead of the English measures, is that the metric measures are not in common use, and that the common measures must be learned for practical application when the children leave school.

The older books in arithmetic gave many tables of different kinds of measures, many of which have been discarded without injury but with distinct benefit, in arithmetics of the present day. We find in the older books that it was thought necessary to learn the measures of barleycorn, firkin, punch, fother, tod, stone, last, weigh, tierce, puncheon, kilderkin, butt, strike, coom, chaldron, and many others. While most of these measures have gone out of use, the real buying and selling is carried on by many measures that most of us do not know unless we are in the business ourselves. The market reports of any paper today express prices in such units as bale, bolt, basket, barrel, box, car, crate, bag, bunch, tub, carrier, hamper, flat, sack. If grown up persons out of school can get along without any definite knowledge of the measured values of these units it seems evident that the children in the first three grades of school can do the same. And if they can get along without a definite knowledge of these eminently practical measures, it seems that they would not be wholly unintelligent without a knowledge of the traditional school measures that are not more commonly used but which represent a survival from an ancient period of arithmetic teaching. To increase the difficulty of arithmetic teaching a hundred fold by using measures that some of us do use now, on the supposition that children will, sometime, need to learn them, is an exceedingly wasteful process.

The second division of arithmetic is the manipulation of

the instrument, which is the decimal notation. The decimal notation is a deliberate invention, as truly so as is any machine an invention. Its chief characteristics are that it has a constant base, which is ten, and being constant does not need to be expressed when numbers are written in this notation. Second, numbers are expressed by nine digits. Third, it employs the device of place value. Fourth, it employs a zero to fill vacant places. This adoption of a character to fill vacant places is a later invention than are the preceding characteristics of the decimal notation. Fifth, a decimal point is used to indicate units place. This is still more recent and has been added to the decimal notation since the settlement of Jamestown.

The introduction of the decimal point makes it possible to express numbers less than one in the decimal notation. It extends the decimal notation to the right of units place, as well as to the left. Decimal fractions ought not to be called fractions. Their affiliations are altogether with the decimal integers, and not with fractions. They belong to the decimal notation, and not to the fractional notation.

The fractional notation must also be learned, and the same psychological laws of learning apply to both. The fractional notation differs from the decimal notation in several respects. It does not employ the device of place value, and consequently uses no decimal point. But the most important difference is that it does not have a constant base, which makes it necessary to indicate what is the base of the system in which it is written. This base is expressed by the denominator.

The decimal notation is in effect a machine devised by an inventor. In order to operate the machine it is necessary to follow the rules laid down by the inventor for its operation. We may or may not know the reason for these rules, and the conditions of the machine which make the rules necessary for its operation. Just as in the use of logarithms, we may or may not know how to make a table of logarithms, but by following the rules laid down by their inventor we are able to use them to very great advantage. So in using the decimal notation, if we strictly follow the rules, we shall obtain the correct result.

This recognition of the place of the decimal notation in the general subject of arithmetic will indicate to us the proper

method to be employed in learning the fundamentals. The fundamental operations are learned most effectively by following rules laid down, without any elaborate process of reasoning to answer the question why do we thus and so. Mr. Thorndike is perfectly right when he says that the only reason a child should be required to give for doing a certain thing in arithmetic is to say, "Because it gets the answer." This is a perfectly correct statement when it is applied to the fundamentals, addition, subtraction, multiplication and division, to any process in the manipulation of the instrument. It is distinctly not true when it is applied to the solution of problems, the third part of arithmetic.

It is in this department of arithmetic that the greatest improvement is yet to be made. It is in this department that the most time is unprofitably spent. In general we may say that the principal source of this misspent time is due to a failure to focalize the attention directly upon the thing to be learned. The number concept has not been thoroughly developed, and we frequently try to develop the number concept at the same time we are trying to teach the fundamentals. This is sometimes done by making the children build up the different tables and solve simple problem by using different kinds of objects, in the belief that we are making the operations concrete.

The attempt to make the fundamental operations concrete is not always helpful, and sometimes leads to disastrous consequences. Sometimes methods of imaging numbers in terms of the objects employed are developed that exercise a distinctly detrimental effect upon subsequent arithmetical study. Following is the testimony from one such case: Miss Edith W. says that every number appears to her as a series of dots, dark in appearance, and she must see the dots before the number idea occurs. Thus seven consists of a series of dots, three in a row, three in a row just below the first, and one below the six. Eight appears as eight dots in two rows. Sixteen is represented by two series of eight dots each, one series above the other. Miss W. believes that this method of visualizing numbers is decidedly disadvantageous to her. She finds it difficult to work with numbers, and she wishes that she had some other way of thinking of them.

Miss W.'s case is only one of quite a series, and it appears likely that her method of thinking of numbers came from the work of some zealous teacher who was trying to make the work concrete.

A second way in which time is unprofitably spent in teaching the fundamentals is by making the child demonstrate every step in the process under the fallacious notion that we are thereby contributing to thoroughness. We require pupils to say why we place units of the same denomination in the same column, why we carry the tens to the next column, why we invert the divisor and multiply. All this is unnecessary and wasted energy. Mr. Thorndike is right when he says that in all such cases, the good and sufficient reason is that it gets the correct answer.

A third method of expending time injudiciously is by trying to secure drill in the fundamental operations, or in learning to manipulate the instrument, by requiring children to solve a large number of problems of rather a simple nature. Success in teaching depends very largely upon our success in isolating difficulties, and setting the difficulty to be overcome clearly before the pupil. As generally practiced, the giving of large numbers of simple problems to the children is done for three purposes, not for a single one. It is done for the developing of the number concept, for learning the fundamental operations, and for learning to solve problems. The difficulties should be isolated rather than combined. When we are learning to manipulate the instrument, the attention should be focalized upon the instrument itself.

A very helpful indication of improvement in the teaching of the fundamentals is found in the development of several series of practice tests, of which the Courtis Practice Tests and the Studebaker tests may be taken as examples. These tests are devices for encouraging practice upon the fundamentals themselves, and the stimulus to practice is the time in which a certain amount can be accomplished. A pupil measures his performance each day by his performance of the day before, and is thereby induced to concentrate his energies upon the attempt to improve his performance.

The extent to which rapidity and skill in the fundamentals can be obtained is almost incredible. In one class, tested by

the writer on the Courtis tests in fundamentals, one person in a second year college class was able to attempt only four of the addition problems in eight minutes, and got only one of them right. In the same class one other person worked all twentyfour of the problems in about six minutes, and expressed the opinion that she believed she could have completed forty in the eight minutes allowed. One other person completed the twentyfour problems before the eight minutes were up. Both of these persons had just completed a course in rapid calculation in a business college. But it is to be noticed that all persons who acquire the degree of skill indicated in the above examples did not acquire it by the manipulation of objects, nor by the solving of simple problems. The skill was acquired by the concentration of the attention upon the adding, subtracting, multiplying or dividing by itself.

The degree of expertness in fundamentals is always measured or described in terms that involve a time element. How many operations can be performed in a specified amount of time. It would seem, then, as if this would offer a valuable suggestion about the methods to be employed in acquiring skill in the manipulation of the instrument. A stop watch will be found a valuable instrument for a teacher in teaching the fundamentals.

This consideration justifies the practice, or explains the advantage, of such tests as the Courtis tests in measuring the ability in fundamentals. The Courtis tests are of four kinds: addition, subtraction, multiplication and division. The test in addition consists of 24 examples, each example consisting of nine 3 place numbers which are to be added. The examples are all of equal difficulty, and the score is the number that can be accomplished in eight minutes. In subtraction, there are 24 examples, all of equal difficulty, and the score is the number that can be accomplished in four minutes. In multiplication there are 24 examples, and the score is the number that can be accomplished in six minutes. In division there are 24 examples, and the score is the number that can be done in eight minutes. The standard score for each process is the number of examples that ought to be completed in the time allowed. This standard score has been obtained by giving these tests to many thousand children. Any class that attains the

standard score may be considered as being up to grade. There is a steady increase in the standard score for each grade from the third to the eighth.

The Courtis tests represent the most hopeful development of arithmetic teaching in recent years. There are many other tests in the fundamentals of arithmetic but none that are more significant nor better known. The Woody tests represent a somewhat different idea. They differ from the Courtis tests in the fact that the examples are of unequal degrees of difficulty, and each example represents a different problem in manipulation. They are called diagnostic tests, and by the examples which a pupil fails to solve, there is indicated the kinds of examples in which drill is needed and will be most beneficial. Theoretically this is a very good principle to embody in a test. Practically, it represents the same kind of incongruity that would be manifested in weighing a load of coal on a balance that is sensitive to one tenth of a gram. Nearly all other tests for measurement in the fundamentals of arithmetic are variations of one or the other of these two kinds of tests.

The processes of addition, subtraction, multiplication and division have a certain relation to each other, but they represent altogether different psychological processes. It may be true, as many writers have asserted, that addition implies subtraction. But it is distinctly not true that the acquisition of skill in addition leads to a correlative degree of skill in subtraction. The two processes have little or nothing in common. It may be true that learning to repeat the alphabet forward implies its repetition backward; but the learning of it forward does not carry with it the ability to say it backward. Neither does the committing to memory of the stanza, Twinkle, twinkle, little star, carry with it the ability to repeat the same words backward.

One of the important results coming from the experimental investigations by means of mental and educational measurements, has been the demonstration that mathematical ability is not one kind of ability, but many kinds. Proficiency in one kind of ability is not a guaranty of proficiency in another kind. The following experiment can be carried out by any one: Two classes of students are given a test in subtrac-

tion. Then one class is thoroughly drilled in addition, until a high degree of proficiency has been attained while the other class is given no drill in addition. After the conclusion of the drill period, both classes are given the test in subtraction. In the example reported by Mr. Poffenberger, (Journal of Educational Psychology, volume 6, page 459) both classes showed a slight improvement in subtraction, but tbe class that had had the drill in addition, showed less improvement in subtraction than did the class with no drill in addition. This seems to indicate that improvement in addition does not improve the ability to subtract, and it is only the fact that the difference in the ability to subtract, exhibited by the two classes on the second trial is so small, that prevents the conclusion being drawn that increased ability to add has an inhibiting effect upon the ability to subtract. The same thing is true of multiplication and division, and in general we may say that the mental processes involved in the four fundamental operations are not only not identical, but they have no direct relation to each other.

The general psychological direction, that the manipulation of the instrument, the fundamentals, should be learned by the following of the rule, without necessarily any demonstration of the rule, will apply to any operation which comes under the same head. It will apply to the extraction of the square root and the cube root and there is no particular objection to including these operations in the elementary school course in arithmetic. It is only when we come to study the instrument itself, not merely its operation, that we need to know the reasons underlying the rules by which it is operated. This point is not reached in the course in elementary arithmetic.

The third process in arithmetic is the solution of problems. This is arithmetic proper, and is the part which justifies the study put upon the manipulation of the instrument, and which makes necessary a knowledge of how to handle the decimal notation. It is in this part that nearly all the improvement in arithmetic teaching has been made, which justifies the assertion that it has improved 200 per cent in the past thirty years.

The former method of solving problems in arithmetic was by an application of a rule. In teaching, the children were required first to learn the rule, and then to apply it to the solu-

tion of illustrative problems. The Rule of Three is a good example of the kind of rules which once constituted the principal feature of arithmetic study. The Rule of Three may be stated as follows: Place for the third term the number that is of the same denomination as that required in the answer. Then consider from the nature of the question, whether the answer should be greater than the third term or less. If it should be greater, place the larger of the remaining two numbers for the second term and the smaller for the first. Multiply the second and third terms together and divide by the first. The quotient will be the answer.

The rule of Position, both single and double position, was another famous rule. The rule of Double Position is stated in Pike's arithmetic as follows: Take any two convenient numbers (in some books this is described by saying Choose your positions) and proceed with each according to the conditions of the question. 2—Place the errors against their positions, or suppositions, thus (X) and if the error be too great, mark it plus. If too small, mark it minus. 3—Multiply them crosswise, that is, the first position by the last error, and the last position by the first error. 4—If the errors be alike, that is both too small, or both too great, divide the difference of the products by the difference of the errors, and the quotient will be the answer. 5—If the errors be unlike, that is one too small and one too great, divide the sum of the products by the sum of the errors and the quotient will be the answer. While both the rule of Three and the rule of Position were dropped from arithmetics generally about 1840, the idea of solving problems by rule persisted until about 1880 or 1890, and we still see traces of it. In Pike's arithmetic, the leading authority upon arithmetic until about 1825, there are given more than 200 rules for solving various kinds of problems. A large part of the skill in arithmetic consisted in selecting the proper rule by which to work any particular problem.

At present, problems are not solved by rule. Problems are solved by a direct perception of the relations involved among the quantities in the problem. The perception of relations constitutes reasoning, and the solution of problems constitutes an exercise in reasoning, which the old method of solving by rule did not do.

It is interesting to notice that about 1821 Warren Colburn published an arithmetic called First Lessons, which became the forerunner of a large number of Mental Arithmetics. It was received with tremendous enthusiasm, and many persons believed that it constituted a revolution in arithmetic teaching. Its influence died out after twentyfive of thirty years, and the present improvement originated from another source.

The distinctive features of Warren Colburn's method embodied in his First Lessons were three. First, he used problems with small numbers. Many persons were unable to see beyond this feature, and mental arithmetic came to be contrasted with written arithmetic in the fact that in mental arithmetic small numbers that did not need to be written down were used, while written arithmetic was a man's sized subject demanding written figures. Really, small numbers may involve relations of the same nature as those existing between large numbers and the reasoning practice may be just as valuable. There is no real justification for a preference for problems involving large numbers over problems involving small numbers, among which the same relations exist.

But it was not the smallness of the numbers that constituted the most distinguishing feature of Warren Colburn's arithmetic. He used no rules, but all problems were solved by the direct perception of relations. The importance of this feature was generally unrecognized, and written arithmetic continued to employ rules for solving problems.

The third feature of Colburn's method was that he did not require or permit problems to be studied outside of the class. All the work had to be done in the class. In these days when the advantages of supervised study have been so fully described, we can see that this condition was one of the things that contributed a great deal to the success of Colburn's method. Then, too, any one who has investigated the methods of teaching pupils to perceive relations can understand how important is the direction and assistance of the teacher, in solving problems by this method, without any rules.

The method of measuring the results of teaching in arithmetical reasoning, or the solution of problems is well understood. Several well standardized scales have been devised, and are generally used. The method consists essentially of the se-

lection of a series of problems, and the difficulty of each problem is measured. The pupil's score consists of the sum of the values of each problem solved. In some scales there is a time limit, and in others the pupil is expected to have all the time necessary to solve all the problems that are within the range of his capacity.

The Stone arithmetic tests are among the best known. This test consists of twelve problems, of unequal degrees of difficulty, and different amounts of credit are assigned to the different problems to correspond to their different degrees of difficulty. The first five problems are each assigned a credit of 1. The sixth is assigned a credit of 1.4, the seventh and eighth a credit of 1.6 each, the remaining four problems are allowed a credit of 2 each. The time allowance is fifteen minutes.

Starch's test in arithmetical reasoning is of a similar nature, although Mr. Starch has arranged the problems in the order of difficulty, and the score is expected to be the number of the last problem solved. The pupil is allowed all the time necessary. The difficulty of each problem has been measured independently, and Starch's scale may be used, by placing a time limit on it, in exactly the same manner as the Stone test is used.

There are many other standardized test for arithmetical reasoning, but these two will illustrate the general process employed in the development of any such test.

The fourth part of arithmetic is the part that is chiefly responsible for the greater portion of the wasted and unprofitable time devoted to it. This is the part that is variously described as practical arithmetic, everyday arithmetic, or applications of arithmetic. In some of the older books, although comparatively modern, the following rules, or list of topics might be found: Compound or denominate numbers, including tables of linear measure, cloth measure, square measure, cubic measure, Troy weight, apothecaries weight, avoirdupois weight, dry measure, wine or liquid measure, ale or beer measure, time measure, circular measure, longitude and time, duodecimals, exchange of currencies, interest, compound interest, bank discount, true discount, insurance, duties and taxes, partial payments, partnership with time, stocks and bonds, commission and brokerage. While this may not be an exact list of

topics in any one of the present day arithmetics, there is enough of a similar nature to make this rather a typical list.

Older books, such as Pike's arithmetic referred to above, and its successors, included many things that have been dropped from present day arithmetics, no doubt with great regret on the part of many persons who had learned them. These older books included problems on all the mechanical powers, the lever, wheel and axle, inclined plane, specific gravity, the lifting power of balloons, problems on the pendulum, on the barometer, on chronology, including problems on how to find the day of the week for any day of the month in any year, to find the time of Easter, to find the dominical letter, the cycle of the sun, the year of the indiction, the golden number, and many others of a similar nature. In fact, the best of the old arithmetics was a thesaurus of general information, introduced to permit the pupil to have an opportunity to apply the arithmetical knowledge he had been acquiring.

Although we have dropped out of our arithmetics many of the things once taught, and those subjects seem strange to us, because they are no longer taught in school, our practical arithmetics still partake of the encyclopedic character that the older books manifested so completely. Under the name of practical arithmetic, we still teach things beyond the experience of the child, defending the practice upon the ground that it will be a good thing for him to know it sometime, and it furnishes him an opportunity to apply his arithmetical knowledge.

The long series of chapters included under the name of applications of percentage includes the chief offenders against good judgment. Percentage is easy and enjoyable for children, but the applications of percentage constitutes a dreary nightmare in the experience of most of the children who have studied arithmetic. Better far are square root, cube root, greatest common divisor, least common multiple, than are compound interest, bank discount, partial payments, and insurance. Square root and cube root give some knowledge of the properties of number. Bank discount gives no knowledge of the properties of number, but is only supposed to give some information totally foreign to arithmetic, about the way in which men do some kinds of business.

There are few subjects in school whose proposed elimina-

tion would cause a greater shock than that of simple interest. But for the benefit of the children who study arithmetic, simple interest is one of the first things that should be eliminated. It should be eliminated because the ideas underlying interest are foreign to the experience of the children themselves. Few children in school ever have any occasion to pay interest, and fewer still will have occasion to draw interest from any one else. The direct receiving and paying of interest is about as far removed from the experiences of children as is the year of the Roman indiction; and they have about as much need to know how to compute interest as they do to know how to calculate the date of Easter. It is unwise, to say the least, to try to give children experiences in the present whose meaning and need only perhaps may come to them ten years in the future.

Besides, this, the real method of computing interest, employed by all persons who have occasion to compute it as a practical matter, is to use a set of interest tables. What we actually do in school is to teach the child the things which it is necessary for him to know if he should ever want to compute an interest table.

We have become able to relegate the problems of specific gravity, the pendulum, the lever and inclined plane to the subject of physics. We can leave the problems about the moon and the calendar to astronomy. We ought to be able to leave the problems in the applications of percentage to business or commercial arithmetic, and make them a part of vocational training.

There is abundant experience in the child's life to furnish material for the application of all his arithmetical knowledge. Arithmetic is not the place in school for the acquisition of new experiences solely for the sake of furnishing the pupil an opportunity to apply his knowledge of arithmetical processes.

By eliminating the dead wood from arithmetic, and making an application of psychological principles to the learning the manipulation of the instrument, and to the solution of problems, we shall find it possible to give children a better knowledge of number in three years of school than they now get in seven or eight. The fourth, fifth, and sixth grades, or

the fifth, sixth and seventh grades are sufficient for the study of arithmetic.

COLLATERAL READING

1—J. M. Rice, Causes of Success and Failure in the Schools, Forum, volume 34, p. 281 and 437. Two articles.

2—C. W. Stone, Arithmetical Abilities and Some Factors Determining them.

3—Starch, Educational Measurement, p. 114-131.

4—Monroe, DeVoss and Kelley, Educational Tests and Measurements, p. 17-65.

5—Freeman, Psychology of the Common Branches, p. 179-209.

The following text books have proved very useful in illustrating the changing conceptions of arithmetic, and the direction in which improvement has been made. The order is that of publication and the year is the approximate date.

1—Pike, Arithmetic, 1785.
2—Dilworth, Schoolmasters Assistant, 1791.
3—Daboll, Schoolmasters Assistant, 1799.
4—Adams, Scholar's Arithmetic, 1801.
5—Finlay, Arithmetical Magazine, 1803.
6—Vyse, Tutor's Guide, 1806.
7—Douglass, Arithmetical Illustrator, 1809.
8—Webber, Arithmetic, 1812.
9—Lacroix, Arithmetic, 1818.
10—Burritt, Logarithmick Arithmetick, 1818.
11—Warren Colburn, First Lessons, 1821.
12—Warren Colburn, Sequel, 1829.
13—Smith, Arithmetic, 1829.
14—Stockton, Western Calculator, 1832.
15—Emerson, North American Arithmetic, part 2, 1832.
16—Emerson, North American Arithmetic, part 3, 1834.
17—Ray, Key to Ray's Third Part, 1845.
18—Rose, Practical Arithmetic, 1848.
19—Stoddard, American Intellectual, 1849.
20—Davies, University Arithmetic, 1850.
21—Dodd, Elementary and Practical, 1854.
22—Ray's Higher Arithmetic, 1856.
23—Ray's Intellectual Arithmetic, 1857.
24—Ray's Practical, or Third Part, 1860.
25—Robinson, Progressive Higher, 1860.
26—Orton, Lightning Calculator, 1866.
27—French, Arithmetic, 1869.

CHAPTER IV

THE PSYCHOLOGY OF READING

The most important subject in school is reading, and it is the most difficult to teach. It occupies about one fourth of all the time that a pupil spends in school, and there is room for much improvement in its teaching. However, there has been so much improvement that it is perhaps not an exaggeration to say that the teaching of reading has improved five hundred per cent in the past thirty years.

Reading was formerly regarded as the pronouncing the words on the printed page, and this is the notion with which, usually, young children begin their reading experience. This definition of reading was rendered almost inevitable by the practice of teaching children to read by tbe alphabet and other synthetic methods. Later, teachers tried to have their children actualize the definition that reading is talking from a book, which was intended to emphasize the naturalness of the expression. Other teachers adopted the definition that reading is getting the thought of the author, which definition was intended to emphasize silent reading. We may modify it to advantage by leaving out the idea of the author, and say that silent reading is getting thought, not the thought, from the printed page. Perhaps it would be a more satisfactory statement to say that silent reading is putting ourselves into such relations that thought will be aroused in us by the words on the printed page. In the same way we must define oral reading as expressing the thought that it aroused in us by the words on the printed page.

This form of the definition is in harmony with the principle of apperception which shows that we learn anything by means of the related knowledge which we already possess, and which is technically known as the apperceiving mass. Notice that in this definition it is not the author's thought that is expressed, nor is it the thought on the printed page that is expressed. It is the pupil's own thought. Reading is always the expression of the reader's thought, not the thought of the author, except as the two may happen to coincide. The thought

that is aroused in the reader by the words on the printed page will be determined in very large part by his knowledge and previous experience.

Thinking consists of the perception of the relations. Reading demands the perception of relations between the ideas that we already have and new ideas which the words express. If we do not have a group of related ideas, and if the relations between them and the new ideas which the words express are not perceived, then we can get no meaning and we cannot be said to read. But this perception of relations is exactly the process which we employ in the solution of problems in arithmetic. We solve problems by the perception of the relations between the quantities involved in the problem. It is the same thing in the analysis of a sentence in grammar. Analysis of a sentence in grammar consists in the perception of the relations that exist between the elements of a sentence. Thus we see that good reading, the solution of problems in arithmetic, and the analysis of sentences in grammar all involve the same identical process, the perception of relations. This accounts for the fact that a pupil who is really a good reader is not likely to experience any difficulty in learning arithmetic, nor in his lessons in grammar. It is this fact also, that justifies the statement that reading is the most important subject in the curriculum. It is also the most difficult, because it is a difficult process to teach a child to perceive relations.

We may readily distinguish primary from advanced reading. Primary reading is that kind of reading in which the attention of the learner is concentrated upon the process itself, while advanced reading may be described as the kind in which the attention is centered, not so much upon the process of reading itself, as upon the result of the reading. Primary reading is the process of learning to read while advanced reading is rather reading to learn. Primary reading may roughly be considered as the reading that is taught in the first three grades, and advanced reading may be thought of as the reading that is taught in the grades four to eight.

The five hundred per cent improvement in the teaching of reading has almost all of it been made in primary reading. Not all teaching of primary reading is equally good today, and in fact there is much poor teaching in this subject, but con-

trasting the teaching of primary reading with that of forty years ago, it would seem that the practice of the best teachers of primary reading is susceptible to but little improvement. There is the problem for every new teacher to learn what is the practice of the best teachers, and a knowledge of the psychology of the subject is necessary for learning what that practice is.

The revolution in the teaching of reading came with the development and very general adoption of the word method. The word method was devised and practiced to a limited extent before, but it did not come into general use until about 1880. After that date its adoption was rapid. Before that time the alphabet method was the one commonly used, and lingering examples of its use can still be found.

The alphabet method was one in which the children were required first to learn the names of the letters of the alphabet, usually in two forms, capitals and small letters. After the letters had been learned, they were combined into syllables. Then the syllables were grouped together into words, and the whole word was recognized. Thoughtful teachers would have the children begin to spell words and syllables as soon as a sufficient number of letters had been learned to make up short syllables. The syllables were learned by spelling them, or naming the letters that entered into their composition. After the letters had been named, the syllables were pronounced, and the naming of the letters was supposed to lead, in some way, to a knowledge of the syllables. The recognition of the syllables was the purpose sought. There was no thought of meaning attached to the syllables.

The syllables learned at first were such syllable as a-b, ab; e-b, eb; i-b, ib, o-b, ob; u-b, ub. Then the process was reversed and such syllables were learned as b-a, ba; b-e, be; b-i, bi; b-o, bo; b-u, bu; b-y, by. The first reading lessons were such sentences as the following, taken from Webster's Elementary Spelling Book:

go on	I am on	do we go up
go in	I am in	we do go up
go up	we go up	is it an ax
an ox	up we go	it is an ax
		an ax is by me

Ultimately, after practice on syllables and words of two letters, the children were introduced to three-letter words, and sentences of such words as the following were read:

She fed the old hen
The old hen was fed by her
I met him in the lot

The arguments always advanced for the alphabet method were that learning the letters of the alphabet furnished a key to the reading of the entire English language. It was argued that one letter was one twentysixth of the language, and that the letters gave command of the entire vocabulary. The reasoning was logical, but it was not psychological. The alphabet method was founded upon adult logic and not upon child psychology. It is not difficult to prove that no child did really learn to read by the alphabet method. It was not the recognizing nor naming of the letters of the word or syllables that enabled him subsequently to recognize and pronounce the syllable or word. The naming of the letters was rather an obstruction than a help. It was the perception of the syllable or the word itself that induced the subsequent recognition. We now know that a larger number of words and syllables could have been learned in the same length of time without the spelling than in connection with it.

Neither did the spelling of the word provide any assistance in making out new combinations. The child taught by the alphabet method was as helpless before a new and unexperienced combination as is a child taught by the word method. This was recognized by many teachers, and the responsibility was laid upon the non-phonetic character of the alphabet. Consequently, the phonic method was devised, which instead of using the letter names, used the letter sounds in learning the alphabet. Otherwise, the principles were the same as those exemplified by the alphabet method.

A difficulty in the phonic method was recognized in the fact that while the English alphabet had only 26 letters, these letters were required to represent about 43 different sounds. It was argued that a much more logical method would be to devise a single character for every sound, and this led to the adoption of the phonetic method. The only real distinction between the alphabet method and the phonetic method was in

this fact of the more numerous characters to represent the 43 sounds, and each phonetic character being known by its sound instead of its name.

There are fundamentally only two methods of teaching reading, the synthetic and the analytic. The alphabet, phonic and phonetic methods are synthetic methods. They begin with the parts, or the simplest elements, which are learned independently, and build them up into larger wholes which express thought. The synthetic method keeps constantly the expression before the thought. The thought comes last, and follows the expression.

The analytic method begins with the thought, learns its expression, and separates that expression into its simpler elements. A synthetic method begins with the letters, builds the letters into syllables, combines the syllables into words, the words into sentences, and then recognizes the thought which the sentence expresses. The analytic method begins with the thought, learns the expression of that thought, separates the sentence which expresses the thought into words, the words into syllables, and the syllables into letters. It keeps the thought before the expression.

Concerning the merits of the two classes of methods, there can be but one opinion. An analytic method is psychologically the only one admissible. Practically, an analytic method will always produce better results than will any synthetic method when both are taught with equal skill and confidence.

The word method begins with the whole word, and the word must always be one for which the child has a meaning. There must be a thought in the child's mind for which the word is an expression. It must be a word that is already in the child's vocabulary. The sentence method in which all the words of a sentence are taught at the same time is even better, because a sentence more completely expresses a thought than does a word. The first sentences for reading are expressions of the child's thought which they themselves have used.

It is as easy for a child to recognize and learn an entire word as it is to learn a single letter. Children in reading recognize words as wholes, never as combinations of different letters. The words are recognized as word forms, and not as letter combinations. It takes no longer for a child to recog-

nize an entire word than it does to recognize a single letter. An experiment conducted by the writer showed that the person who was experimented with as subject, could recognize the letters of the alphabet in the average time of 42 thousandths of a second. It required only 27 thousandths of a second to recognize l, while it took 81 thousandths to recognize x. Twentyfive words, averaging about four letters to a word, were recognized in the average time of 48 thousandths of a second, only three thousandths of a second longer than to recognize the single letters. The word this was recognized in 25 thousandths, a shorter time than any single letter, while the word black taking longer than any other word, was recognized in 71 thousandths, a shorter time than was required to recognize the single letter x. To recognize thirteen sentences of about four words and fifteen letters each, required on an average about 87 thousandths of a second, only 8 thousandths of a second longer than to recognize the single letter x. The longest time was 115 thousandths of a second, required to recognize the sentence The birds build nests. The shortest time was 60 thousandths of a second, required to recognize the sentence Winter has come.

It is now well known that in reading the eye does not move at a uniform rate of speed from one end of the line to the other, but that it makes short pauses, and skips from the focus of one pause to the next. The reading all seems to be done in the interval of the pause. It seems also that as much as can be fixated in the interval of one pause can be recognized in about the same interval of time.

The principal objection that the advocates of any synthetic method of teaching reading make to an analytic method, is that the analytic method does not give to the child any special power over new words. They believe that the child taught by an analytic method is unable to make out the pronunciation of a new word, while a synthetic method will enable him to do so. This fact that the synthetic methods enable a child to make out the pronunciation of a new word is regarded by its advocates as the chief recommendation of a synthetic method.

The objection lays too much emphasis upon the pronunciation of a new word. Compared with the thought which the

word expresses, the pronunciation is of relatively little value. Almost all methods that lay emphasis upon the pronunciation of new words almost invariably neglect the thought. Besides this, grown up persons do not depend upon their ability to make out new words in reading, but they either consult a dictionary, or ask some one else who is already familiar with the word how it is pronounced. No person feels confident of his pronunciation of a new word until he has done one or the other of these two things. The single letters give but little clue to pronunciation of an unfamiliar combination. Besides this, the word or sentence method does not leave a pupil absolutely helpless in making out the pronunciation of a new word. New words are learned by the analogy to other words, although to make out new words for which no meaning is apparent is not a highly valuable acquisition.

The fundamental principle in teaching reading, always and invariably is that the reading must be an expression of the thought. In the case of primary reading, where the children are learning to read, the thought must be in the minds of the children before the reading is attempted. There must be a real thought. This principle is violated in every example of teaching the children to read by the alphabet method, and it is not greatly different in the phonic, phonetic, or other synthetic method.

Advanced reading is that kind of reading which goes beyond the experience of the children, and children learn things from their reading while they read. This kind of reading begins to be prominent about the age of the third or fourth grade. There is a very noticeable difference between primary and advanced reading. In primary reading the thought is experienced before the words are read, while in advanced reading the thought must be aroused by the words themselves. Consequently, the teacher's most difficult problem is to cause the thought to be aroused by the words on the printed page. When the thought is aroused, vivid, vigorous and clear, it will easily find expression.

Good reading demands adequate thought. The practical problem with every teacher of reading is how shall this adequate thought be aroused, and how do we get meaning from what is read? According to the doctrine of apperception, we

learn a new thing by means of the apperceiving mass, or the things that we already know. This doctrine states a profound truth, although this may not be at all the best way to express it. The meaning of anything consists in the relations that it holds to something else. A thing has no meaning if it is out of all relations to everything else. It is only when we perceive the relations that it holds to something else that the thing comes to have a meaning for us.

The most general meaning we can give to the term relation is to say that it is the likeness or difference between two ideas. The likeness or difference may exist in any one of a great many qualities, but whenever we are perceiving a likeness or a difference in any quality, we are perceiving relation. Consequently, in order that anything we are reading shall have any meaning for us it must be associated with something else that we already know in such a way that relations shall be perceived. Meaning consists in the associations that are formed.

The older books on reading used to give a list of words with their definitions at the beginning of every lesson. Some books advertised themselves by saying that every word used in the lessons was defined in the book. But such definitions had little value. We get the meaning of words by perceiving the relations in which they are used in the reading. We get the meaning of a word by perceiving the similarities between the uses that are made of it in many sentences.

Meaning then, is obtained from associations with something else that is already known. There must be time enough for the associations to form themselves, and there must be a sufficient number of vivid ideas that are related to the ones expressed by the words to be read so that associations can readily be formed. Without these associations, no ideas will be aroused, and no meanings will be obtained.

The first thing, then, in teaching a reading lesson is to obtain a sufficient number of related ideas. All the circumstances involved in the selection for reading must be clearly in the mind of the child. If the selection for reading is an extract from a larger whole, the larger whole should have been read, or should have been described by the teacher. All allusions should be known and their significance fully recognized.

Compared with these things, the definitions and pronunciation of the words are relatively unimportant, although these are the things on which usually the most emphasis is placed.

Whether a child gets this adequate setting for the arousing of thought or not depends largely upon the teacher. The teacher who does not herself have the kind of elaborate knowledge of the circumstances and related ideas suggested above, cannot teach a lesson very successfully. A teacher will find that she can teach some selections in a book more successfully than others, but it is not likely that a teacher can teach very successfully a large number. It is in the assignment that the teacher can do most to assure good reading. The assignment must always take on the form of the study of the lesson by both teacher and pupils. There is but little value in assigning a lesson in reading to be studied by the pupils alone.

Few teachers are aware of the ludicrous misapprehensions that children get in their reading lessons. Any person who will read over the lessons he read at school when he was a child is likely to recognize many examples of this kind. The present writer remembers that when he was reading in the Speech of Logan, Chief of the Mingoes, that the expression, "I now rejoice at the beams of peace," always brought up the image of the beams overhead in his father's barn. So in Mrs. Sigourney's poem of the Dying Boy, the directions that he gave about his grave, "Plant there some box or pine," always suggested to him that it was a typographical error, and that it should have read, box of pine. The image of the box was that of a drygoods box, which in his observational experience was always made of pine lumber. Why the Dying Boy wanted a dry goods box stuck down at the head of his grave was incomprehensible, but there it was plainly stated in the book, and there was no going behind the returns.

With some persons the associations take the form of vivid visual images which are projected out in space, and which seem as vivid as real objects would be. From a list of 35 cases described to me by the individuals who experienced them I may abstract the following accounts which will represent the typical characteristics: Miss Clarissa F. visualizes everything that she reads. In reading Hiawatha, she clearly sees the scenes and the characters of the story. She feels herself to be in the

middle of the situation, and the scenes are real and all around her. The images that she sees do not appear as pictures, but are real objects, and perfectly clear. She describes them as being 100 per cent as bright as the real objects would be. Color occurs in all of them, and the colors are the natural colors of the objects represented. She describes them as more real than pictures. She does not like to have pictures in books, and says that she enjoys reading more than going to a moving picture show, because she has a clearer succession of more beautiful pictures than the show represents.

Miss Helen H. visualizes everything that she reads, and she reads very slowly in order that the pictures shall have time to pass along. She does not like to have pictures in books, because the pictures are not likely to correspond to the scenes that she projects, and when such is the case, she does not like the book. The images that she projects do not seem to be pictures, but images of real things, objects which she perceives. She believes they are at least 75 per cent as bright as real objects would be under the same conditions. When reading, she loses the details of the story, and watches the changing scenes that are projected.

The two examples above are rather typical. Variations exist among the different accounts. In some, the projected images appear to be pictures, and not real objects. In some cases, the images are projected upon the pages of the book that is being read, or just at the top of the page. In other cases, the images are projected upon a background of some familiar locality. The brightness varies according to different estimates, from fifty per cent as bright as the real objects would be to 100 per cent. Some like to have pictures in books and others do not. Whenever the experiment is tried, an after image of the projected object is seen. Nearly all agree in the statement that they do not understand how any one can enjoy reading who is unable to project images of the things he is reading about.

The phenomena of projected images in reading have been but little studied, but it appears to be one very effective way in which some highly favored persons get meaning from what they read. It appears that four or five persons in every hundred get the meaning in this way.

There is another theory of meaning in reading that can best be discussed in the light of an examination of the phenomena of lip moving. In the beginning of silent reading, there is nearly always a strong tendency to move the lips, which in some of the least skillful readers is never completely overcome. This tendency for a muscular contraction to accompany every mental process furnishes the principal basis for the theory that some kind of a muscular movement is an essential condition for every mental process. The theory assumes that every nervous impulse must originate in some sense organ, pass through a brain center, and terminate in some muscle producing movement before there can be a mental process. Following this theory to its logical conclusion some students of the psychology of reading assert that the actual meaning of what is read consists of certain contractions in expressive muscles, especially in the vocal organs and muscles of the throat. Mr. Huey in his Psychology and Pedagogy of Reading adopts this view (page 167) where he says: "We may safely conclude then, that meanings in reading are mainly feeling reactions and motor attitudes attaching most intimately to, and fused with, the inner utterance of the words, and especially of the sentences that are read."

There is absolutely nothing to commend this view, nor the psychological theory upon which it is based. Neither has any support in fact, except the fact that whenever there is a mental process there is likely to be some muscular contraction, or some tendency toward contraction. But this accompanying muscular contraction cannot be taken as evidence of the theory unless it can be shown that such theory is the only possible, or at least the best theory for its explanation.

The theory that meanings in reading consists of muscular contractions and tendencies toward contraction in the vocal organs reduces to absurdity when we call to mind the fact of lip moving. If meanings are muscular contractions, the lip mover gets the best meanings, which is not generally allowed to be the case. The lip movement is something to be discouraged and overcome, not perhaps because it interferes with the reading and the comprehension, but because it is an indicator of a lack of skill in reading. The lip movement may be ex-

plained in the way that any other expression of feeling is explained.

When we are reading, a nervous impulse is traversing some brain center. If this brain center has not been traversed a great many times, that is if the reader is not skillful, it is likely to offer a certain amount of resistance to the transmission of the impulse. This resistance causes the impulse to overflow into the motor centers, and the movement of the lips follows. As the reader becomes more skillful, and impulses traverse the brain centers a greater number of times, the resistance deceases and the movements of the lips become less conspicuous.

Consequently, we may safely take the ground that these muscular movements, completed in lip moving, or incipient in slight movements scarcely detectable, are not meanings, but rather the contradictory of meanings. The real meanings are the associations with related ideas, concomitants of nervous impulses passing through other than the motor centers. With a given amount of nervous energy, the less of muscular movement, or tendency toward the same, that there is, the clearer the meanings will be. The lip mover is not so good a reader as he would be if he did not move his lips, or as he will be after he has become able to read without moving his lips.

There are two kinds of reading that ought to be discriminated, oral and silent reading. Up till recent years, reading, as used in any discussion such as this, meant altogether oral reading. Recently much emphasis has been placed upon silent reading, and it is now much favored over oral reading.

The principal claim made for silent reading as an improvement over oral reading is that silent reading can be carried on much more rapidly than can oral, and it is believed that there is a direct relation between rapidity of reading and the amount of thought that can be aroused, or the amount of comprehension, or the amount that can be retained after one reading. Experiment seems to confirm this. One experiment from the writer's classes will illustrate the relation. A difficult selection for reading was furnished to the class, and all of them were told to read silently as much as they could in one minute. The number of words read averaged 223, with 188 for the smallest number, and 298 for the largest. Then all were asked to an-

swer as many as they could of ten questions upon the first paragraph. The number of correct answers ranged from 1 to 8, and in general, the persons who answered the largest number of questions were the persons who had read the largest number of words. The one who answered 8 of the questions was the one who had read 298 words. The coefficient of correlation between the number of correct answers and the number of words read was plus .250, which means that if a person had read more than the average number of words the chances were about five to three that he would also answer more than the average number of questions. The experiment was not altogether satisfactory, because the material was too difficult, and the coefficient of correlation was too low to be decisive.

The advantage in favor of the rapid reader in this experiment is rendered more emphatic by the fact that the questions were all asked from the first paragraph, which all had read, and which was about the limit of what the slowest reader had done. If the questions had been extended over the entire amount that the most rapid reader had read, the advantage in favor of the most rapid reader would have been very much greater.

The reason for the superiority of the rapid readers over the slow readers has not been satisfactorily explained. Many persons have assumed from the face of the returns, that rapid reading is the cause of the greater comprehension, and have proposed to increase the effectiveness of the reading by increasing the rate. The conclusion does not seem justified by any evidence that is available, but the demonstrable explanation has not yet been worked out.

There will always be a place for oral reading. Leaving out of consideration the pleasure derived from listening to elocutionary effects, oral reading is an important aid in teaching beginners to read. It is the most certain and the most convenient method of expressing to the teacher the adequacy of thought that is aroused in the mind of the child by the words on the printed page. In teaching children the first lessons in reading, it would seem almost imperative, although some teachers have accomplished the task of teaching beginners to read without any oral reading.

The method needs to be explained and we may take the

following example as an illustration: On a chart were a number of simple sentences so selected that each sentence was a direction to do something. Such sentences as:

Bounce the ball
Take three steps
Open the window

The teacher pointed to one sentence and the child who was then designated to do so, performed the action. By many such repetitions the children became familiar with the written words which conveyed the direction. It was a tedious and slow process, and it seemed to the writer that it could have been performed much better and much more readily by oral speech.

There is no aspect of reading work that has suffered more from an inadequate or false psychology than that of expression. Not only has it been believed that expression could be taught by rule, but it has been held as a fundamental doctrine that there was an appropriate gesture, or a particular tone of voice, a peculiar emphasis and a proper inflection naturally and inevitably associated with particular words and phrases. The more nearly the teacher could get the children to approximate these naturally associated inflections and gestures the more satisfactory the reading would be.

The books that were used as textbooks in reading not very many years ago were filled up with rules for reading. Such rules as the following were common. When we come to a period we should stop long enough to count four and should let the voice fall. When we come to a semicolon, we should stop long enough to count two and let the voice fall. When we come to a comma we should stop long enough to count one and keep the voice up. A direct question demands the rising inflection. An indirect question demands the falling inflection. Every member of a commencing series should have the falling inflection except the last, which should have the rising inflection. Every member of a concluding series should have the falling inflection except the last but one, which alone requires the rising inflection.

All such rules are worse than useless. Scarcely better is that kind of oral reading in which there is deliberate and intentional drill for expression. When the attention of the read-

er is centered upon the expression, it ceases to be an expression of thought and becomes the thing itself.

We like to have children in reading give proper emphasis and inflection, with animated manner. These things are indications of an abundance of nervous energy which is one of the essential conditions of clear ideas and vivid thought. If there is an abundance of nervous energy, the thought is likely to be clear and the strong nervous impulse will overflow into the expression centers. The proper expression is an indication to us that the pupil is getting an adequate thought, or that an adequate thought is being aroused in the mind of the pupil. It is the most effective means we have of judging how adequate is the thought that the pupil is getting. To have the pupil answer questions, or tell the story in his own words is a crude and unsatisfactory method of letting the teacher know how adequate and sufficient is the thought compared with the information we get from the child's oral reading.

Good reading is that kind of reading which is an expression of a clear vigorous thought. A clear vivid thought is the concomitant of a strong nervous impulse, and this clear idea will find an expression, according to the law of dynamogenesis. Unless the impulse is strong and vigorous, the thought will be weak and inaccurate. A strong nervous impulse will always encounter more or less resistance. This resistance has at least two effects. One is that more or less feeling is likely to be aroused, and the other is that the impulse is likely to overflow into the motor centers, and the muscles of the face, hands and the whole body are likely to contract, and move in consequence of this overflow. So we have learned to associate, unconsciously, this expression of voice, facial muscles, free movement of the hands and arms with clear vigorous thought, since all of these things are conditioned upon the same circumstance, that of a strong, vigorous nervous impulse.

With this understanding of what expression means and how it is brought about, we are ready to understand how expression is to be secured in a class. The essential condition for good reading, which adequate expression represents, is the causing of an adequate thought to be aroused in the minds of the pupils.

One of the means for securing an adequate thought and

its consequent proper expression consists in much good reading to the pupils by the teacher. Good reading by the teacher is valuable and important for two purposes. The first is that it gives the children a proper notion of what good reading is. Much poor reading arises from a wholly inadequate conception of the nature of good reading, and the teacher's reading may serve as a model to show them what may be done. In the second place, good reading by the teacher is very frequently the most effective method of giving to the children a conception of the thought of the selection. In no other way can the delicate shades of meaning be so clearly defined, and in no other way can the children interpret so accurately the thought that is aroused by the printed words.

The methods of measuring reading consists of the application of scales of several kinds. Oral reading scales that have been devised are not altogether satisfactory. The best known is that of W. S. Gray, which consists of a series of paragraphs of unequal degrees of difficulty. The teacher listens to reading of the pupil, noting the number and kinds of errors, and from these estimates the pupil's reading ability. The scale is subject to the same limitations that are found in any scale in which the general judgment of the teacher determines the score of the pupil's performance. The score cannot be determined by counting the number of errors, for not all errors are of equal value, and some characteristics of the reading that determine whether the thought is adequate or not cannot be listed in the table of errors.

The measurement of silent reading is much more satisfactorily accomplished. Silent reading is measured by determining the rate of reading and the amount of comprehension. The rate of reading is easily determined by counting the number of words read in one minute, or by summing up the rate value of all the paragraphs that are read in a certain length of time. The rate value of the paragraphs depends upon the number of words in a paragraph.

The comprehension value is measured by summing up the comprehension values of all the correct answers that are given to the questions or directions in the paragraphs read. Paragraphs are selected of such a nature that each demands an answer or the performance of some action which can be indicated

very briefly. Many such tests have been devised, but Monroe's standardized tests are among the most used and the best known.

In Monroe's standardized tests, and in the Kansas Silent Reading tests upon which they are based, a time limit is established and the score depends upon how much has been accomplished in the standard time. In the Thorndike reading scales no time limit is set, and the comprehension value is determined by the number of correct answers that can be given to a series of questions asked upon each paragraph, the instructions being to read the paragraph over as many times as is necessary. Such scales as the Thorndike scales are more difficult to score, and those constructed on the model of the Monroe tests are more commonly used.

COLLATERAL READING

1—Huey, Psychology and Pedagogy of Reading.

2—Starch, Educational Measurement, p. 20-50.

3—Monroe, DeVoss and Kelley, Educational Tests and Measurements, p. 66-111.

4—Freeman, Psychology of the Common Branches, p. 67-97.

5—Rusk, Experimental Education, p. 226-251.

A list of text books in reading which illustrate changes in methods and ideals of teaching reading.

1—New England Primer, 1790.

2—Webster's Elementary Spelling Book, 1795.

3—Murray's English Reader, 1799.

4—Introduction to Murray's English Reader, 1801.

5—Sequel to Murray's English Reader, 1804.

6—Bingham, Columbian Orator, 1810.

7—T. Strong, The Common Reader, 1818.

8—David Blair, The Reading Exercise, 1819.

9—Mead, School Exercise, 1820.

10—J. L. Blake, The Historical Reader, 1825.

11—Putnam, Analytical Reader, 1826.

12—Porter, Rhetorical Reader, 1832.

13—D. B. Emerson, First Class Reader, 1834.

14—Pierpont, National Reader, 1835.

15—B. Bridge, American Reader, Number 1, 1835.
16—Sanders, Third Reader, 1833.
17—Sanders, Fourth Reader, 1842.
18—Sanders, New Third Reader, 1860.
19—Sanders, New Fourth Reader, 1860.
20—Sanders, Primer, 1846.
21—McGuffey, Second Reader, 1853.
22—McGuffey, Third Reader, 1853.
23—McGuffey, Fourth Reader, 1853.
24—McGuffey, Fifth Reader, 1853.
25—McGuffey, New Second Reader, 1857.
26—McGuffey, New First Reader, 1857.
27—Cobb, Fourth Reader, 1844.
28—Cobb, Fifth Reader, 1844.
29—Goodrich, Fifth Reader, 1846.
30—Goodrich, Sixth Reader, 1846.
31—Swan, Primary School Reader, part 2, 1844.
32—Comly, Reader and Book of Knowledge, 1845.
33—Osgood, Third Reader, 1855.
34—Osgood, American Second Reader, 1871.
35—Epes Sargent, Standard Third Reader, 1855.
36—Epes Sargent, Standard Fourth Reader, 1855.
37—Parker and Webb, National Sixth Reader, 1863.
38—Hilliard, Sixth Reader, 1860.
39—Marcius Willson, Primer, 1860.
40—Webb, Word Method, 1867.

CHAPTER V

THE PSYCHOLOGY OF GRAMMAR

In 1882, Dr. J. M. Gregory published an article in the Proceedings of the Department of Superintendence of the National Education Association, in which he argued that grammar, in common with most of the other commonly accepted school subjects, was not a proper subject for common school instruction. In 1906, Mr. Franklin S. Hoyt published the results of some experiments which seemed to prove that practically none of the claims that had been made by school men for the advantages of grammar as a school subject were justified. In 1913, Mr. Louis W. Rapeer repeated Hoyt's experiments, arriving at the same discrediting conclusions with regard to grammar. In 1913 also, Mr. Thomas H. Briggs, using methods similar to those employed by Hoyt and Rapeer, but in a rather more elaborate way, confirmed the conclusions of the previous writers. The concurrence of the conclusions of these three investigators seems to render inevitable the dropping of grammar from the elementary school.

On the other hand there is the testimony of many persons concerning their own individual experiences, similar to that of the present writer. I began to study grammar at about the age of twelve, in a country school. The first year and the second produced no valuable experience in any way. The third year, at about the age of fourteen, it began to produce an effect. In the years of fifteen, sixteen, seventeen and eighteen, my study of grammar was such that it seemed to me that I never studied a subject that was more attractive, nor that did me more good than did grammar. That was my opinion at the time, it is my opinion now. I am glad, now, that I studied grammar in that country school, and I was glad at the time. This experience finds corroboration in the expressed opinions of Tyndall and other writers too numerous to mention. There was no method available at that time for measuring the amount of improvement in any one mental function, so the testimony must of necessity be that of opinion or hypothesis.

It will be observed, in the testimony recorded above, that

my profitable study of grammar occurred after the age of fifteen, in a country school, which in those days was inevitably a poor school, and with a poor teacher. Subsequently I studied grammar in a normal school with a most excellent teacher, and my impressions of that study are that not nearly so much good was derived from it as was derived from the study with a poor teacher in the country school.

Here we have a paradox that demands explanation. It appears that Hoyt, Rapeer and Briggs are essentially right in their conclusions that grammar, taught to children in the elementary grades, by good teachers, does not improve the abilities of the children of the ages tested, in the functions in which advocates of grammar teaching say that it should. On the other hand we have the testimony of many persons like the writer, who are of the opinion, which it is true may be illusory, that grammar, taught in a poor school by a poor teacher, to pupils above the ages of fifteen to eighteen does improve the ability to think.

We may seek an explanation of this paradox in the psychology of the subject, and the psychology of grammar can best be elaborated by making the distinction, which is very important, between structural and functional grammar.

Nearly all the grammar that is printed for the use of schools is structural grammar, and that is the only kind that the children in the elementary grades are likely to be called upon to study. They have little opportunity to study functional grammar, from which nearly all the improvement from the study of grammar must come, and if they had the opportunity they would not have the ability to comprehend it.

Structural grammar determines the nature of the words in a sentence largely by their form. Functional grammar determines the nature of the words by the thought they express. Structural grammar deals largely with declensions, conjugations and other inflections of words. Functional grammar considers the relations that each part of a sentence bears to the other parts. Structural grammar considers language as an instinctive character of man out of which thought grows. Functional grammar considers language as the expression of thought.

Our English grammar is constructed upon the model of

the Latin and the Greek. Greek and Latin are highly inflected languages, and a knowledge of the inflectional forms is the all essential feature for learning these classical languages. In Latin the noun has six case forms, and the Greek noun has five. In English there is practically no declension, the form of the possessive case being so similar to the nominative that there is really no necessity for learning more than the rule for its use. The possessive plural and the possessive singular are so nearly alike that there is no discrimination in oral language, and an artificial device, the apostrophe, which is wholly unnecessary, is the only variation in the written forms.

There is a real declension in the personal pronoun, but this is almost the only bit of declension that has survived the evolutionary process by which the English language has been produced. We may say that there is no such property as case in the English noun, in the sense in which it is used in the languages from which the English grammar has been derived. Case means change in form, and there is no change in the form of the English noun to express the relation that a word holds in a sentence.

In the sentence "It is me," almost any person, when asked what case is me, will answer objective case. This answer is correct, if we are talking in term of structural grammar; but if we are talking in terms of functional grammar, it is as truly a nominative case as if the form were I. The abandonment of the structural conception of case as being the change in the form of the word to express relation, for the definition that case is the property of the noun that expresses the relation it holds in the sentence, does not help us out of the difficulty. In the sentence, James is a good boy, both James and boy are in the nominative case, but they hold distinctly different relations to the other parts of the sentence, and under the definition of case suggested, they ought to be described as different cases. We are tied up to the structural definition of case inevitably.

In James M. Teeter's grammar, published in 1836, the nominative case is called the Efficient case.

In the Greek and Latin languages the adjective is declined, and must change in form to agree with the form of the noun to which it belongs. Even the article is declined, and adjec-

tives and other modifiers have gender, which has no relation whatever, except an accidental one, to sex character. In English grammar the adoption of gender as one of the properties of nouns has led to an attempt to associate it with the sex of the object which the noun represents. This character of gender is altogether foreign to the character of the property of nouns designated by the same name. The sex character applied to objects, not to nouns, limits the genders to two; but many grammars account for four, thus very consistently applying the idea not to the objects, but to the nouns as is done in the Latin and the Greek.

Latin and Greek have many verb forms. The Greek verb has three numbers, the singular, dual and plural. In English, we have dropped the dual, retaining only a trace of it in the comparison of adjectives. We have three degrees of comparison, and the comparative is used when only two are compared. But this use of the dual in the comparison of adjectives is not necessary to a clear comprehension of thought, and its consistent use is likely to cause one to be recognized as a pedant.

The Greek verb has three voices, the active, passive and middle. The English has dropped the middle, retaining only the active and passive. The Greek verb has five modes, seven tenses and three persons. A full conjugation of a complete Greek verb in which all the forms were represented would necessitate 945 forms. Not any one Greek verb actually does exhibit all these forms, but enough forms are found in almost any Greek verb to make it a holy terror to students. Our English verb has never had its conjugation definitely settled. Throughout the entire period of English grammar publication, there has been a constant variation in the modes represented. Noah Webster, in his very notable English grammar, published in 1790, says that the English language has no modes in the sense that the Romans and the Greeks had. Nevertheless he discusses four modes, omitting the potential. In Joseph Buchanan's grammar, published in 1826, the potential mode is omitted, but the Enquiring mode is introduced. In Bradford Frazee's grammar, published in 1844, the only subjunctive mode that some other grammars admit, (Clark, 1847, Harvey, 1868), exemplified by such sentences as If he come, If he write, is discarded and called pedantic. In James M. Teeter's gram-

mar, published in 1836, only three modes are allowed, the indicative, infinitive and imperative. In Barnard's grammar, published in 1836, not only are the ordinary five modes indicated, but two more are devised. Instead of one potential mode and one subjunctive, there is a potential mode proper and a potential mode doubtful. There is a subjunctive mode proper and a subjunctive mode doubtful. In Wells' grammar, 1846, the potential mode is described as a form of the indicative but to compensate for its loss, the participial mode is introduced.

A really consistent English grammar would adhere closely to the Latin and Greek model. This was done by William Bingham, in his English grammar, 1867, who acknowledges that his purpose is to prepare children in school for the beginning to study Latin and Greek. He defines case as the variation in form which shows the relation to other words, and then inconsistently describes six cases, nominative, genitive, dative, accusative, vocative and ablative. The inconsistency appears in the fact that while the English noun may be used in these six relations, it does not have six forms to indicate which one of these relations it is used in. He introduces the gerund into the conjugation of the verb, but describes it as a verbal noun.

These distinctions in English grammar are all of them structural, and derived from the changes in the form of words in the languages which have served as a model for our English grammar. In the English language there are so few distinctions in form that it is not an exaggeration to say, that from a structural standpoint, English is a grammarless language. It is quite likely that the study of the grammar of a grammarless language will not produce that clearness of thought and other effects which have been claimed as derivable from the study of grammar, and which Mr. Hoyt and Mr. Briggs so conspicuously failed to find.

The terms used to express the various relations of words to each other are structural. Adjectives belong to nouns, or modify nouns, which opens the way to put into the same group classes of words as adjectives which are as unlike each other as chalk and cheese. Prepositions are so called because they stand before nouns. A noun is the object of a verb, but no explanation of the object of a verb can render understandable

the application of the same term to the object of a preposition. Neither can an indirect object have any understandable explanation in structural terms, and how an adjective can take an indirect object is an idea so obscured by the word object that no one who has not studied Latin can get the slightest comprehension of it.

Functional grammar is different. Functional grammar looks constantly for the relations in which words or terms stand to each other, and cares little about the form. Functional grammar has not approached anything like the degree of development that structural grammar has done, and in fact, can scarcely be said to have any existence as a formulated subject. Structural grammar treats of language as a construct on which thought depends; functional grammar treats of language as the expression of thought itself. Structural grammar makes its distinctions in the forms of words; functional grammar looks for the distinctions in the thoughts which the words express.

A few illustrations are all that can be given to show the difference between the two, or what would constitute the subject matter of functional grammar. We have to go to the psychological processes involved in order to obtain a clear notion of the distinctions between the various parts of speech.

A sensation is a simple mental process that makes us acquainted with a quality of an object, and which is accompanied by a peripherally initiated impulse. A peripherally initiated impulse is one that originates in a sense organ. If an impulse originating in the brain traverses the same sensation center, the sensation is a faint sensation.

A percept is the sum of all the sensations, both faint and vivid that we get from an object as they combine and modify each other. In a percept, some of the sensations must be vivid sensations. If the same process were accompanied by faint sensations only, so as to give a reproduced or remembered percept, we should call the mental process an idea. The expression of a percept, or of a remembered percept, is a proper noun.

If we examine a number of similar objects, we abstract from them their common qualities, and in effect, we make a table of resemblances among them This table of resemblances

constitutes a general abstract notion It is general, because all the properties that enter into the table are found in all the objects that we have examined It is called abstract, because the qualities have been abstracted from the objects in which they exist It is evident from this exposition that there is no real, material, tangible object which is the counterpart of this general abstract notion. We may use one word to express this table of resemblances, and when we do, that word is a common noun. A common noun, then, is an expression of a general abstract notion composed of the resemblances between objects. If we make a table of resemblances between a grasshopper, bumble bee, butterfly and some more similar objects, we may express that table of resemblances by the word insect. The table of resemblances may include such characteristics as three body divisions, chitinous exoskeleton, three pairs of legs, one pair of antennae, breathe by spiracles, and many others. The table of resemblances constitutes the general abstract notion, and the word insect which expresses it is a common noun.

But not every general abstract notion is expressed by a common noun. If we examine the colors of a number of objects and perceive the resemblances between the colors, we have in effect made a table of resemblances between the colors, and this table is a general abstract notion which can be expressed by one word. This word is an adjective. An adjective, then, is the expression of a general abstract notion composed of the resemblances between qualities.

But qualities are made known to us by sensations, and sensations differ in intensity. Comparison of adjectives is an expression of the difference of the intensity of sensations by which we know the qualities that constitute the general abstract notion which an adjective expresses. In effect then, there is a close resemblance between a common noun and an adjective. Both are expressions of general abstract notions, the difference being in the things from which the table of resemblances are abstracted.

So we may make a table of resemblances between the method of moving of a horse, a dog, a man, a wagon, an automobile, and this table of resemblances would be a general abstract notion which could be expressed by one word. Suppose

that we use the word run to express it. Run is a verb, and it expresses a table of resemblances between actions.

We may perceive the resemblances between various relations, and make a table, which table we may express by one word. Let us suppose the word is up. Up is a preposition, and a preposition is the expression of a general abstract notion which is composed of resemblances between relations.

A qualifying adjective is the name of a sensation, or is the expression of a general abstract notion consisting of the resemblances between qualities which are known to us by sensations. Adjectives may be compared, which comparison is an expression of differences of intensity between sensations. But a limiting adjective has no reference to sensations. It is derived from a totally different process. We use a common noun with a limiting adjective as a substitute for a proper noun. We use it in consequence of the lack of a proper name. Lacking a proper noun to express a singular concrete notion, we use a common noun and point it out, finger like, by a limiting adjective. The common noun expresses the sum of resemblances, but resemblances presuppose differences existing. The limiting adjective removes the differences and constitutes a substitute for a proper noun. So psychologically there is no relation between a limiting and a qualifying adjective, although in structural grammar they are called by the same name.

With this method of conceiving the various parts of speech, we can understand more easily some more complex relations. A proposition is the expression of a judgment. A judgment is the perception of the agreement or disagreement between two notions. If we represent the two notions by two circles that intersect and have a common section, we can clearly picture several relations. Let mx represent one circle which we shall call A, and ny represent the other circle which we shall call B. Let x and y be the common section, and be identical with each other. Then it is easy to see that A resembles B, or that mx resembles ny, or that x is y.

Lead is a metal is the type of such a proposition. Among the properties which constitute the general abstract notion of lead will be found the properties which constitute the general abstract notion of metal. In such a proposition it is almost

impossible for a child using the terms of structural grammar, to discover any difference that discriminates the subject from the predicate. The fact that both lead and metal are described as being in the nominative case, contributes to the confusion. But in functional grammar the difference is easily described. The two notions, lead and metal, occupy different relations in the sentence. Metal is the expression of the notion that is used as the standard of comparison, and lead is the expression of the notion that is compared with it. In logic, metal is called the major term, and lead is called the minor term. The word is is the copula and is the expression of the judgment itself.

This is the real distinction between the subject and the predicate. If by case we really mean the relation that a word holds in a sentence, there ought to be a different term to describe the case of the predicate from that which describes the case of the subject. The two are not identical at all.

When I say that "All insects have six legs," I have expressed the agreement between two notions as truly as if I had used the word is, or some other form of the verb be. Have is as truly copulative as is the word is. The example John struck James, does not illustrate the relation expressed by the word have. The word have, in this case, expresses the fact that all the properties that constitute the general abstract notion of six leggedness, are found among the properties that constitute the general abstract notion of grasshopper. The word have expresses the agreement between the two notions, and there is no more justification for describing the term six legs as being in the objective case than there is for calling it the nominative. Both terms are confusing.

If we go back to our example of two intersecting circles, we see that the two notions are compared directly. Let us suppose that circle A, representing one notion, also represents the combination of brain cells traversed by a nervous impulse when we experience the notion A, and let B represent a combination of brain cells traversed by an impulse when we experience the notion B. In a case where the circles intersect, and some cells are common to the two combinations, such as is represented by x and y, the nervous impulse passes directly into B from A by means of the common section, and we have a

direct comparison of the two notions, which we call a judgment, and whose expression is a proposition. If the two circles do not intersect, and we have to connect them by intermediate circles in order to secure the transmission of the impulse through the two combinations, we have a more elaborate process which we call reasoning.

But in the two combinations of cells represented by A and B the nervous impulse may first enter A, pass into B, and from B pass into some muscular or expression center, and movement follows. In such a case we may say that the judgment is motivated from B. If this is the case, we have a relation which in structural grammar may be identified as the indicative mode. But the impulse may go the other way, entering into B, and leaving by A, being motivated from the subject notion. In this case we have a relation which in structural grammar might be identified as the subjunctive mode. As the nervous impulse must be motivated from one or the other of these two notions, we see the possibility of only two modes.

Such are some of the things that illustrate the kind of study that must constitute functional grammar. These ideas are not within the reach of the mental capacity of children but this and much more complex conceptions are involved in the study of grammar. Grammar is logic, not the formal static logic of the old type, but dynamic logic, which constantly tests itself by means of psychological conceptions.

Grammar is not a subject for small children, nor for the elementary grades of school. In Joseph Buchanan's Grammar, published in 1826, the author says that it would be a good thing for children to start the study of grammar at six years of age, and they would in two or three years become good grammarians. He says it is peculiarly adapted to invigorate their minds. Such a notion of grammar led to the production of many very elementary grammars, of which Green's, Harvey's, Pinneo's, Hart's, and Fewsmith's, may be taken as good examples.

The grammar that is believed to have great value by those who have testified concerning it, is not the structural grammar of the ordinary text, but it is a grammar which perceives relations between the thoughts which the words express. It lays much more emphasis upon the analysis of sentences than

it does upon the parsing of words. It ought not to be undertaken until the college years, if the greatest amount of good is to be obtained from it.

Grammar, functional grammar, has a close affinity to the solution of problems in arithmetic. Both demand the perception of relations, and this perception of relations constitutes thinking. How much a training to think in one kind of relations will increase the ability to think in another kind, has not been satisfactorily determined. But it is upon this training to think that the advocates of grammar teaching must principally rely.

It is such facts as those recorded above that tend to explain the paradox that good teaching of grammar is some times not so effective as poor teaching. Good teaching of grammar quite often concerns itself with thorough drill upon structural grammar, and emphasizes much less the direct perception of relations which constitutes the distinguishing feature of functional grammar. Emphasis upon the learning of declensions and conjugations, rules, with lists of exceptions, is likely to be strongly characteristic of what would be called good teaching of grammar. This is principally structural, from which small benefit may be expected.

Grammar has suffered too, from a kind of psychology that lays emphasis upon language in the wrong place. Language has been regarded as a construct of thought, and as a necessary antecedent for any kind of thinking except the most simple. Many psychologists, even today, are ready to assert that thought depends upon language. Thus Ward says, "Thinking, it may be fairly said, owes its origin to the acquisition of speech" (Psychological Principles, page 286). Warren asserts that "The growth of thought depends intimately upon the existence of words" (Human Psychology, p. 328). Even greater emphasis is laid upon language by Watson, who says that "Thought is the action of language mechanisms" (Psychology from the Standpoint of a Behaviorist, p. 316).

On the contrary it is possible to prove that except as a means of obtaining a social inheritance, language has very little to do with thought. It is a common opinion that the capacity to speak is dependent upon a capacity to think. That speech is in some way a mark and a measure of intelligence.

That dogs and horses do not speak because they are not intelligent enough, and that if they were more intelligent they would be able to talk. Dogs and horses do not talk because they do not have a speech center in the brain. Children talk as soon as the speech center has become developed, and this does not depend upon the development of the capacity to think. Lack of ability to speak does not imply lack of capacity to think.

I have in my classes today two girls, each about twentyone years old, both of whom are above the average of their classes in intellectual ability. One of them began to use words at the age of seven months, spoke rather freely at eleven, talked two languages at two years. The other did not begin to talk until she was seven years old, although there was no difficulty with the vocal organs, nor was there any suspicion of mental defectiveness.

Any one who has observed a normal child who did not begin to talk until he was two and a half or three years old is not likely to be convinced that the development of thought depends upon the development of language. One case will serve as a type of a large number of examples. The baby was two and a half years old and had not talked a word. One day I heard a squall. I went down stairs and said, "What is the matter, baby?" Immediately he pointed to his mother, saying m—m—m— then spatted his hands together viciously. No one could be mistaken in supposing that he understood the import of the question, and that he knew exactly the right answer to give.

The language mechanisms are totally distinct from the thought mechanisms. Speech is instinctive, and the brain centers that are traversed by impulses when a child talks are organized as a result of an inherited tendency to grow, and not as the result of experience. So strong is this instinct that in many children who do not have the best opportunity to learn the language employed by the people around them, a language will develop itself. We may call this an original language. In consequence of the tendency to eliminate an original language as soon as it manifests itself, only a few are recognized, and of these few none have been sufficiently studied.

The measurement of ability in grammar has not been very

satisfactorily achieved. Mr. Starch has prepared three grammar scales. One is a scale in which the pupil is required to designate the part of speech of as many words as possible of a short selection in three minutes. A second calls for the naming, or designating of the case of as many nouns and pronouns as possible, in a short selection, in three minutes. A third requires a brief designation of the mode and tense of as many verb forms from a list, as can be done in three minutes. The practice of different teachers, using different texts is so diverse that it is difficult to get a common basis for separate schools.

The principal part of the energy devoted to measuring language processes has been employed in development of scales for correct usage. Several plans have been employed in the construction of these scales. One plan consists of a series of incorrect sentences mingled with others that are correct. The pupil is required to discriminate those that are correct from those that are incorrect and to indicate the corrected form. In other kinds, the pupil is required to indicate a superfluous word, or to make choice of a word with which a blank may be filled correctly.

Several composition scales have been devised, the earliest and perhaps the best known being the Hillegas scale. All such scales consist of a series of productions of different degrees of excellence, each carefully standardized by taking the combined opinions of many competent judges. The examiner is supposed to determine the specimen on the scale which is most nearly equal in excellence to the composition to be measured. It is questionable whether the results obtained by any one of such scales attain any high degree of accuracy. They have the same limitations that are found in all scales in which it is merely the general judgment of the examiner upon the relative merits of the two selections, the specimen to be measured and the scale specimen.

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